FEDERAL UNIVERSITY OF TECHNOLOGY
MINNA, NIGER STATE, NIGERIA

SCHOOL OF ENVIRONMENTAL TECHNOLOGY
INTERNATIONAL CONFERENCE (SETIC) 2018

CONFERENCE Proceedings

CONTEMPORARY ISSUES AND SUSTAINABLE PRACTICES IN THE BUILT ENVIRONMENT

EDITORS:
Asimiyu M. JUNAID
Olatunde F. ADEDAYO
Richard A. JIMOH
Luqman O. OYEWOBI

School of Environmental Technology International Conference (SETIC) 2018

10-12 APRIL 2018

Federal University of Technology Minna, Niger State, Nigeria

CONFERENCE PROCEEDINGS

Volume 1

Editors
Asimiyu M. JUNAID,
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Conference Proceedings of the School of Environmental Technology International Conference (SETIC) 2018

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10th – 12th APRIL 2018
School of Environmental Technology,
Federal University of Technology, Minna, Niger State, Nigeria.

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FOREWORD

The organising committee of the 2nd School of Environmental Technology International Conference is pleased to welcome you to Federal University of Technology Minna, Niger State Nigeria.

The conference provides an international forum for researchers and professionals in the built and allied professions to address fundamental problems, challenges and prospects that affect the Built Environment as it relates to Contemporary Issues and Sustainable Practices in the Built Environment. The conference is a platform where recognised best practices, theories and concepts are shared and discussed amongst academics, practitioners and researchers. The scope and papers are quite broad but have been organised around the sub-themes listed below:

- Architectural Education and ICT
- Building Information Modeling
- Construction Ethics
- Energy efficiency and Conservation
- Environmental Conservation
- Facility Management
- Green Construction and Efficiency
- Health and Safety Issues
- Information Technology and Building Maintenance
- Information Technology and Construction
- Information Technology and Design
- Innovative Infrastructure Development
- Resilient Housing Development
- Smart Cities Development
- Social Integration in Cities
- Sustainable Building Materials Development
- Sustainable City Growth
- Sustainable Cost Management
- Sustainable Property Taxation
- Sustainable Architectural Design
- Sustainable Urban Transportation Systems
- Theory and Practices for Cost Effectiveness in Construction Industry
- Urban Ecology Management
- Urban Land Access
- Disasters, Resilient Cities and Business Continuity

We hope you enjoy your time at our conference, and that you have the opportunities to exchange ideas and share knowledge, as well as participate in productive discussions with the like-minded researchers and practitioners in the built environment and academia.

Local Organising Committee
School of Environmental Technology International Conference (SETIC) 2018
APRIL 2018

ACKNOWLEDGEMENTS

We have tried to build on the success of the maiden of SETIC held in 2016 which came with good feedbacks and memories. The success of the 2nd School of Environmental Technology International Conference holding at the Main Campus of the Federal University of Technology Minna, Nigeria is predicated on the support and goodwill from Vice-Chancellor of Federal University of Technology, Dean School of Environmental Technology and many other highly motivated people.

I sincerely wish to appreciate you for attending this Second edition of SETIC and to warmly welcome you to the city of Minna the capital of the *POWER STATE.* It is a great honour to have you in the beautiful campus of Federal University of Technology Minna, Nigeria. I am aware of the great sacrifices made by many of you to be present in this occasion and I will definitely not overlook the long distances some of you have had to cover to get to the conference venue. We genuinely appreciate all your efforts. It is our singular hope and desire that this 2nd edition of the conference (SETIC 2018) meets your expectations and gives you unquantifiable experience and tremendous developmental networking opportunities for a life fulfilling career.

We are grateful for the presence of the Vice Chancellor of the Federal University of Technology Minna Professor Abdullahi Bala whose leadership and distinguished academic career has served as inspiration and encouragement to many academics within and outside Nigeria. His desire to continue on the path of greatness for this Humble University of ours has seen the University become a destination for International conferences, Public lectures, Book Development, Presentations and Seminars that meet International standards. We are happy to have you as the Chief host to declare the conference open and deliver the welcome address.

We are grateful to the former Dean of School of Environmental Technology, Federal University of Technology Prof A.M. Junaid and the Ag. Dean of School of Environmental Technology Prof. S.N. Zubairu for providing the healthy platform, academic backing, management and guidance for the organisation of the conference. You increased the level of challenge from 2016 and provided the required resources, direction, energy and strategies for achieving its success, it is a great honour of having the opportunity to work closely with you and learning never to give up.

I wish to thank also all the special guests particularly leaders of the Industry, Built Environment and Academia.

A special thanks goes to the Bursar of Federal University of Technology, Mrs. Hajara Kuso for the timely responses to all our requests regarding the financial aspects of access to funds for the conference.

SETIC is beginning at the foundation this year and for this I wish to thank all those who have supported us through various forms of participation. Specifically I wish to thank the delegates and the partners for contributing significantly to the conferences. I wish to thank Prof. S.N. Zubairu Prof. A.M. Junaid, Prof. O. O. Morenikeji and Prof. Y.A Sanusi, who all genuinely and consistently monitored the progress of the conference preparations. My desire in 2016 was for SETIC to become a constant feature in the calendar of the University and global conference listings, am a happy person today seeing this desire fulfilled with the SETIC 2018 edition.

Delegates to SETIC 2018 are from different academic and research institutions that are spread across different countries. This offers participants a wonderful opportunity for exchange of cultural, social and academic ideas during the conference periods. It is also an opportunity to create awareness about programmes and events at the participants' individual institutions. I encourage you all to make good use of the networking opportunities that are available.

In this 2nd edition we received 258 abstract submissions because we had a wide distribution outlet as compared to the 1st edition which is an indication of growth. Using a rapid review system we accepted a total of 209 abstracts and the authors were communicated on what issues they were to examine while developing the full papers based on their titles and aim of the paper. Two hundred (200) full papers were received and reviewed. We sent back the reviewed papers and reviewers comments forms to each of the prospective authors to assist

in the preparation of the revised papers. It was after this rigorous and time consuming process that we were able to accept 172 papers for presentation at the conference. It gives me great joy therefore to congratulate all the authors whose papers made it to the conference. It is my sincere believe that the presentation of the different ideas in your paper would go a long way in improving the knowledge of the participants and also generate meaningful discussions over the tea beaks, lunch and beyond.

I wish to express my utmost gratitude to each of the Seventy-three (73) reviewers for a wonderful job done well and for tolerating our deadlines and Oliver Twist syndrome. It is your dedication and expertise that has ensured that the conference is a success.

Special thanks to all our keynote speakers, Arc. Umaru Aliyu, (ficiArb, fnia, ppnia) (*President, Architects Registration Council of Nigeria (ARCON)*, Prof. Stella N. Zubairu (*Former Dean Postgraduate School, Federal University of Technology Minna*), Dr. Julius A. Fapohunda, (*Editor-in-Chief: International Journal of Sustainable Energy Development & Leader: Sustainable Building and Urban Growth Research Unit, Cape Peninsula University of Technology).*

It is important to appreciate the roles and efforts of the following people for their selfless and very significant contributions made towards the successful organization of the conference: Oyetola Stephen, Alonge Olubunmi, Lynda Odine, Adedokun John, Idowu Oqua, Bamidele Eunice and Muhina Lami (for being available to run around at very short notice),

The organisation of this conference would not have been this easy without dedicated individuals offering to serve. My heartfelt gratitude goes to Dr. Taibat Lawanson, Dr. R.A. Jimoh, Dr. L.O. Oyewobi, Dr. N.I. Popoola, Dr. Lekan Sanni, Dr. I.B. Muhammad, Dr. A.A. Shittu and Dr. A. Saka for their unflinching support all through the process.

It is our sincere hope that this conference will serve as a forum for the advancement of research in the urban sphere towards achieving a sustainable environment. It is our sincere believe that academics and professionals in practices will continually participate in this forum.

Worthy thanks goes to the members of the Local Organising Committee for the tireless effort. The success of the conference goes to these wonderful people. You have made SETIC 2018 to ROCK.

Once again I wish to thank you all for creating time out of your busy schedule to attend this conference. Please do enjoy your stay at Federal University of Technology Minna, and the city as a whole. Ensure that you make use of the different fora created throughout the conference to build new relationships for the future and strengthen existing relationships. I look forward to seeing you all in future.

Olatunde Folaranmi ADEDAYO
SETIC 2018 LOC Chairperson
APRIL 2018

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DECLARATION

PEER REVIEW AND SCIENTIFIC PUBLISHING POLICY STATEMENT

10th APRIL 2018

TO WHOM IT APRIL CONCERN

I wish to state that all the papers published in SETIC 2018 Conference Proceedings have passed through the peer review process which involved an initial review of abstracts, blind review of full papers by minimum of two referees, forwarding of reviewers' comments to authors, submission of revised papers by authors and subsequent evaluation of submitted papers by the Scientific Committee to determine content quality.

It is the policy of the School of Environmental Technology International Conference (SETIC) that for papers to be accepted for inclusion in the conference proceedings it must have undergone the blind review process and passed the academic integrity test. All papers are only published based on the recommendation of the reviewers and the Scientific Committee of SETIC

Names and individual affiliation of members of Review and Scientific Committee for SETIC Conference 2018 are published in the SETIC 2018 Conference Proceedings and made available on www.futminna.edu.ng

Olatunde Folaranmi ADEDAYO
Chairman SETIC 2018
Federal University of Technology, Minna, Nigeria

Papers in the SETIC 2018 Conference Proceedings are published on www.futminna.edu.ng.

REVIEW PANEL

We wish to express our deepest and sincere gratitude to the following people in no particular order who provided comprehensive scientific reviews and made commendable suggestions towards improving the over 258 abstracts and 182 full papers submitted to SETIC 2018. They provided constructive comments to authors regarding their papers, it is necessary to state that there was no reported case of conflict of interest by any of the reviewers or the authors.

Prof. Lekan Sanni,	Department of Urban and Regional Planning, University of Ibadan, Ibadan
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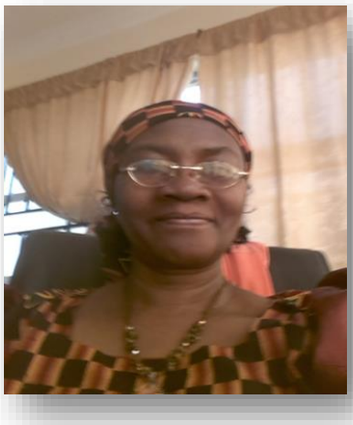
Dr. O.F. Adedayo,	Department of Architecture, Federal University of Technology, Minna

PROFILE OF KEYNOTE SPEAKERS

SETIC 2018 organisers wishes to thank our keynote speakers for accepting to create time to share from their rich wealth of knowledge and interact with delegates and participants on varied issues being examined at this year's conference. A brief profile of each keynote speaker is provided here, this would allow for future interaction and networking with them.

Prof. ZUBAIRU, Stella Nonyelum
Federal University of Technology, Minna

Academic Qualifications: PhD (Building Maintenance, 1999); MSc (Facilities Management, 1989); BArch (Architecture, 1980).
Professional Registration: Registered Architect with Architects Registration Council of Nigeria (F/483, 1985); Member, Nigerian Institute of Architects; Member, International Federation of Facilities Managers.
Contact email stellazubairu@gmail.com; stellazubair@futminna.edu.ng



Prof Stella Nonyelum Zubairu is a lecturer in the Department of Architecture, School of Environmental Technology, at the Federal University of Technology, Minna, Niger State, Nigeria. She obtained a second class upper division degree (BArch) in Architecture from the University of Nigeria, Enugu Campus in 1980. She served in the National Youth Service Corps in Niger State Housing Corporation, Minna, after graduation (1980 -1981), then she worked briefly for a private architectural firm, SWACON, in Lagos before joining the Niger State Ministry of Housing and Environment in 1983 as an architect II. The Ministry later merged with the Ministry of Works and was renamed Ministry of Works and Housing. She rose through the ranks in the Ministry and reached the position of principal architect. During this time, she was involved in many projects in the State including the design and construction of the Government House, extension of the Governor's office, supervision of all health projects in the State and later the design and construction of the Old Peoples' Home and other social welfare projects in the State. In 1988, she was granted study leave to go to Strathclyde University, Glasgow, where she obtained an MSc degree in Facilities Management in 1989. In 1991 she left the Ministry to join the Federal University of Technology, Minna as a lecturer I. In 1995 she was granted a study fellowship to study for her PhD at the University of Lagos which she completed in 1999 with a PhD in Building Maintenance. She was appointed Head of the Department of Architecture, Federal University of Technology, Minna (1999 – 2006). She was promoted to the rank of professor in October 2006. She served as Deputy-Dean Postgraduate School (2008); then she was appointed as Director, Centre for Human Settlements and Urban Development (2008 – March 2011) in the same University. She was then appointed Dean of the Postgraduate School (March 2011 – March 2015).

SCHOOL OF ENVIRONMENTAL TECHNOLOGY INTERNATIONAL CONFERENCE (SETIC) 2018 PROGRAMME

DAY ONE	**TUESDAY**	**10TH APRIL 2018**			
	07.30 – 09.00	**REGISTRATION**			
	09.00 – 10.50	**OPENING SESSION (SET LECTURE THEATRE)** **Chairman Opening Session: Prof. S.O.E. Sadiku Former Deputy Vice- Chancellor, Federal University of Technology Minna**			
	09.00 – 09.05	Welcome and Introduction of Delegates and Guest – **Olatunde Adedayo**			
	09.05 – 09.10	University Anthem			
	09.10 – 09.15	Welcome Address by the Dean, School of Environmental Technology, Federal University of Technology, Minna **– Prof. S.N. Zubairu,**			
	09.15 – 09.25	Recognition of Conference Reviewers			
	09.25- 09.35	Presentation of 100 Years Book **– Prof. S.N. Zubairu,**			
	09.35 – 09.45	Developing Unique gifts items using Paper Art **- D.O. Hans**			
	09.45 – 09.50	Opening ceremony Chairman Speech **- Prof. S.O.E. Sadiku**			
	09.50 – 10 00	Goodwill Messages			
	10.00 – 10.10	Keynote Speech by President Architects Registration Council of Nigeria (ARCON) - **Arc. Umaru ALIYU**			
	10.10 – 10.25	Conference Opening Speech and Declaration by the Chief Host: Vice-Chancellor of Federal University of Technology, Minna, Niger State, Nigeria - **Prof. Abdullahi BALA**			
	10.25 – 10.45	**CONFERENCE LECTURE** **Intelligent Buildings and Green Buildings –Which Way for Nigeria?** **- Prof. Stella N. ZUBAIRU**			
	10.45 – 10.50	Close of Opening Ceremony and SETIC 2018 Group Photographs			
	10.50 – 11.10	**TEA BREAK**			
	11.15 – 12.05	**PLENARY SESSION I** **Chairman of Session: Prof. M.G.M. Kolo, Dean Postgraduate School, Federal University of Technology, Minna** **Session Rapporteur:** ***Dr. R.A. Jimoh, Federal University of Technology, Minna***			
	11.15 – 11.45	**Plenary Paper I** **Promotion of professional degree programmes in Engineering and Built Environment fields.** ***Dr Julius Ayodeji Fapohunda, Editor-in-Chief: International Journal of Sustainable Energy Development***			
	11.35 – 11.55	**Q&A Dr. R.A. Jimoh**			
	11.55 – 12.05	**Session Chair Remarks**			
	12.05 – 12.15	**Split to Parallel Session**			
		PARALLEL SESSION 1			
	12.15 – 12.55	STREAM 1 (LECTURE THEATRE 1)	STREAM 2 (LECTURE THEATRE 2)	STREAM 3 (PG SEMINAR ROOM)	STREAM 4 (SET BOARDROOM)
	Chair	**Prof. M.G.M. Kolo**	**Prof. A.M. Junaid**	**Prof. Y.A. Sanusi**	**Prof. S.N. Zubairu**
	Rapporteur	***Dr. R.A. Jimoh***	***Dr. O.A. Kemiki***	***Dr. A.D. Adamu***	***Dr. P Ayuba***
	Theme	**Environmental Conservation**	**Theory and Practices for Cost Effectiveness in Construction Industry**	**Sustainable Building Materials Development**	**Sustainable Architectural Design**
	12.15 – 12.25	Socio-Economic Impact of Fadama III Programme in Tunga-Kawo Irrigation Scheme, Wushishi Niger State, Nigeria *Olaseni G.O. and Musa Dalil*	Restructuring the Construction Industry and the Built Environment in Africa: A Polycentric Environmental Planning Strategy *Samson R. AKINOLA*	Early-Age Properties of Sorghum Husk Ash and Calcium Carbide Waste Binder In Mortar *C. I. Egwuda, I. O. Hassan, B. J. Olawuyi, & M. O. Enejiyon*	Integrating Cultural Identity to Broadcasting Station Design in North Central Nigeria: Perception of Broadcast Station Workers *Bamidele, I. And Akande, O.K.*
	12.25-12.35	Evaluation of Waste Management Practices in Garment Factories, Kaduna, Nigeria	Perception of Drug Abuse on Productivity of Construction Site Workers in Minna, Niger State	Compressive Strength of Revibrated Concrete Using Sawdust Ash from Selected Wood Species as Partial	Crowd Control in Public Building Designs: Current Trend and Strategies for Ecclesiastical

		Demide A.R and Isah A. D	*Bamgbade Adebisi Abosede, Amos Kelechi Goodluck, Okosun Blessing, Akanbi Memunat Oyiza*	Replacements for Cement *Auta, S.M., Agie, V.N. & Alhassan, M.*	Buildings in Abuja, Nigeria *Ikibe J. H. and Akande, O.K.*
	12.35 – 12.45	Exploring the Tourism Potentials of Cultural Landscape of Nupe Communities in Central Nigeria *Isyaku Mahmud & Isa Bala Muhammad*	Evaluation of Factors Affecting Labour Productivity in Selected Building Construction Sites in Abuja Metropolis, Nigeria *M. O. Peter and D. A Muazu*	Affordable Housing in Nigeria Using Alternative Building Technologies and Materals: A NBRRI Perspective *Danladi Slim Matawal, Nwanade Ocean, Chukwuma Gerald, And Aliyu Kawu*	Adaptation of Interior Design as a Therapeutic Tool in Paediatric Hospitals in Federal Capital Territory, Nigeria *Ummi Hamidu Mai*
	12.45 – 12.55	Q&A			
	12.55 – 13.50	**LUNCH**			
	13.50 – 15.15	**PARALLEL SESSION 2**			
		STREAM 1 (LECTURE THEATRE 1)	STREAM 2 (LECTURE THEATRE 2)	STREAM 3 (PG SEMINAR ROOM)	STREAM 4 (SET BOARDROOM)
	Chair	**Dr. A. Saka**	**Dr. Samsideen Ojoye**	**Dr. Nasir. Abdulkarim**	**Dr. J.T. Kur**
	Rapporteur	***Dr. M.T.A. Ajayi***	***Dr. Hassan Ogiri***	***Dr. D. Opaluwa***	***Dr. E. Ogunbode***
	Theme	**Architectural Education and ICT Information Technology and Building Maintenance**	**Health and Safety Issues Information Technology and Construction**	**Smart Cities Development**	**Resilient Housing Development Innovative Infrastructure Development**
	13.50 – 14.00	Creative Art and Transformative Development in Architecture Nexus: A Case of Federal University of Technology Minna *A .S. Alfa*	Effect of Health and Safety Management Practices on Safety Performance of Construction Contractors *David B.R., Idiake J.E. & Shittu A.A.*	Prospects and Challenges of Smart City Development in Nigeria *Nda, Khadijat Yakubu &Babah, Bishara Musa*	Study of Residents' Satisfaction with Housing Conditions in Urban Centres of Southwest Nigeria *Mukaila El-Hussain Abdulrahman*
	14.00 – 14.10	Users' Perception Of Informal Interaction Spaces In Research Institutes in the Federal Capital Territory, Nigeria *Otu Muhammad Adeiza & Isa Bala Muhammad*	Assessment of Pattern of Accident Occurrence on Building Construction Sites in Abuja, Nigeria *Adeniyi, K. E. & Mohammed Y. D.*	Exploring Factors that Contributes to Residential Environment Liveability In Minna, Niger State *Sule Abass Iyanda, Ojetunde Ismail, Morenikeji Gbenga, & Abdulkareem Sekinat*	Micro-Housing Development as Feature of Class Stratification in the Jos Metropolis of Plateau State, Nigeria *Sulyman, A.O And Kudu, S.E.*
	14.10 – 14.20	Q&A			
	14.20 – 14.30	Trends, Problems and Prospects of Computer & ICT in Architectural Education and Practice In Nigeria *Abdulwahab Engworo Etudaiye, Precious Ugochukwu & Abubakar Adamu Girei*	Impact of Safety Managers' Leadership Styles on Workers Safety Behavior on Construction Site in Abuja *Ajala J. O.& Mohammed Y. D.*	Analysis of Livelihood Diversification in Peri-Urban Settlements Of Minna *Gimba S. L. & Sanusi Y.A*	Assessment of User Satisfaction as a Basis for Sustainable Housing Provision in Nigeria *OCHEPA Yahaya Sadiq*
	14.30 -14.40	Proposed Architectural Curriculum Framework for Sustainable Development *Mudashir Gafar And*	Assessment of Health and Safety Measures in Selected Basic Schools in Abuja *UGBAN, Nguseer Cynthia & OLASENI, Gbenga Olaolu*	Investigation of Space Flexibility Principles in the Design of Student's Social Centres *Aliyu Usman*	Integrated Approach: A Sustainable Strategy to Adequate Housing Provision by the Urban Poor in Lokoja, Nigeria

		Abubakar Abdullah			*Amlogu G. Y. & Sulyman A.O.*
	14.50 – 15.00	Facility Maintenance Management Plan – A Case Study of Kashim Ibrahim Library, Ahmadu Bello University, Zaria *Musa Sylvanus Hassan*	Impact of Information and Communication Technology (ICT) Facilities Deployment on Quantity Surveying Practice in Abuja *Alabi, T. T. & Anifowose, O. M.*	Integration of Recreational Spaces in Abuja Commercial Centres Designs *ZAKARI Nathaniel Sunday*	Effects of Infrastructure Provision on Residents of Selected Private and Public Housing Estates in Lokoja Metropolis, Nigeria *Okpanachi, M. & Zubairu, M.*
	15.00 – 15.10	Q&A			
	15.10 – 15.15	**Session Chair Remarks**			
	15.15 – 15.25	**SNACK BREAK**			
	15.25 – 16.55	**PARALLEL SESSION 3**			
		STREAM 1 (LECTURE THEATRE 1)	STREAM 2 (LECTURE THEATRE 2)	STREAM 3 (PG SEMINAR ROOM)	STREAM 4 (SET BOARDROOM)
	Chair	**Dr. M.B. Nuhu**	**Dr. M.T.A. Ajayi**	**Dr. P. Ayuba**	**Dr. O.A. Kemiki**
	Rapporteur	***Dr. Abbass***	***Dr. I.B. Muhammad***	***Arc. Oyetola***	***Dr. B.J. Olawuyi***
	Theme	**Theory and Practices for Cost Effectiveness in Construction Industry**	**Sustainable Property Taxation** **Sustainable Architectural Design**	**Sustainable Cost Management**	**Sustainable City Growth**
	15.25 – 15.35	Cost Implications of Rework due to Design Errors in Institutional Building Projects in Abuja *C. Salihu & A.D. Adamu*	Estate Surveyors' Perspectives on Residential Property Tenancy Determination in Ilorin Metropolis *Ibrahim Tajudeen Akogun, Olatoye Ojo, Agava, Yusuf Halim, Adeogun Sunday Adekunle*	Factors Responsible for Variation in Cost of Mechanical and Electrical Services in Building Projects in Nigeria *Ladan, M. & Shittu A.A*	Spatial Variation of Factors Influencing Neighbourhood Change in the Peri-Urban Areas of Minna, Niger State *Idowu, O. O., Shaibu, S. I.; Bako , A. I. Raheem, W. A. & Martins, V. I.*
	15.35 – 15.45	Evaluation of the Nigeria Construction Industry Preparedness to Adopt Supply Chain Management Practices *Abah, E. & Adamu A. D.*	Residential Property Investment Returns Inequalities in Ilorin *A.S. Adeogun, M.B. Nuhu, N.B. Udoekanem, N.I. Popoola, M.B. Wahab, and W.O. Shittu*	Impact of Contractual Claims on the Performance of Public Building Projects in Nigeria *Saidu, J. K. And Oyewobi, L.O.*	Assessment of The Application of Crime Prevention Through Environmental Design (CPTED) in Residential Estates in Minna *Idris Attahiru Muhamad, Sarah Kakajiya Goshi & Isa Bala Muhammad*
	15.45 – 15.55	Q&A			
	15.55 – 16.05	Evaluating the Current Teaching Techniques to the Nigerian Undergraduate Quantity Surveying Students *Saidu I., Nkollo O.W., Danjuma M. & Shakantu W.*	Effectiveness of Passive Design Features in Active Security Installation in Large Shopping Centres in Abuja, Nigeria *Bamidele Oluwatosin Eunice, Adedayo O.F.*	Effect of Contractual Risks on Building Contracts in Abuja, Nigeria *Alhaji, Lawal Haruna & Muhammad, Yakubu Danasabe*	Improving and Sustaining Access to Water and Sanitation in Nigeria: Opportunities and Constraints *Gognaje, Sunday Barde*
	16.05 – 16.15	Assessment of Labour Productivity and Construction Workers Wages on Active Sites in Minna *O. A. Obanibi, and D. A. Muazu*	Assesement of Student Satisfaction with Provision of Recreational Spaces in Faculty Buildings in Public Universities in North Central Nigeria *Nasirdeen M. Y. & Adedayo, O.F.*	Assessment of the Cost Implication of Reviving Abandoned Public Projects in Abuja, Nigeria *Saleeman Yinusa & Anifowose, Opeyemi Maroof*	Achieving a Sustainable City Growth Through Neighbourhood Levels in Bosso Estate, Minna Niger State *S.I. Shaibu, S.O. Medayese, O.O. Idowu, P.O. Abah And G.S. Owoyele*
	16.15 – 16.25	Q&A			

	16.25 – 16.35	Assessment of Leadership Capability in the Nigerian Construction Industry for Effective Project Delivery *Akinsanya, A.Y., Olanrewaju O. D., Ikegwu E. M. & Oke, E.*	Adaptive Reuse Design Consideration in Campaign Office Buildings in Minna, Niger State *Jimoh, Rukayat Olajumoke, Abdulrahman, M. E.*	Impact of Money on Price Direction of Building Materials in Abuja *Omoboye, Olayinka Gideon & Anifowose, Opeyemi Maroof*	Appraisal of EU Financed Rural Water Supply Project in Selected Communities in Akwa Ibom North Senatorial District, Nigeria *Edem, E. Essien, Mohammed B. Banki & Ohadugha, C. B*
	16.35 – 16.45	Effect of Motivation Strategies on Labour Output of Small and Medium Construction Contractors in Nigeria *Uzoma, C. N., Shittu, A. A. & Oke, A. A.*	Assessing User Perception on the Efficiency of Passive Security Control Measures in Modern Public Secondary Schools in Minna, Niger State *Omeje, S.C. & Olaniyan, O.A.*	Developing Building Cost Indices Using Federal High Court Projects of 2007 to 2016 *Wakili, Abubakar & Ibrahim, Ahmed Doko*	Neighbourhood Crime Vulnerability Mapping in Ilorin, Nigeria *Lekan Mohammed Sanni*
	16.45 – 16.55	Q&A			
	16.55 – 17.05	**CLOSE**			

DAY TWO	**WEDNESDAY**	**11TH APRIL 2018**			
	08.40 – 09.00	**Highlights of Day One** ***Dr. R.A. Jimoh***			
	09.00 – 09.55	**Plenary Paper II** **Chairman of Session: Prof. O.O. Morenikeji, Department of Urban & Regional Planning, Federal University of Technology, Minna** **Session Rapporteur: Dr. B. Ganiyu, Federal University of Technology, Minna**			
	09.00 – 09.05	**Session Chairman Remarks**			
	09.05 – 09.45	**WORKSHOP SESSION I** **Research method best practice- The Approach to achieve Valid and Reliable Findings Part 1** **Dr Julius Ayodeji Fapohunda, Editor-in-Chief: International Journal of Sustainable Energy Development**			
	09.45 – 09.55	**Q&A Dr. B. Ganiyu**			
	10.00 – 11.00	**PARALLEL SESSION 4**			
		STREAM 1 (LECTURE THEATRE 1)	STREAM 2 (LECTURE THEATRE 2)	STREAM 3 (PG SEMINAR ROOM)	STREAM 4 (SET BOARDROOM)
	Chair	**Dr. A. Abdulkadir**	**Dr. Mairo Mohammed**	**Dr. R.A. Jimoh**	**Dr. R. Ojutiku**
	Rapporteur	***Dr. Owoeye***	***Dr. Abdulrahman***	***Dr. Anifowose***	***Dr. Hassan Ogiri***
	Theme	**Sustainable City Growth**	**Social Integration in Cities**	**Energy Efficiency And Conservation**	**Urban Ecology Management**
	10.00– 10.10	Users Perception in the Planning of Markets: A Case Study of Abuja, Nigeria *Muhammad Abubakar Sadiq*	Social Capital: A Poverty Reduction Mechanism in Minna, Niger State, Nigeria *Martins V. I., Sanusi Y. A., Akande S. O., Mohammed N. & Adeleye B. M.*	Determinants of Households Domestic Cooking Energy Choice and Technology in Minna, Niger State Nigeria *Ohadugha, C. B.; Sanusi, Y.A; Morenikeji, O.O; Zubairu, M. & Olaide, A.*	Assessment of Recreational Spaces in Public Secondary Schools, Minna, Niger State *Hassan, B. Y. & Yelwa, M. U.-K*
	10.10 – 10.20	Urban Development Control as a Viable Measure for Achieving Sustainable Development Goals *Nasiru, S., Kemiki, O.A., Emmanuel, S.G.*	Appraisal of The Role of Informal Economic Enterprises in Minna, Nigeria *Ibrahim, Bilkisu and Kawu, A.M*	Passive Techniques for Energy Conservation in Hotel Buildings in Minna, Nigeria *Zhiri, G. H. & Akande, O. K.*	Livelihood Opportunities in Solid Waste Recycling in Kaduna Metropolis, Nigeria *Shaibu, S. I.; Nwamuo A. G. and Medayese, S. O.*
	10.20 – 10.25	Q&A			
	10.25 – 10.35	Challenges Facing the Development of	Livelihood Opportunities from the Periodic Markets	Analysis of Energy Poverty in Rafi Local	Spatial Inequality in Environmental Amenities

		Sustainable Petrol Filling Stations in Minna, Niger State- Nigeria *Aisha Panti ABDULLAHI and Olatunde Folaranmi ADEDAYO*	in Eastern Part of Niger State, Nigeria *Mbaukaan Eric Iormba & Sanusi Yekeen Adeeyo*	Government Area of Niger State, Nigeria *Akande S.O., Sanusi Y.A., Mohammed N., & Ohadugha C.B.*	Distribution in Bida, Niger State, Nigeria *Mohammed N., Sanusi Y. A., Akande S. O., Adeleye B. M., Ohadugha C. B., Mohammed M.*
	10.35 – 10.45	Design Considerations for Crime Prevention through Environmental Design in Minna Shopping Centres *Jatto .A. Ibrahim & M.E. Abdulrahman*	Analysis of Do It Yourself (DIY) Approach in a Neighbourhood Community Sanitation Project in Sokoto Metropolis *Ashiru Bello*	User's Satisfaction Level With Passive Cooling Design Techniques in Public Secondary Schools Minna, Nigeria *Isijola Deborah Boluwatife, Adedokun John & Goshi Sarah Kakajiya*	User Satisfaction with Organic Architecture Design Considerations in Hospital, Abuja *Ajiboye Oluwaseun Charles , and M.UK Yelwa*
	10.45 – 10.50	Q&A **Session Chair Remarks**			
	10.55 – 11.15	**TEA BREAK**			
	11.15 – 13.00	**PARALLEL SESSION 5**			
		STREAM 1 (LECTURE THEATRE 1)	STREAM 2 (LECTURE THEATRE 2)	STREAM 3 (PG SEMINAR ROOM)	STREAM 4 (SET BOARDROOM)
	Chair	**Dr. I.B. Muhammad**	**Prof. Musa Ahmed**	**Prof. A.M. Junaid**	**Dr. Joy Maina**
	Rapporteur	***Dr. A.D. Adamu.***	***Dr. Isa Aka***	***Dr. R. Babtunde***	***Dr. A.I. Sule***
	Theme	**Sustainable Architectural Design**	**Sustainable Urban Transportation Systems**	**Energy Efficiency And Conservation**	**Disasters, Resilient Cities And Business Continuity** **Sustainable Geomatic Tools And Techniques**
	11.15 – 11.25	Elements of Architectural Design and Interpretation of Buildings and Monuments in Kaduna State *Isa Sani Mohammed, Anas Muhammad & Aisha Wali Aminu-Umar*	Commuters' Assessment of Intra-City Bus Service in Kaduna Metropolis, Nigeria *Oluwole Matthew Sunday & Tolufashe Stephen Afolabi*	Integrating Natural Lighting Design Approach to Library of Public Universities in North Central Nigeria *Mukaila Elhussein Abdulrahman & Ibrahim Charles Adejoh*	Post-Resettlement Changes and Adjustment: A Case Study of Sabon Wuse in Niger State, Nigeria *Sulyman, A.O And Kudu, S.E.*
	11.25 -11.35	Assessment of User Centered Design Approach in Schools of Architecture, Nigeria *David Odinya Emmanuel & Oluwafemi Kehinde Akande*	Users Circulation Satisfaction in Nnamdi Azikiwe International Airport (NAIA) Terminal Building Abuja, Nigeria *Yabagi M. & Isah A. D.*	Energy Consumption Pattern Among Households in Minna Metropolis, Niger State, Nigeria *Akanmu, W. P.; Jimoh, I.A. and Bajere, P. A.*	Institutional and Community Awareness on the Environmental Impact of Municipal Solid Waste Management in Bida Metropolis, Nigeria *Yahaya, U.; Abd'razack, N.T.A. & Mohammed, M.*
	11.35 – 11.40	Q&A			
	11.40 – 11.50	Assessment of Design Features for Circulation in General Hospitals in Kogi State, Nigeria *Ocheje, Eneojo Abdulmunin And Olagunju, R. E.*	Assessment of Circulation Safety Design Features in Train Terminal Buildings in Nigeria *Adeboh, David & Olagunju, R. E.*	Evaluation of Thermal Comfort in School Of Environmental Technology Complexes in Selected Government Owned Universities in South East Nigeria *Eze, Chukwudum Jasper & Okoro Emmanuel Ijioma*	Development Control: A Strategy for Flood Vulnerability Assessment In Suleja *Adeleye, B.M[1], Zitta, N[2], Popoola, A.A. and Ayangbile, O. A.*
	11.50 – 12.00	Assessment of Design Features for Crowd Control in	Assessment of the Extent of Traffic Congestion in	Assessment on the Extent of Passive Cooling Strategies	Towards resilient in Design and Construction of

		Sport Centres In Nigerian Universities *Grace Olushola Jaiyeola, Isa Bala Muhammad & Olagunju R.E*	Selected Traffic Appian in Minna, Nigeria *Medayese S. O, Abd'razack, N.T.A & Ajumobi O.*	Integration in Public Centers Ado-Ekiti, Ekiti State, Nigeria *SANTHUS Ericson Beshel*	Housing in Coastal Area of Lokoja, Nigeria *Abdulmutalib Ohinoyi Ibrahim & Ochepa Yahaya Sadiq*
	12.00 – 12.10	Integration of Crowd Control Mechanisms in Civic Centre Design in Kaduna State, Nigeria *Izigah Sunday Anthony & Abubakar Danladi Isah*	Spatial Analysis of On-Street Parking in Kpakungu Area of Minna, Nigeria *Medayese, S. O., Musa-Daud F.A & Matins, V.I.*	Using Waste Heat Recovered from Household Refrigerator to Heat Water for Domestic use *MUSA Nicholas Akhaze, AKINBODE Folorunsho Olayiwola & NJOKU, Benedicta Chidinma*	Geospatial Information Systems Solutions to the Consequences of Modernization and Technological Advanvements On The Built Environment *Onuigbo, Ifeanyi Chukwudi*
	12.10 – 12.20	Q&A			
	12.30 – 12.40	Impacts of Therapeutic Environments on the Recovery Process of Patients in Healthcare Facilities in Nigeria *Uzoh Oghor Jewel*	Road Passengers' Perception on the Quality if Bus Terminal Facilities in Nigeria *Edikan B. & A.D. Isah*	A Review of Literatures on Energy Performance in Low Income Housing, Using Retrofiting Techniques in View of Optimizing Energy Efficency *Mbohok, O. E. and Akanmu,W. P.*	A Method for Assessment of Optimal Choice of Parametric Model in Least Squares Collocation *Odumosu, J.O., Onuigbo, I.C., Nwadialor, I.J. And Kemiki, O.A.*
	12.40 – 12.50	Assessment of Courtyard Functions and its Design Considerations in Hospitals in Niger State *Mamud, M.I. And Yelwa, M.U.K.*	Spatial Analysis and Modelling of Campus Shuttle Stops in Federal University of Technology, Akure, Nigeria Nzelibe I. U., Idowu T. O. & Ajayi G. E.	Integration of Biomimicry Principles as a Means to Energy Efficiency in Office Design, Abuja, Nigeria *Abubakar Usman Karofi & Eze J.C.*	Investigation of the Robustness of Different Contour Interpolation Models for the Generation of Contour Map and Digital Evelation Models *Kuta A. A., Ajayi O. G., Osunde T. J., Ibrahim P. O., Dada D.O. & Awwal A. A.*
	12.50 – 13.00	Q&A **Session Chair Remarks**			
	13.00 – 13.55	**LUNCH**			
	14.00 – 15.35	**PARALLEL SESSION 5**			
		STREAM 1 (LECTURE THEATRE 1)	STREAM 2 (LECTURE THEATRE 2)	STREAM 3 (PG SEMINAR ROOM)	STREAM 4 (SET BOARDROOM)
	Chair	**Prof. S.N. Zubairu**	**Dr. B. Ganiyu**	**Dr. J.E. Idiake**	**Dr. L. Sanni**
	Rapporteur	***Dr. Ayuba***	***Arc. Oyetola***	***Dr. N.I. Popoola***	***Dr. I. Saidu***
	Theme	**Sustainable Architectural Design**	**Social Integration in Cities** **Sustainable Cost Management**	**Sustainable Cost Management**	**Facility Management**
	14.00 – 14.10	Design Considerations for Pedestrian Circulation Control in General Hospitals, Abuja *Okonkwo Emmanuel Obinna And Isa Bala Muhammad*	Assessment of User's Perception of Outdoor Eating Area in Abuja Restaurants *Idris, Ahmad Loko & Mukaila El-Hussain Abdulrahman*	Assessment of Post-Project Review Systems for Construction Projects in Abuja, Nigeria *John, M. And Oyewobi, L. O.*	The Contributory Effect of Externalities to the Void Periods for Residential Buildings in Minna, Nigeria *Ogunbajo, R. A, Adewusi, A. O, Usman, B.S. & Ayoola, A. B.*
	14.10 – 14.20	Evaluation of Integration of Users Needs in Paediatric Ward Designs in General Hospitals in Niger State	Evaluation of Social Interactive Spaces of Shopping Centres in Abuja, Nigeria *Sulyman, O.S. And Akande, O.K.*	Design Firm's Perception on Risk Occurrence and Impact on Construction Project Budget Performance	The Prospects of Facility Management in Real Estate Sector in Nigeria

		Adedokun A. J., Adedayo O. F., Isijola D. B. & Onwuka B. N.		*S.U. Gbate, K.J. Adogbo & H. Musa*	*Emmanuel C. Osuji1, Joshua Daniel Auta, Patricia Ehi Ehoche*
	14.20 – 14.30	Q&A			
	14.30 – 14.40	Integration of Open Spaces in Maternity Hospital Design for Therapeutic Functions in Kaduna, Kaduna State *Mordi, C.Y & Ayuba, P*	Preference and Compatibility: Ageing in Place Limitations in Nigeria *Onanuga Omotayo Adebayo*	Impact Of Wage Differentials On Productivity Of Construction Companies In Abuja *Abdulmalik, Amina & Y. D. Muhammad*	Assessment Of User Satisfaction With Facilities In Rest-Stops Along Kano-Abuja Highway *Abubakar Aisha Sadiq & Shittu Abdulmajeed Olaremi*
	14.40 – 14.50	Adoption of User's Perception of Landscaping Elements for Passive Security in Public Recreational Parks in Nigeria *Ogbonna C. O. & Isah D. A.*	Assessment of Interactive Spaces in High Rise Residential Building in Lagos City, Nigeria *Ogunlowo M. O. & Oyetola S.A.*	Evaluating the Performance of Public Private Partnership in the Delivery of Public Housing Schemes in North Central Nigeria *Oni Olalere Simeon & Adamu Anita Dzikwe*	Evaluation of Health Implication of Off-Campus Residence as a Sustainable Alternative in Tertiary Institutions *Ibok U. Okon, Udomiaye Emmanuel And Odaudu Ugbede Sunday*
	14.50 – 14.55	Q&A			
	14.55 - 15.05	Assessing Flexible Features in the Design Of Event Centres in Minna, Niger State Nigeria *Agah, F. A. & Ayuba P.*	Assessment of the Relationship Between Housing and Livelihood Pattern of Urban Residents of Bida, Niger State, Nigeria *Sulyman A.O. & Dzukogi U.A.*	Stakeholders` Perception of The Causes and Effects of Variation Orders in Public Construction Projects in South-Eastern Region of Nigeria *Emmanuel Tayo Adu & A. Opawole*	User Satisfaction with Informal Space Efficiency in Selected Office Buildings in Lokoja Kogi State Nigeria *Audu Muhammad Onoruiza & Eze Chukwudum J.*
	15.05 – 15.15	Assessment of Passive Security Measures in Hotel Design in Osun State, Nigeria *Jimoh Olawale Uthman & Sarah Kakajiya Goshi*	The Impacts of Microfinance on Livelihoods of Women – A Study of Lapo Microfinance Women Clients in Minna, Niger State, Nigeria *AKANBI, Memunat O. and BAMGBADE, Adebisi A.*	Assessment of Contractors' Perception on the Effect of Cash Flow on Construction Project Delivery *Ali A. A., Idowu Faruq Ayobami & Musa Abdulrasheed Alhassan*	Assessment of Space Provision and Adequacy in Peadiatric Hospital Design: A Case Study of Offa, Kwara State *Lawal Aminat Abiola*
	15.15 – 15.25	Assessment of The Level of Integration of Organic Architecture in Hotel Buildings in Makurdi, Benue State *Icha, Lazarus O. and Arc. Eze, Chukwudum J.*	Impact of Public Procurement Reform on Construction Project Delivery in Kaduna State *ADOGA, Angela Omoyemen and Abdulateef SHITTU*	Strategic Management Initiatives in Small and Medium Scale Construction Companies in FCT Abuja *Olubajo, O. O. & Olawuyi, B. J.*	Post-Occupancy Evaluation of Students Hostel Facilities in Federal Universities in North Central Nigeria *Abdul Christopher Ileanwa & Ayuba Philip*
	15.25 – 15.35	Q&A **Session Chair Remarks**			
	15.35 – 15.50	**SNACK BREAK**			
	15.55 – 16.40	**WORKSHOP SESSION II** **Research method best practice- The Approach to achieve Valid and Reliable Findings Part 2** **Dr Julius Ayodeji Fapohunda, Editor-in-Chief: International Journal of Sustainable Energy Development**			
	16.40 - 16.50	**Q&A Dr. O. A. Kemiki**			
	16.50 – 17.15	CLOSE			

DAY THREE	**THURSDAY**	**12TH APRIL 2018**			
	08.40 – 09.00	**Highlights of Day Three Dr. I.B. Muhammad**			
	09.00 – 10.20	**PARALLEL SESSION 6**			
		STREAM 1	STREAM 2	STREAM 3	STREAM 4 (SET BOARDROOM)

		(LECTURE THEATRE 1)	(LECTURE THEATRE 2)	(PG SEMINAR ROOM)	
	Chair	**Prof. O.O. Morenikeji**	**Prof. A.M. Junaid**	**Prof. Y.A Sanusi**	**Dr. M.B. Nuhu**
	Rapporteur	***Dr. M.T.A. Ajayi***	***Dr. Ayuba***	***Dr. O.A. Kemiki***	***Dr. L.O. Oyewobi***
	Theme	**Sustainable Architectural Design** **Sustainable Urban Transportation Systems**	**Materials and Energy**	**Urban Land Access**	**Green Construction and Efficiency**
	09.00 – 09.10	Assessment of Display Techniques Design Consideration for Car Sales and Service Station Abuja *Aliyu, Musa Chiji and Olagunju, R. E.*	Effect of Calcium Carbide Waste and Groundnut Shell Ash Blended with Cement in Concrete Production *U. Nuhu, T.Y. Tsado, and M. Abdullahi*	Effectiveness of Compulsory Land Acquisition Process in Durumi District, Abuja Nigeria *Kuma, S. S., Fabunmi, F. O., Adamu, S. And Kemiki, O. A.*	Promotion of Green Infrastructures in Nigerian Urban Settlements for Sustainable Development: An Advocacy *Olufemi, J. E. & Nuhu, A.A;*
	09.10 – 09.20	Assessment of Passive Crowd Design Control Considerations in Jumuat Masjids (Mosques), Minna, Niger State *ALIYU Muhammad Baba & EZE J. C.*	Performance Evaluation of Egg-Shells and Cow Bone Ashes as Pozzolana in Concrete Production *Y. Adamu , T. Y. Tsado, &T.W. E. Adejumo,*	Developing an Efficient Urban Land Market in Warri, Nigeria: The Challenges and a Road Map *Bernard Adjekophori*	Perceived Benefits and Potential Challenges of Implementing Green Building Practices in Lagos, Nigeria *Ola, Olumide Samson*
	09.20 – 09.30	Q&A			
	09.30 – 09.40	Evaluation of Crimes, and User's Perception on Preventive Measures in Commercial Buildings in Nigeria *SALAWU,Abdulkareem Muda and Isah Abubakar Danlami*	Sustainability, Resource Consumption and Ecological Footprint of Bida, Nigeria *Oluwafemi Joshua OJO & N.T.A. Abd'Razack*	Access To Residential Land In Minna, Nigeria: Methods And Constraints *Chukwuma C. Nwuba & David Adoga*	Strategies For Material Wastage Mnimization On Building Construction Sites In Kaduna State – Nigeria *Okosun B.O., Oyewobi, L.O., And Odine, L.C.*
	09.40 – 09.50	Intergration of Green Design Principles in Circulation Spaces of Shopping Centers, Ilorin, Nigeria *Oyebode Abdulhafeez Olabode & Isah Abubakar Danladi*	Sugarcane Straw Waste Ash as a Potential Binder in Concrete Production *Ahmed, A. and Amali, N.U*	A Comparison of The Performance of Manual and Digital Land Information System in Kwara State, Nigeria *ADEKOYA Adeola Adesanya, ADEWUSI Amos O.*	Evaluation of an Eco-Friendly Approach for the Physically Challenged People in Nigeria *Dauda C. G. & Akande O. K.*
	09.50 – 10.00	Q&A			
	10.00 – 10.10	Assessment of Passive Security Measures in Senate Buildings of Federal Universities in North Central Nigeria *Egwuma Macaulay*	Integration of BIM Technology into Facilities Space Planning and Management at A Tertiary Educational Institution in Nigeria *Bajere, P. A., Akanmu, W. P. And Jimoh, I. A*	Impact of Peri Urban Growth on Agricultural Land in Minna Suburb *Morenikeji, G., Popoola, N. I., Alfa, M., and Adeleye, B.M*	Evaluating the Barriers in Developing Green Building in Nigerian Construction Industry *Idowu Faruq Ayobami, Salawu Abdulfatai Oyebode & Peter Gangas*
	10.10 – 10.20	Users' Satisfaction of Tricycle as Urban Commercial Transportation in Minna, Nigeria *Owuri Aishat Ize & Aliyu Kawu*	Preference And Compatibility: Ageing In Place Limitations In Nigeria *Onanuga Omotayo Adebayo And Oviasogie Collins O*	Urban Green Infrastructure Planning in Europe and the United States: Lessons for Nigerian Cities *Alabi, A.M. and O.M. Olaniyan*	Evaluation of Design Features for Adoption of Bright Green Concept in Hotels in Minna, Nigeria *Ijege, A. A.*
	10.20 – 10.25	Q&A **Session Chair Remarks**			

	10.25– 10.45	**TEA BREAK**			
	10.45 – 12.45	**PARALLEL SESSION 7**			
		STREAM 1 (LECTURE THEATRE 1)	STREAM 2 (LECTURE THEATRE 2)	STREAM 3 (PG SEMINAR ROOM)	STREAM 4 (SET BOARDROOM)
	Chair	**Dr. L.O. Oyewobi**	**Dr. Anita Adamu**	**Dr. Joy Maina**	**Dr. P. Bajere**
	Rapporteur	***Dr. O.A. Kemiki***	***Dr. R. Babtunde***	***Dr. I.B. Muhammad***	***Dr. C. Ohadugha***
	Theme	**Information Technology and Design** **Theory and Practices for Cost Effectiveness in Construction Industry**	**Sustainable Building Materials Development**	**Building Information Modelling**	**Energy Efficiency And Conservation** **Facility Management**
	10.45 - 10.55	Design and Implementation of a Computerised Battery Analyser *E.N. Onwuka, E.I. Nwankwo, P. Oluwabiyi, A. Nurudeen & S.O. Aliyu*	Effect of Revibration on the Flexural Strength of Concrete, Using Mahogany Sawdust Ash as Partial Replacement for Cement *Auta, S.M., Peter, O. & Saidu, M.*	Building Information Modelling: A Tool for Diffusion of Information in Nigeria *Hamma-Adama, M., Galadima,Y. K. & Kouider, T.*	Application of Courtyard Concept as a Passive Cooling System Case of Artisan Training Institute in North Central Nigeria *Abdul Hakeemat Eneze*
	10.55 – 11.05	Ergonomics of Three-Wheeled Wheelchair as a Mobility-Aid Used in Kano City *Munir Moukhtar Mai*	Effect of Superplasticizer on Setting Time and Strength of Mortar Made Using Rice Husk Ash (Rha) and Calcium Carbide Waste (CCW) as Binder. *M. O. Enejiyon, B. J. Olawuyi, I. O. Hassan, And C. I. Egwuda*	Appraisal of the Extent of BIM Integration in Facility Management Practices in Abuja, Nigeria *M.H. Yunusa, M. Abubakar And M.Abdullahi*	Evaluation of Natural Lighting as a Solution Towards Achieving Sustainability in the Design of Shopping Malls in F.C.T Abuja Municipal Area *Obinna C.Q. and Akande, O.K.*
	11.05 – 11.15	Q&A			
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OVERVIEW OF CHALLENGES OF SUSTAINABILITY

ARC. UMARU ALIYU, ficiArb, fnia, ppnia,
PRESIDENT,
Architects Registration Council of Nigeria (ARCON)

The world is experiencing rapid urbanization in the 21st Century. The challenges of sustainability have become an integral part of our lives.

The concept of Environmental Sustainability has been around now for many years in the construction industry. However, studies indicate that the Construction Industry accounts for significant energy consumption and environmental pollution. According to recent studies Building material manufacture takes up approximately 10% of global energy-use. Up to 40% of global primary energy is consumed as energy-in-use of buildings in the operational phase and in turn these buildings produce about 24% of global CO2 emission. Due to the increase in energy cost and scarcity of natural resource, it has become increasingly important to minimise energy consumption and Green House Gas, GHG, emission attributed to the Architecture, Engineering and Construction (AEC) Sector.

Contemporary concepts such as Building Information Modelling (BIM) Management allows the superimposition of information from the various supplier disciplines within a single model - in a Common Data Environment (CDE). This approach provides the opportunity to introduce and analyse environmentally sustainable enhancement measures at the early stages of the design process.

Our lifestyle is having profound impact on the Earth's ecosystem. How much nature are we prepared to sacrifice to sustain our lifestyle? And does it matter? Are we living sustainably? What are the conservation challenges? This conference explores major challenges to contemporary issues and sustainable practices in the built environment. The several papers to be presented at this conference are expected to review the progress that has been made so far and to explore how progress might be measured in these areas.
Where our Energy comes from is a topic of importance for energy security, cost and environmental reasons. Rapid urbanisation has come with a catalogue of challenges such as the need for sustainable Urban Transportation, Affordable Housing and Waste Management. Papers to be delivered, as part of this conference, will also examine how these might be best addressed, in terms of evaluating options, their feasibility and viability. Most of the papers to be presented at this conference would cover the following key areas:

- Energy Efficiency and conservation
- Environmental Conservation
- Sustainable Facility Management
- Sustainable Building material development
- Building Information Modelling Management
- Smart Cities Development
- Urbanization and Urban Ecology Management
- Resilient Cities and Sustainable Housing Development

In summary, the contemporary issues and sustainable practice conference will essentially look at ethical issues, examine the choices ahead of us and the impact on societies world-wide.

I would like to thank the School of Environmental Technology, Federal University of Technology Minna for giving me the opportunity to deliver the key note speech at this conference.
Thank you once again and enjoy the conference paper presentations.

arconigeria@yahoo.com

Umaru Aliyu (2018). **OVERVIEW OF CHALLENGES OF SUSTAINABILITY.** Contemporary Issues and Sustainable Prac tices in the Built Environment.. School of Environmental Technology Conference, SETIC, 2018

INTELLIGENT BUILDINGS AND GREEN BUILDINGS – WHICH WAY FOR NIGERIA?

Prof Stella N. Zubairu
Department of Architecture, Federal University of Technology, Minna.

Buildings in the 21st Century incorporate information and communication technology resulting in intelligent buildings and smart environments. Concern with global warming and ensuring the sustainability of the environment has resulted in green or sustainable or eco-friendly buildings. Many countries have established green building certification criteria such as BREEAM and LEED to determine the level of sustainability of buildings. This paper discusses intelligent and green buildings using a case study approach. A total of twelve buildings were studied from different parts of the world. The findings reveal that there is a merging of intelligent and green buildings. Professionals in the building industry have discovered that building intelligence can actually enhance building sustainability. As the way forward for Nigeria, the paper recommends the establishment of Nigerian green building assessment criteria, the utilisation of renewable sources of energy as total power source for buildings, government policy to encourage utilisation of local building materials and greater emphasis on teaching of green building design in schools of Architecture in Nigeria.

Key words: building, green, intelligent, smart, sustainable.

INTRODUCTION

The 21st Century is a world of information and communication technology and this technology affects all spheres of life including building technology. Buildings of today incorporate information and communication technology resulting in intelligent buildings and smart environments. The concern with global warming and ensuring sustainability of the environment has also affected the construction industry and resulted in green or sustainable or eco-friendly buildings. Are intelligent buildings and green buildings mutually exclusive? This paper discusses this issue and considers the way forward for Nigerian building designs.

Intelligent Buildings

An intelligent building is a building which contains an integrated network of information management systems which control services such as: Heating, Ventilation, Air-conditioning, Lighting, Security, Fire control, Lift control and Water supply (Albino, *et al.*,2015; Ghaffarianhoseini, *et al.*,2015; Peluffo,2015; The Congress of Intelligent Buildings, 2016).Since all these systems are powered by electricity, it is obvious that for such a building to perform efficiently, there must be an alternative source of power supply in case of failure from the main power source. Some intelligent buildings have two back–up power sources, for example, Willis Tower, Chicago; without power, an intelligent building cannot function. Building automation, smart environments and smart houses are terms that are used in connection with intelligent buildings therefore they are defined below:

Building automation – is a programmed computerized network of electronic devices that monitor and control various services in a building. A building that has one or two of these systems is described as partially automated. A building with many of the systems is fully automated and therefore an intelligent building (Alwaer, *et al.*,2013; Arup, 2013; Wang, 2009).

Smart Environments: are environments which are richly interwoven with sensors, actuators, display and computational elements, embedded in the everyday objects of our lives. Smart environments aim to satisfy the experience of individuals by replacing hazardous work, physical labour, and repetitive tasks with automated agents (Buckman, *et al.*, 2014).

Smart Houses - Any device in a house that uses electricity can be put on your home network and be activated at your command. This command could be by voice, remote control, tablet or smart phone. You can therefore command your lights to switch on or off, switch on your cooker, electric kettle, television, CD player, thermostat, and switch them off, all without moving from your chair. You can even do it from a distance from your house depending on how sophisticated your device is. You can monitor security in your house, confirm that your doors are locked, check who came to your house in your absence, and ensure that the police are notified if a burglar tries to break into your house in your absence (Arup, 2013; Jonstone, 2013; Preiser and Schramm, 2002).

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Several universities are developing smart houses that go far beyond the state of the art luxury market. Researchers at the Massachusetts Institute of Technology (MIT), Georgia Institute of Technology, and University of Colorado, among others, are experimenting with sensors, cameras, and monitors installed in experimental houses to learn more about the physical and social environment and the pattern and habits of the occupants.

Researchers are reaching for unobtrusive or pervasive computing where tiny devices are invisibly embedded in the house and seamlessly integrated with one another and the humans who benefit from them. They will fit in so naturally, be so intuitive and effortless, that people will no longer be aware that they are there. The information gathered on the habits and behaviour of the occupants of the house, is stored and analysed by a computer, which can then use it to help people with preventive health care, alert remote family members to changes in living patterns or remind an occupant on essential daily activities like taking medication or even feeding the fish (Alwaer, *et al.*,2013; Arup, 2013; The Congress of Intelligent Buildings, 2016).

Environmental Sustainability and the Built Environment

The growing concern about global warming and ensuring sustainability of the world around us has led to greater focus on green or sustainable or eco-friendly building construction (Jimoh and Banuso, 2008; Green Building, 2012; Zubairu, 2012; Dahiru, *et al.*,2014). Green buildings are defined below:

Green Buildings

Green buildings or sustainable buildings are buildings which are environmentally friendly, that is buildings which have minimal adverse effect on the environment, ensuring water and energy efficiency, utilising renewable sources of energy and as much of recycled and local building materials as possible (Brandon and Lombardi, 2011; Green Building Index [GBI], 2013).

This focus on environmental sustainability in the building construction sector has led to various organisations in different parts of the world producing methods of rating and assessing the sustainability of buildings.

Green Building Certification Methods

1.BREEAM – This was the first assessment method and emerged from the United Kingdom in 1990. BREEAM stands for Building Research Establishment Environmental Assessment Methodology. It was first published by the Building Research Establishment (BRE), a former United Kingdom government establishment that carried out research and consultancy for the construction and built environment sectors in the UK. It is the world's first known method of rating and assessing the sustainability of buildings.

The categories used by BREEAM for the assessment are: Management, Health and wellbeing, Transport, Water, Materials, Waste, Land use and ecology, and Pollution. BREEAM is used in more than 70 countries with several in Europe having gone a stage further to develop country-specific guidelines (BREEAM, 2017).

2.LEED CERTIFICATION -LEED stands for Leadership in Energy and Environmental Design. It is a green building certification programme that recognises best-in-class building strategies and practices (US Green Building Council,2017). To achieve LEED certification, building projects have to satisfy prerequisites and earn points to achieve different levels of certification. It was developed in 1998 by a non-profit body in the USA called the US Green Building Council (USGBC).

Certification Levels:

(i) Certified: 40 -49 points.
(ii) Silver: 50 – 59 points.
(iii) Gold: 60 -79 points.
(iv) Platinum: 80 points and above.

3.CASBEE- CASBEE stands for Comprehensive Assessment System for Built Environment Efficiency. CASBEE was developed by the Japanese Sustainable Building

Consortium (JSBC) in 2001. It has various criteria which are used to evaluate and rate the environmental performance of buildings and the built environment (CASBEE, 2017).

4.GREEN STAR –Green Star is a voluntary sustainability rating system for buildings in Australia. It was launched in 2003 by the Green Building Council of Australia. The system assesses the sustainability of projects at all stages of the built environment life cycle (Green Building Council of Australia, 2017).

METHODOLOGY

A case study approach was utilised in this paper. Studies were carried out into world renowned intelligent and green buildings. The major study was into the first skyscraper to obtain platinum LEED certification in the United States of America.The extent to which building intelligence affected or assisted in building sustainability was considered in the case studies to determine whether they are compatible in the design of buildings. A total of twelve buildings were studied from different parts of the world under the categories of intelligent, green and intelligent + green.

(i)Intelligent Building – Willis Tower (former Sears Tower), Chicago, USA (1974)
Architects- Skidmore, Owings and Merrill.
On completion in 1974, the Willis Tower (Plate 1) was the tallest building in the world. It is one of the early intelligent buildings with fully automated services. The building has two back-up generators in case of power failure from the power supply company as any loss in power would automatically shut down most operations in the building.

Plate 1 – Willis Tower, Chicago
Source: Emporis.com(2006)

(ii)Intelligent Building – The Ahwatukee House, Phoenix, Arizona, USA (1979)
The architect, Charles Robert Schiffner, had a vision of an automated home. He wanted to incorporate a sophisticated means of control of services and security in the home using information technology. He contacted the Motorola Technology Company to develop a home manager computer system for the building. The Ahwatukee House (Plate 2), was the first smart home and was described as the House of the Future. Tourists used to pay to visit the house and exclaim in wonder at the technology. Smarter homes have been designed since then but the Ahwatukee House was a trail blazer in the field of automated home design (Smith, 2009).

Plate 2: Ahwatukee House, Phoenix, Arizona
Source: Smith (2009)

(iii)Intelligent Building - Bahrain World Trade Center (2008)- Architect – Atkins
The building features advanced security systems and automation of services. The shape of the building channels airflow through three turbines that are 95 feet in diameter (see Plate 3). The turbines generate 11-15% of the building's energy needs (7 Intelligent Buildings, 2017).

Plate 3: Bahrain World Trade Center
Source: 7 Intelligent Buildings (2017)

(iv) Intelligent Building – Burj Khalifa, Dubai, United Arab Emirates (2010) – Architects – Skidmore, Owings and Merrill. This skyscraper is the tallest building in the world at 828 metres in height and 160 storeys (see Plate 4). The building has a total of 57 elevators and eight escalators. It has the world's tallest service elevator with a capacity of 3.500Kg (m.burjkhalifa.ae, 2017). The building has an intelligent lighting control system that is automated and flexible. The system is user friendly and delivers the appropriate lighting levels according to the time of the day.

Plate 4 – Burj Khalifa, Dubai, United Arab Emirates
Source: Facts & Figures| Burj Khalifa (2017)

(v)Intelligent Building – Al Bahr Tower, Abu Dhabi (2012)– Architect – Aedas
The building is clad with a unique dynamic shading system that reduces its solar gain by 50% (see Plates 5(a) and 5(b)). The shading system is computerised to adjust to changing weather conditions (7 Intelligent Buildings, 2017).

Plate 5(a): Al Bahr Towers, Abu Dhabi
Source: 7 Intelligent Buildings (2017)

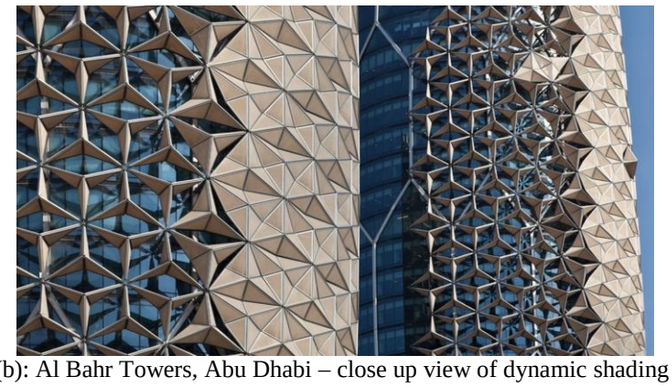

Plate 5(b): Al Bahr Towers, Abu Dhabi – close up view of dynamic shading system
Source: 7 Intelligent Buildings (2017)

(vi)Green Skyscraper – One Bryant Park – Bank of America Tower, New York, USA.
One Bryant Park, New York, is one of the greenest or most eco-friendly skyscrapers in the world (see Plate 6). The building was completed in 2010 and is the first skyscraper in North America to achieve LEED Platinum certification. The architect is Richard Cook of Cook + Fox; the building has 55 stories and is 365m in height. The initial cost of the building was about 5% higher than a normal skyscraper due to some of its sustainable features. However the building now reduces annual energy and water consumption by 50% (Cook + Fox Architects, 2011).

Plate 6 – One Bryant Park – Bank of America Tower, New York, USA.
Source: Cook + Fox Architects (2011)

The features which make the building environmentally advanced include the following:

1. Re-cycled steel was used for the framework of the building.
2. Blast furnace slag from the steel mill was used in the concrete mix for the building reducing the amount of cement used. It therefore emitted less carbon into the atmosphere during mixing of concrete and also produced stronger concrete.
3. Materials used for the construction of the building were obtained from sources as close to the building site as possible to reduce transportation costs.
4. Natural ventilation – the air that enters the building is passed through a state-of-the-art advanced air filtration system for exceptional indoor air quality.
5. Special glass was used for the facade that lets in light but deflects heat keeping the interior cooler. The interior of the building also has enough daylighting so use of artificial lighting is reduced during the day.
6. Green roof that utilises compost from tenant cafeteria waste; the green roof keeps the roof cool, absorbs carbon dioxide and emits oxygen.
7. Harvesting of rain water which is purified and used throughout the building.
8. There is an ice cooling system in the basement so water is stored in tanks then passed through the system and used for the air-conditioning when required (Cook + Fox Architects, 2011).

(vii)Green Building - The Bullit Center, Seattle, Washington, USA. Architects – Millner Hull Partnership
The Bullit Center is one of the greenest office buildings in the world (Plate 7). It has 575 solar panels on the roof that spread out like the canopy of a tree to generate electricity for the city of Seattle in summer months. It is designed to run essentially zero energy, water or waste.

Plate 7 – The Bullit Center, Seattle, Washington, USA
Source: https://www.archdaily.com

(viii)Green Building - Jacobs Institute for Design Innovation, Berkeley, California, USA.

Architects – Leddy Maytum Stacy. The Institute is devoted to introducing sustainable design innovation as the core of university life (see Plate 8). The building was designed as both a collaborative, project-based educational space and a symbol to the region of the university's commitment to sustainable innovation; it reduces energy use 90% below the national baseline.

Plate 8: Jacobs Institute for Design Innovation, Berkeley, California, USA.
Source: https://www.archdaily.com

(ix)Biosciences Research Building, Galway, Ireland. Architects – Payette and Reddy.
The building was designed to utilise natural ventilation and is supplemented less than 10% of the year with radiant heating. 45% of the building is able to function without mechanical ventilation (see Plate 9).

Plate 9 :Biosciences Research Building, Galway, Ireland.
Source: https://www.archdaily.com

(x) Green Building – Heritage Place, Ikoyi, Lagos, Nigeria.
Architects – Capita Symonds, UK and ECAD, Nigeria – Heritage Place (see Plate 10) is the first commercial building in Nigeria to achieve LEED certification. It is a 14 storey building that promises 30 – 40% reduction in energy use compared to that of other buildings in Lagos. Green features in the building include water recycling and reuse, high efficiency lighting and building orientation to maximise natural light and ventilation (heritageplaceikoyi.com,2016).

Plate 10 – Heritage Place, Ikoyi, Lagos
Source: heritageplaceikoyi.com

(xi) Intelligent + Green – Taipei 101, Taipei, Taiwan. Architects – C. Y. Lee and Partners Taipei 101 was the tallest building in the world from 2004 to 2010. It achieved LEED Platinum certification in 2011. The curtain walls of the building comprise of double-paned blue-green glass that is highly reflective and blocks solar gain by 50%. Other sustainable features include energy efficient light bulbs, low-flow water fixtures and a smart energy management and control system (skyscrapercenter.com, 2017).

Plate 11- Taipei 101, Taipei, Taiwan
Source: Skyscrapercenter.com

(xii)Intelligent + Green – The Duke Energy Center, Charlotte, North Carolina, USA Architect – tvs design.
The building has LEED Platinum certification (see Plate 12); it also features a building automation system by Siemens that integrates multiple platforms and protocols, running ten independent systems over one IP network.

Plate 12: The Duke Energy Center, Charlotte, North Carolina, USA
Source: https://www.archdaily.com

FINDINGS

There appears to be a merging of intelligent and green buildings. The focus in the 1980s up to 2000 had been on building intelligence. However, as greater awareness on environmental sustainability was heightened, architects started designing green buildings. Green building certification systems were established in developed countries and architects and developers strive to ensure that their buildings have high green certification. Building professional bodies in many countries around the world have established annual awards for greenest buildings. Professionals in the building industry have discovered that building intelligence can actually enhance building sustainability. The Willis Tower, Ahwatukee House and Burj Khalifa save energy by automatically switching off lights when sensors detect that a room is empty. In the Bahrain World Trade Center, apart from the building automation, the shape of the building channels air flow to three wind turbines that generate renewable energy for the building. The shading systems in the Al Bahr Tower, use building intelligence to adjust to changing weather conditions. One Bryant Park, which has numerous green features, also uses building intelligence to carry out the recycling of water in its water harvesting process. The Bullit Center, Jacobs Institute for Design Innovation, Biosciences Research Building, and Heritage Place, all green buildings, also use building automation to enhance the performance of the systems in the buildings. Granted that intelligent buildings require electricity to function, the integration of systems can actually result in greater energy efficiency and energy conservation in buildings (Continental Automated Buildings Association [CABA], 2008). For example, sensors can ensure that lights are automatically turned off if no one is in a room. Entry cards can be programmed that the staff member that uses his entry card after work will activate only the lights in his section of the building. Taipei 101 and the Duke Energy Center clearly embrace all the advantages of green design and building intelligence. They have the highest LEED certification (Platinum) and all the building automation systems of a highly intelligent building.

A building that encompasses all the attributes of green buildings and building intelligence has been described as a “bright green building”(Walker,2008).This is illustrated in Fig 1.

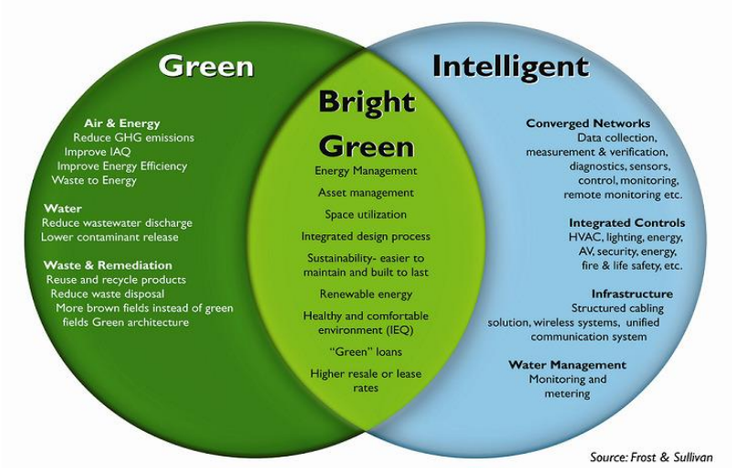

Fig. 1 – Convergence of Green and Intelligent buildings to form Bright Green Building
Source: Frost and Sullivan(2008)

There are clearly benefits to be derived from *bright green buildings.* The use of building automation to enhance building sustainability is a challenge for all architects.

The Way Forward for Nigeria

It is clear that Nigerian building professionals should focus on green building construction. The Federal government, professional bodies and educational institutions of higher learning all have roles to play to achieve this in Nigeria. These are highlighted below:

(a)Establishment of Nigerian Green Building Assessment Criteria -Most countries of the developed world have adopted a green building assessment method to ensure sustainability in the built environment. Professional bodies in these countries award prizes to buildings that obtain high certification points, making it a competition for architects, builders and developers to strive for recognition as leaders in the green building movement. The Nigerian Institute of Architects should make it a top priority to ensure the adaptation of one of these green building assessment methods to conform with our climate and culture. The Institute should also present annual prizes for the greenest buildings constructed in the country each year.

(b)Utilisation of Renewable Sources of Energy as total power source for buildings –
The problem to be solved by Nigerian architects and engineers is how to provide enough energy in a building to make building automation effective. As mentioned earlier, intelligent buildings require 24 hour power supply with back-up. Without this, it would be a chaotic scenario with total system failure. At present in Nigeria, power supply from the National Grid is totally inadequate. Architects need to work with electrical engineers and other building professionals to design buildings with renewable energy sources that will guarantee 24 hour power at a cost-effective rate totally independent of the National Grid if we are to achieve the dream of *bright green buildings* in Nigeria.

(c)Government policy – Policies to restrict importation of building materials, develop the local building material industry and encourage recycling of building materials, would be a major boost for green buildings in Nigeria. The Architects Registration Council of Nigeria (ARCON) and the registration councils of the other professional bodies should come together to produce a bill that would be presented to the National Assembly as a first step to establish such policies in Nigeria.

(d)Schools of Architecture in Nigeria to focus on Green Building Design – The curricula of the various schools of Architecture in Nigeria should be reviewed to incorporate a deliberate focus on green building design right from 200 level. The principles should be engrained into students right from an early age so that it becomes part of their thinking in any type of design project.

CONCLUSION

New discoveries in technology have made the design of buildings more challenging and innovative. The imagination of designers has to be constantly stimulated and broadened to keep track of changes in the environment and their effects on humans. The lack of expected advancement in development in various sectors in Nigeria should not discourage our building professionals. Let us see it as a challenge; we must devise means to overcome these shortcomings and join the developed world in the design of bright green buildings.

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ARCHITECTURAL EDUCATION AND ICT

CREATIVE ART AND TRANSFORMATIVE DEVELOPMENT IN ARCHITECTURE NEXUS: A CASE OF FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

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Understanding design process through creative art that supports transformative development in Architecture is one process that needs to be carefully studied. This is because most studies the traditional studio practice of Architecture students focuses more in the end product of the design, without much attention given to the design process. However, creative art which is used in the design process constitutes an important avenue in the understanding of the transformative development of Architecture Students. This paper therefore explored the design process through creative art and how it influences creative thinking and problems associated with learning creative art that support transformative development of ideas in design process. In carrying out the study, Steven Temple's Bio-Experiential Model which emphasises is on the developmental relationship between concrete and abstract process of learning was adopted. The unit analysis was the students design works as well as their freehand creative arts, the Freehand Sketching practical drawing of year one and two was the data collected, the content analysed and the findings shows that there is a strong relationship between the flexibility involve in design process and the path that creative process follows in transforming ideas into concrete design. The findings therefore suggest that it is possible to improve confidence as well as reduce the fear to take decisions on individualistic design approach, style and technique. Most importantly is that the strategy will eliminate rigidity and copy- cat syndrome, hence produce master piece design. It is recommended that Freehand Sketching should be a core course throughout their year of study, in order to allow developmental transformation all through.

Keywords: Design process, Transformative Development, Creative process, Aesthetic, Concrete and Abstract Learning process.

INTRODUTION

Art and Architecture have always been interrelated from time immemorial; art is the tool of communication in Architecture. Creative Art and Architecture were treated as one entity because both have to do with planning, designing and constructing form, space and ambience that reflect functional, technical, social, environmental and aesthetic considerations (Parsaee, Parva, & Karimi, 2014). To further buttress the relationship of Creative Art and Architecture, (Illies & Ray, 2009), define Architecture as the Art or Science of building or that branch of creative art which has for its object the production of edifices and ideas. And so, creative art provides an extended memory for visual images in the mind for more facile manipulation of ideas, and a principal medium of external thinking, they are necessary extension of a designer's cognitive capability, data representation, constrain propagation and mental simulation (Vanwindeken, Stilmant & Baret, 2013). (Seaman,& David(2000), also stated that varied conceptions are captured by Architect based on the way it is phenomenological experienced. Hence there is need to investigate the role of creative art and transformative development as it affects stages of conceptualization of ideas in design process in architecture.

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To ascertain the importance and its role in enhancing transformative development in design process. The primary phase of the design process, sketches (creative art), has a crucial role among the traditional mediums and is the elementary depictive action that is performed by designer's during the design process, (Farshad and Khairul, 2016). Garner (1990), mentions that sketching (creative art) fundamentally affects the development, creation, evaluation, and distribution of ideas. Moreover, Goel (1995) suggests that being ''syntactically" and ''semantically "unclear and ambiguous, the sketches (creative art) influence the heuristic, creative, open-ended stage of problem-solving.

Researchers like Fish and Scrivener (1990), Goel (1995), and Goldschmidt (1991) came to the conclusion that rough and untidy (sketching, (creative art) allows the designer to work quickly, suspend judgement on polished features. Moreover, it could help in generating new ideas. Therefore, this paper will explore the design process through creative art, and try to discover how it influences imaginative thinking that solves design problems associated with learning creative art that supports transformative development of ideas in design process for Architecture students. At the end of the research, it should be proved that there is a strong relationship between the flexibility involve in design process and the path that creativity process follows in transforming ideas into concrete design.

Theoretical Frame Work

Ruduolf, in Arthur (2000), has argued vigorously that perception is a cognitive endeavour, that visual perception is visual thinking and creative art is a kind of visual problem solving. That means sensory perception is already cognitive in that it requires the perceiver to select, generalize, an aspect of the objects received by the mind, in order to create a particular design for either functionality or aesthetic purpose. Furthermore, Dilek, (2012), explains that drawing is recognized as the basic form of expression in creative art education. The methods associated with creative art and design, are mainly supported with formal features such as recreating the structure on two dimensional surfaces and use of visual components. However, the way visual information is processed in our mind is not clearly emphasized. Recognizing the objects, we see indicates a process parallel to the formation of images in the mind and perception of reality and comprehension. And this will help to show the way mind processes visual information in visual perception and cognitive structure.

In line with Daniel & Christopher (2010), he suggests that creative art don't merely imitate the statistics of the real world, but could prefer the usage of specific image statistics in producing a design. This result suggests an influence of early visual coding strategies in the production of design through creative art. This on the average possesses the same correlation structure as natural scenes. But Steven (2010), went further by saying that the first concrete experiences of student is an expression of a brain-based learning theory which is responsible for formulation of basic structures of sensory processing as a solid pathways. Therefore creates the structure and put into action form pedagogy of basic design courses that introduce creative process as a basis for learning design. And as such must put into cognisance these experiential, biological developmental relationships as important to developmental starting point for an appropriate basis for design pedagogy, which is a later more abstracted learning experience. Steven (2010) also produces a model explaining beginning design pedagogy on developmental relationships between concrete and abstract process of learning as a basis for transformative creative thinking that develops student's self-development (individualism). Which he (named (Proposal for Pedagogical Structure) based on Kolb's pedagogical model for studio education. Similarly, Piaget (1983), in his developmental learning theories, says that a basic tenant of this approach is that learning at the beginning level of direct experience, self- initiates brain changes which help students form their own structure of learning.

The individual technique and style which serves as a permanent format or pattern for learning experience. This makes decision-making consistent in relationship with biological interactivity between body and mind, concrete and abstract respectively, which initiates brain changes for creativity in design process. Going deeper in this explanation Kolb,(1984) and others, following Piaget in experiential learning theories identified concrete and abstract learning as fundamental poles for acquiring and taking decision on knowledge learning process. They agreed that concrete learning involves direct experiential engagement through heuristic discovery and reflection, which explain further that abstract learning involves indirect representational cues in acts of conceptualizations, synthesis and experimentation. Basic to Kolb's (1984) experiential learning model is that learning is thought of as a process whereby concepts are derived from and continuously modified by experience. Kolb (1984)

believes that ‘’learning’’ is the process whereby knowledge is created through the transformation of experience. Ayuba, & Akpama, (2017), agreed that creating an outdoor learning and physical contact with the environment is an initiative that would incorporate genuine design principles that will help to develop student skill through cognitive, physical, social and emotional experience. This means that creating an outdoor learning helps to develop the power of imagination and creativity, which in turn lead to formation of a pragmatic conceptual design by generating and experimenting with new ideas that gives room for flexibility and manipulation of forms.

Transformative Development in Architecture

Through creative art (sketches), architecture students, in designing can discover and create diverse and more desirable functional forms by transforming previous images through techniques like visual addition, deletion, and modifications. Transformative skills in the form of freehand sketches appear to induce creative, explorative, open-ended environments that are conductive in dealing with the ill-structured nature of design activities (Farshad, and Khairul,2016). Therefore transformative development in architecture is the mechanism that shows the way new designs are generated from unambiguous representations and sustainable changes in form (Tovey, Poter, and Newman, 2003). In order to transform descriptions into depictions, the designer employs a set of quick sketches (creative art), by which the embodied themes in the architectural design are developed. Sequentially, this directs the designer to transform the former image through additions, deletions, and modifications (Tovey et al, 2003). Indeed, transformation moves from unstructured drawing to further detailed and precise illustrated representations. This means that design transformation is the progression from unstructured form to structured form which occurs for creating, modifying, and developing design elements and the design idea. Goel (1995) argued that design is the process from ill-defined problem to the well-defined design problems. It consists of some moves that start from the preliminary phase (unstructured sketch) and the refinement phase of design to detailed (explicit and precise design). This is confirmed by Goel (1994) that lateral and vertical is transformation, whereas duplication is repeating.

A lateral transformation is identified as movement from one idea to a slightly different idea. They are essential for broadening the problem space and the assessment and improvement of kernel ideas. A vertical transformation is identified as movement from one idea to a more detailed version of the same idea. It causes the problem space to deepen. Lateral transformations mostly take place in the initial design stages and are related to unstructured drawing while vertical transformations take place throughout the refinement and detailed design stages and are related to more precise and detailed design. Van der Lugt (2000) investigated features of design transformation that occur in idea links. He defined ideas as three sub classes in a link: supplementary, modification, and tangential links. The supplementary link shows auxiliary and small change on the same version of the idea; The modification link relates to changes in the structure of ideas, however keeping the current line of thought; the tangential link indicates a radical and fundamental change from the earlier idea. Van der Lugt (2000) also mentioned that a creative process consists of a balance among link types. Similarly, Rodger, Green, and McGown (2000) mentioned that the balance between vertical and lateral transformation results in a good design.

According to Kolb (1984), the process of experiential learning can be characterized as four-stage cycle involving four adaptive learning modes-concrete experience, reflective observation, abstract conceptualization, and active experimentation. Movement from stage to stage is a transformation of the other stages. He agreed that there are two distinct basic learning activities identified as opposing poles, in his experiential learning model, (perception and processing). At one end of the perception pole is concrete experience (apprehension, real, human, sensual, intuitive). Experiencing is immersing oneself in ‘’doing’’ of a task. Not reflecting on the task, but carrying it out with intention. Opposing concrete experience is abstract conceptualization (comprehension, representations of experience, mental imagery). Conceptualization involves interpreting the events that have been noticed and understanding the relationships among them.

Design Process through Creative Art

Fashad et al (2016) observed that the whole process of design consisted of two groups of segments, the alone segment which they named the isolated segment and the contiguous segment which is set in one block named the dependency block. This shows that designers focus on previous thought and shift to an alternative topic, item, or space. Suwa and Tversky (1997) name these segments by means of focus-shift that corresponds to lateral transformation; in addition, with the exception of the initial segment, Suwa and Tversky (1997) name further segments located in the dependency chunk as continuing segments that relate to vertical transformation. O'Cathain and Howrie (1994) confirm that the design process is one of devising and experimenting, a process of rapid learning about something that doesn't yet exist by exploring interdependencies of problem and solution, the old and the new. Keith (2010) agreed that asking the students to reflect on how and why a building had been design in the way it had, proved to be a powerful aid in getting the students to consider the process undertaken. And Keith (2010) believes that design process is a reflective conversation that students will enter into if invited.

Lawson (2006:7) said that one of the weaknesses of the traditional studio is that students, in paying attention to the product of their labour fail to reflect sufficiently on their process.'' The assessment is one that concentrates and focuses on the product of the students' efforts, not necessarily the process. Therefore, the very real danger in the studio is that students will concentrate their efforts on the product- the end of project design- and in so doing ignore the development of the essential skills that aid them later in their careers. Fashad et al (2016) divided design transformation into four levels of detailing: diagrammatic, preliminary, refinement, and detail designing. These four levels could also be determined by decomposing the whole design process into three different components for analysing and measuring it: context, chunk, and move. Do el al (2000) stated that transformation can occur in design and context through manipulating shape and changing drawing types and viewpoints. He also confirmed that previous studies have classified context in the design process based on design development, the level of abstraction, and presentation types.

In the first type of context, Goel (1994, 1995, and 2014) categorized the development of design into four subcategories: (1) problem-structuring, which arranges the problem, (2) preliminary-design, which creates some solution options and idea cores, (3) refinement-design, which improves the current sketch by transformation, and (4) detail-design, which presents the design product. Similarly, Abdelmohsen and Do (2007) classified season of design into three phases. In the first phase, several solution options are created in schematic plan drawing. In the second phase, designers refine and improve options. In the third phase, they improve refined drawing to the product of design and organization elements, Although diagram has an important role to play in design thinking and sketching types, design development of Goel do not include diagrams. For Goel, diagrams are more related to form conceptual design. It seems that it may however be more useful to add diagram to design development.

The second type of context is the abstraction level. Designers use abstract diagrams and unstructured forms in early phase of the design process, while they utilize detailed and structured representations in later phases of the design process (Purcell and Gero, 1998). Fish and Scrivener (1990) categorize the element of pictorial representation from depiction to spatial depiction and argue that sketch has an essential role in supporting the mind by interpreting the descriptive propositional information to depiction. Goel (1995) in'' Sketch of Thought'' mentioned that the design process contains some movement from ambiguity and vague shape, which is important in the early phase of design to more structure form in detailed design. Consequently, this is a process of developing from unclear sketch to detailed form; he notes that the design transformation process moves from abstraction level to convention document. Goldschmidt (1992) recognized that chunk consists of some moves and the relationships between them. She define chunk as '' the block of links among successive moves that link exclusively among themselves and are barely interconnected with other moves '', and restricts chunk according to design moves with the large number, whereas Suwa and Tversky (1997) structured them based on segments with the smaller number.

It is agreed that Chunk is often used in linkography, as opposed to other methods. Goldschmidt (1990) decomposes the design process into small parts of '' design moves '' by using linkography. He define a move as '' a step, an act, an operation, which transforms

the design situation relative to the state in which it was prior to that move ‘’ or can be separated as ‘’ the smallest coherent operation detectable in design activity. He mentions that considering design move can result in analysing and assessing the design process. Moreover, Goel (1995) defined three design movements: vertical and lateral, which are transforming, and duplication, which is repeating. Goldschmidt (1991) determined a segment as design move, which is defined as ‘’ an act of reasoning that presents a coherent proposition pertaining to an entity that is being designed’’. Which means a change in the designer’s thought contents, and their action, and their intention in a subject for the sign for the start and the end of the new segment. This clearly shows that different designers will fall into any of these basic categories, confirming that individual student’s proceeds in their design from different point of view show casing individual technique, style and approach which is informed by their personal experience and it varied from one student to another.

Experiential Learning Process

It is a conjecture of a brain-based learning theory that a student’s direct, concrete primary experiences are responsible for the construction of fundamental structures of neural processing as ‘’hard wired’’ pathways. These structures then form the ground of and set into play patterns of later more abstracted learning experiences. Pedagogy of basic design courses that seeks introduction of creative processes as a foundation for design education must recognize these experiential, biologically developmental relationships as basic to developmentally appropriate beginning design curriculum. Steven (2010).

Aligning with developmental learning theories (Piaget and others), a basic tenant of this approach is that learning at the primary level of direct experience self-initiates brain changes where students form their own structure of learning. Thus, initial learning experiences will be those that best enable decision-making consistent with the biological interactivity between body and mind, between, respectively, the concrete and the abstract. This is important because the designed environment in which we all live is grounded in the development of abstract content experientially based in concrete material physicality Steven (2010).

Klob and others, following Piaget) identify concrete and abstract learning as fundamental poles for acquiring and acting on knowledge: Concrete learning involves direct experiential engagement through heuristic discovery and reflection and abstract learning involves indirect representational cues in acts of conceptualization, synthesis, and experimentation. Basic to Kolb’s experiential learning model is that learning is thought of as a process whereby concepts are derived from and continuously modified by experience. Kolb believes that, ‘’learning is the process whereby knowledge is created through the transformation of experiences. Steven (2010) also proposes a cycling of concrete material experiences and abstract learning experiences into an interactive transformational interdependence as a model of creative design processes that engages student self-development toward maturation. Working through direct experience, within the material, sensorial realm, enabling discovery and manipulation of a material’s ‘’ workability ‘’ in uncovering design ideation.

Concrete investigations become balanced, thus building lessons of abstraction upon lessons of concrete experience. Abstraction includes such issues as diagramming, analysis, visual thinking, representational devices such as drawing, modelling, simulation, scale, context, use of narrative and metaphor, and the nature of ideation. He agreed that theorizing conceptual approaches and developing experimental proposals in which concrete experience and reflective observation are implicitly engaged as raw material of creative, abstract thinking. By engaging in design processes as structured concrete and abstract creative discoveries, and students build on experiential dynamic of making-thinking-doing-reflecting to actively make sense of creativity in design. That means primary experiences in which college students first engage similarly form basic structures of neural processing, and these in turn, inevitably and profoundly form mechanisms of learning for successive educational experiences. He also agreed that the brain, as the hub of the nervous system, is experienced as the seat of consciousness in the abstraction of mind but because our nervous systems have their origin in our bodies as our bodies establish a relationship to the physical world. That it is the body in concrete relation to the world that provides the basis of nervous transformations. He also believes that the biologically formative nature of concrete experience casts initial learning experiences as those that enable self-initiated decision-making consistent with the biological interactivity between body and mind, between,

respectively, the concrete and abstract. He proposed that education psychology identifies concrete learning and abstract learning as two opposing yet complimentary and fundamental means for acquiring and acting on knowledge.

He finally emphasized that concrete learning methods are facilitated by immediate experiential contact in which there is direct engagement through heuristic manipulation and discovery, followed by reflective observation and judgment. Abstract learning involves mental mechanisms and cognitive comprehension utilizing indirect representation cues and symbols in acts of conceptualization, synthesis, and experimentation, these helps in interactive cycling of concrete and abstract modes that forms the basic staging of learning and pedagogy.

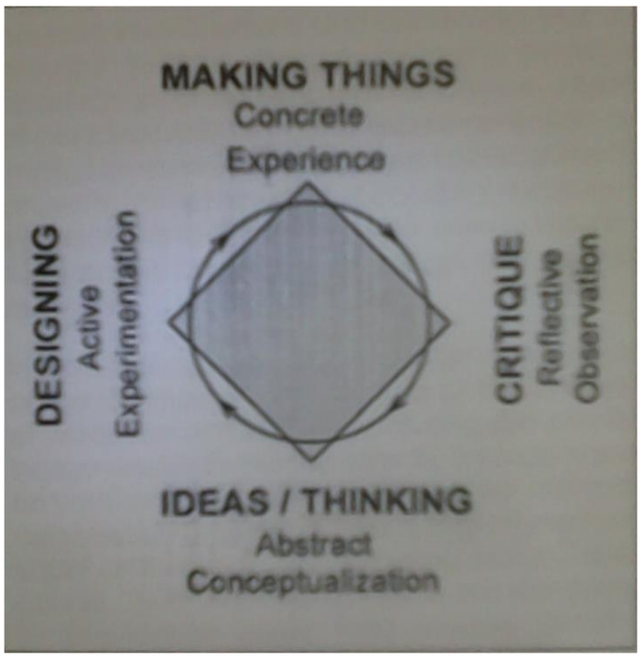

Figure 1: Proposal for Pedagogical Structure.
Source: Steven Temple, (2010).

APPLIED METHODOLOGY

The conjecture of brain-based learning theory of Steven,(2010), Piaget,(1983), Kolb(1984) and others that a student's direct, concrete first experiences are responsible for the construction of fundamental structures of neural processing, nerve strands that serves as connecting pathways, which then creates the foundation and arrange into play patterns of later developed abstract learning experiences. And that it should also be the basis for the beginning design learning through creative process which introduces transformative, experiential, developmental and biological relationships between concrete and abstract process. It is this procedure that eventually introduce self-initiates brain changes which help the best decision-making consistent that culminate into creation of individual technique and style.

In applying this model of Steven temple,(2010) to the pedagogy of learning design process through creative art that support transformative development in the department of Architecture, Federal university of technology Minna, there is the need to first show how Creative art (freehand sketching), it's been taught before the application. Freehand Sketching is a course that helps to develop the skill of drawing, creative thinking and sense of imagination, it is also the tool of communication in architecture with this skill individual technique of each student is develop to the point of individualization. In the first semester of the first year, the students of architecture take this course called Freehand Sketching 1 (Arc 114), and Freehand Sketching 11 (Arc 124) in the second semester, Freehand Sketching 111 (Arc 214) is taking during First semester of the second year of learning while Further Freehand Sketching (Arc 227) and Further Painting (Arc 229) are both elective courses in the second semester of the second year.

It is believed that most of the new student don't have the knowledge of drawing, that is what informed the teaching from known to unknown (from simple to complex), and as such after the introduction to Freehand Sketching, they go out for the first practical drawing which is

drawing of objects that have basic shapes like square, rectangle and circle for example dust-bin, water tanks, and generator house.. Because this is the rudiment of drawing that is the tool of design it is believed that every building design, if broken to parts will conform to a basic geometrical shape. In the second semester of the first year the students are expected to develop their skill further by introducing them to perspective drawing, rendering, landscape and objects in landscape, which allows them to join and combine different geometrical shapes and forms to create realistic drawing. all this while students have not started design it is expected that by now students already have a style and technique of drawing and rendering which is peculiar to individual in its early stage of development.

It is this skill that student carry along with them when they now start architectural design for the first time in their second year of learning, at this level students are expected to be able to transform their skill of drawing to another level by producing solid building forms and the environment in photographic representation. This is the stage where students are expected to exhibit optimal skill in representing realism as it were, because at this period they already started the main course which is Architectural design (Arc 211), it is expected that students should be able to approach design at this stage fully prepared having pass through the rudiment of Freehand Sketching such as, use of space, spatial arrangement, proportion, balance, use of line, different types of shading, different types of rendering, perspective, colour and techniques of achieving three dimensional effect which makes design looks realistic. They have gone outside to draw from what exist which is nature and reality they will now apply their experience in design using imagination to create what does not exist. This is introducing transformative, developmental and biological relationships between concrete and abstract learning process. The individual student now exhibit their unique style and technique in executing the design work, this is because the way each student experience is different and those first outside drawing experiences are responsible for the construction of fundamental structures of neural formation that serves as connecting pathway, which then creates room for later transformation of transitional development of abstract into reality. This is why every work will always come out differently.

The study was conducted by analysing the work of a particular student from the beginning of freehand sketching till the final stage of the drawing course, namely Arc 114, Arc 124, Arc 214, Arc 227 and Arc 229. This will enable the researcher to determine the transformative development that took place during the drawing courses. To take more than a student work for analysis will not be suitable for this research, because each students work will be analysed and the space given for this article will not be adequate for that so that was the justification for the unit analysis. These works shows the different stages of developmental relationship from the beginning of drawing class to the final stage.

DATA ANALYSIS

At this stage the student experimented by sketching an idea down from reality with time the sketch improved by continuous observation from the environment and imagination this is a stage of exploring different styles and technique to arrive on an agreeable sketch. It is the foundation of the work, whereby it serves as a guide for further development every other development proceeds from here. Although changes can be made at this stage, but the basic shape of the object is priority.

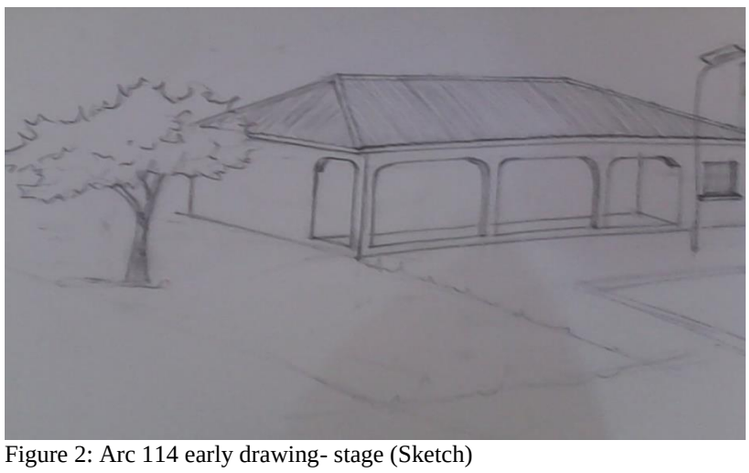

Figure 2: Arc 114 early drawing- stage (Sketch)

At this stage the artist improved on the drawing by transforming the sketch into a full fledge photographic representation. This is the stage where the artist can showcase and manipulate its technique and style in other to achieve individualism, this is the transformative stage.

Figure 3: Arc 114 second stage of development

This is one point perspective where the artist exhibited the skill of imagination to achieve three dimensional effects of distance and solidity, photographic illusion.

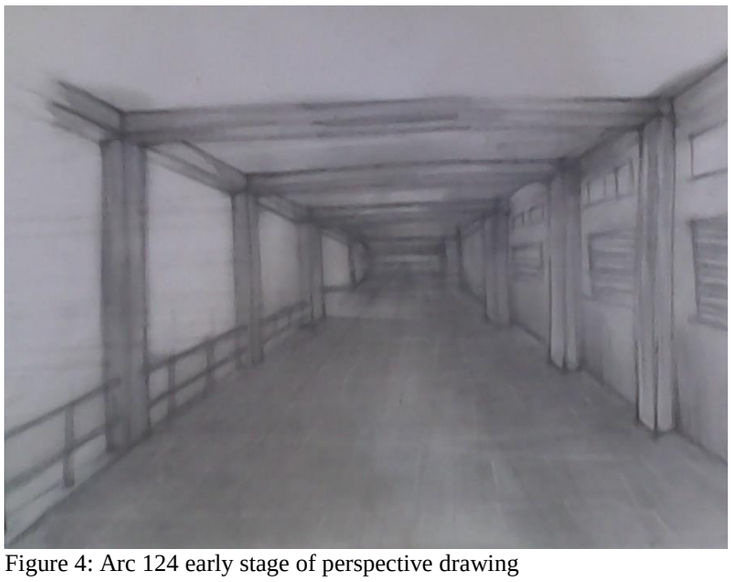

Figure 4: Arc 124 early stage of perspective drawing

This is another version of one point perspective, rendered with a different style and technique.

Figure 5: Arc 214 second stage of perspective drawing

This is an advance stage of drawing where colour is used to render the work in photographic realism. At this stage the artist exhibited a sense of creativity by bringing all the skill acquired during the preliminary stages to bear on this advance stage.

Figure 6: Arc 227 Advance Freehand Sketching

This is another version of the final stage, where paint is used to render a photographic representation of an existing building (the Agricultural building), the style is simple but explicit by exhibiting colour harmony and total control of rendering. This is the final point of rendering where transformative development and high level of creativity is exhibited.

Figure 7: Arc 229 Further Painting

FINDINGS AND DISCUSSION

It was discovered that it is possible to improve confidence as well as reduce fear to take decisions on individual design approach, style and technique. Because the more they draw the better they become in the mastery of their technique and style and so eliminate rigidity and copy-cat syndrome.

It was also discovered that they are able to develop their drawing to the final stage without necessarily seeing the model in question, because drawing out door has helped in recording the picture in their mind and by means of imagination the work is completed.

It was also discovered that working together outdoor, gives room to flexibility of style, ideas and technique due to freedom of interaction with pair group that influences the outcome of the design positively.

It was observed that competition also come to into play whereby every student want to outdo the other, and as such develops more confidence as they advance in drawing and so discovery of new style and techniques is ensue through experimentation and perfection of skill.

The question now is when does this structure of learning takes on form? It is discovered that students of architecture exhibit some features in design showing that the outcome of the final work is determined by multiple experiences, for the design input to be unique and new it is the combination of different experiences of which is not just one and not at a point in time but, at a different point in time with different environmental experiences that exhibits different points of view. So if this is the case it could be agreed that student's direct concrete first experiences are responsible for the construction of fundamental structure of neural processing that creates the basis and set into play patterns of later developed abstract learning experiences but that it should also be the basis for the beginning learning process that introduces transformative, experiential, developmental and biological relationships between concrete and abstract learning process may not completely be true. This is because with time later experiences might usurp the first arrangement and at the end change it completely because of factors like change from traditional studio practice to computer graphics, change in environmental factors like settings, maturity of developmental skills and techniques, pair influence and experimentation that leads to accidental discovery, these factors will definitely change the students view and as such depart completely from its original or early developmental structure.

CONCLUSION AND RECOMENDATION

Without the knowledge of transformative development, students of architecture will find it difficult to produce a convincing design that is pragmatic and at the same time aesthetical in nature. It is believed that with the pedagogy of learning creative art that helps to set in place a way of improving design process which is freehand sketching (tool of communication in architecture) should be giving more attention, especially in the transitional development of the skill of drawing which can be achieved by continuous practice form one level to another. From the works analysed in this research it is observed that from the first stage of drawing students are allowed to form and create their own method of approach which gives room for creativity and as such they will be able to transform their idea without fear of failure. The outdoor experience of the early stage drawing gives the freedom to choose and explore different technique and style and at the end of exploration, individual student must have to choose which of the technique and style of rendering is suitable for his mode of expression. This actually differs with individual student, this is because their experience differs and as such proffers solution to design and drawings with diverse approach. At the peak of drawing experience that is when architectural design begins, that means student will transfer their experience acquired from drawing class into design. For ultimo result Arc 227 and Arc 229 which is the final stage of drawing should be made to be core courses not electives as they are now been taught so that the final experience acquired can be transferred to design. Or else students that stop along the line without completing the final stage may not perform to their ultimo best.

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USERS' PERCEPTION OF INFORMAL INTERACTION SPACES IN RESEARCH INSTITUTES IN THE FEDERAL CAPITAL TERRITORY, NIGERIA

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Contemporary society or civilization are driven and shaped by Science and Technology. The level of investment by governments in research and development determines the global competitiveness of that nation. Interaction takes place everywhere in a research environment. Human beings have the capacity to interact through their reflections and experiences. It is generally considered that the physical arrangement of workplace environments has an influence on social interaction and social structure. Informal interactions between scientists contribute to the sharing of knowledge and expertise but this fact is often over looked in the design of such establishment in Nigeria. The primary goal of this paper is to assess and analyse the extent to which this informal interaction spaces have shaped the interaction pattern between occupants of these organization. The research design is a descriptive study utilizing qualitative approach. Eight research institutes in the Federal Capital Territory were selected purposively for the study, questionnaires were distributed to staffs of these institutes about their perception of informal interactive spaces while observation schedule was used to evaluate the physical informal interaction spaces available. The data obtained was analysed using descriptive statistics and the results were presented in tables and charts. It was detected that the staffs were discontented with the available informal interaction spaces provided. The results show the apathy of employees towards the provision of informal interactive spaces within the research Institute. This drives to the conclusion that informal interaction does offer more collaborative avenue between staff of research institute. It further suggests that the provision of interactive spaces in research institutes does create a sense of belonging amongst staff.

Keywords: Development, Informal, Interaction, Research, sense of place

INTRODUCTION

Changes in the working culture have occurred in recent years and people are more likely to work remotely now in comparison to the past. However, having a physical space for employee encounters and interactions remains valuable (Sailer, 2014). Literature on physical work space environments agree that spatial properties have effects on the social environment of the work place and the way employees perform. These relationships are confirmed in the case of federal offices (Wineman and Adhya, 2007), private companies (Steen, 2009), and research and development facilities (Sailer and Penn, 2009).

Due to global market challenge, research organisations are investing in solutions to become more spatially efficient by considering the physical facilities that optimise the social fabric and prospects for encounters within the office space (Wineman and Adhya, 2007). As a result, the research environment is being thought of as a place to support an organisation's specific needs and spaces are being configured in diverse ways to boost productivity and collaboration.

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Researchers and professionals from the field of space syntax have revealed that research environment layout configuration has a great impact on structuring the patterns of global and local movement as well as staff encounter and interaction thus shaping the organisational culture (Koch, 2012). Metric distance have a positive impact on organisation's innovation; long metric distances facilitated unanticipated encounter, while short metric distance helped move production knowledge forward.

Steen (2009) established that higher correlation with movement occurred on a global level, while locally, more interaction was happening with people sitting in more visible positions.

This suggests that office spaces located in the most visible positions are more likely to influence interaction amongst staffs (Penn et al., 1999).

Several studies have been carried out on many research institutes outside the shore of Nigeria on staff experience concerning informal interactive spaces, however, little or no study exists within the Nigerian context. What seems to be common is research works on the condition of the buildings and environment, and the maintenance of such facilities, (Ofide & Jimoh, 2016; Zubairu & Olagunju 2003). As such there exists a gap on the study of informal interaction spaces in research institutes in Nigeria hence the aim of this study to examine users' perception of informal interaction spaces and the nature of such spaces.

Concept of Informal Interaction in Research Environments

Considering the worth of knowledge produced in research environment, sharing knowledge among researchers becomes essential. Knowledge sharing arises through the interaction of professionals with diverse backgrounds. According to Lansdale, *et al* (2011), social interaction provides some form of emotional and work-related support for the people within a formal environment, this can be extended to the staffs in research institutes. There are two kinds of interaction that work environments supports as shown in figure 1.0 (Kraut *et al.*, 1990). The first one is planned interactions that are formal and scheduled. The second one is unplanned interactions, which are more informal, and they occur by movement and co-presence in a space that influences face-to-face interactions and spontaneous gatherings. It is opined by Kraut, *et al* (1990), that informal interaction or communication is most prevailing in work places, this should form the need for such phenomena to be examined and provided for in research organisation.

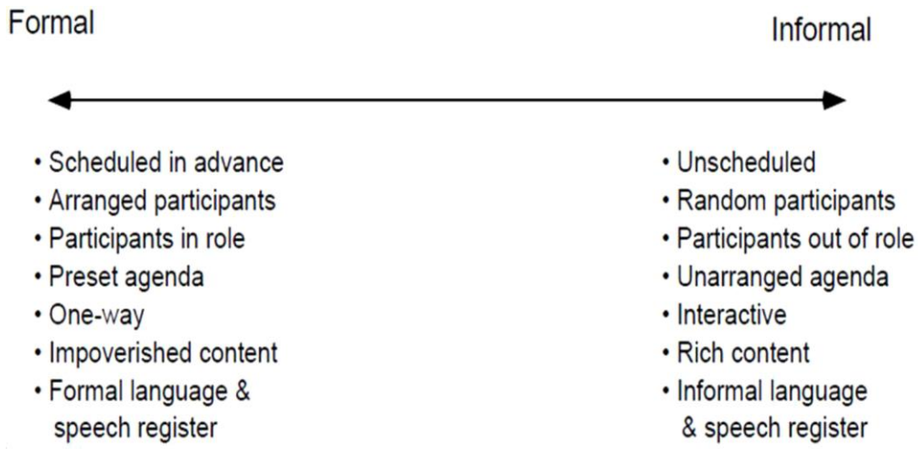

Figure 1.0: The formality of dimension of communication.
Source: Kraut, et al. (1990)

Informal interaction which is frequently referred to as informal communication is any form of interaction that does not follow any laid down format or set rules, it is usually thought-out as a natural means of communication (Anon, 2015). It can be argued that any form of interaction that does not follow the laid down procedure of formal interaction be it in the office or outside the office falls within this category of informal interaction. Brown, et al. (2014), argued that communication between people in any organization is critical to the success of that organization. This was further voiced by Pentland (2012); Stryker, & Santoro (2012), that for informal interaction to be effective it must be face to face between the interacting parties. This possibly explains why employees hang around in groups when they are not in their formal working environment. In these scenarios, there is a critical balance that the work environment facilitates between the possibilities of interaction, collaboration and sense of community (Sailer and Penn, 2009). Collaboration involves two or more people

working together over time to produce a joint product or other outcome (Heerwagen *et al.*, 2004). Repeated interactions are also key for collaboration to succeed (Hua *et al.*, 2010).

Heerwagen *et al.* (2004) investigated the effect of the physical design of workplace and how it enhances collaborations without compromising individual's productivity. Office space can be designed to facilitate interaction and collaboration between employees. However, the benefits must be balanced with noise distractions and work interruptions. Haynes (2007a) observes that office space needs to be designed with the goal of facilitating collaboration between employees, while also ensuring that disruptions and distractions to people engaged in individual tasks are minimized.

Informal interaction spaces in research institutes

Spatial configuration in any space affects movement and creates spatial behaviours such as co-presence and encounter. These spatial behaviours stimulate face-to-face interaction, informal communication, gathering and collaboration among researchers this leads to increase in information dissemination. One group of study investigated the relationship between space integration and interaction patterns (Wineman, Kabo and Davis, 2009; Serrato and Wineman, 1999; Hillier and Penn, 1991). Another group of study focused on the relationship between proximity of offices and interaction patterns (Lansdale *et al.*, 2011; Sailer and Penn, 2009; Kraut, Fussell, Brennan and Siegel, 2002). Space integration means how easily a space can be reached compared to the other spaces in the spatial layout. In other words, it is related to the extent the space is well connected to the other spaces (Peponis and Wineman, 2002).

There is positive effect of spatial integration on interaction patterns such as informal communication and information exchange. For instance, Hillier and Penn (1991) examined the distribution of interaction patterns relative to movement in the two research laboratories and observed that communication increased between research groups who are closer to the spaces of movement. Similarly, Serrato and Wineman (1999), stated that researchers, who are linked to the integrated corridors, have more communication with each other. Wineman *et al.* (2009) opined that offices that are well integrated within the whole building provide greater likelihood of collaboration among staffs by promoting communication.

Informal interaction spaces in research buildings have been said to include; High traffic staircases, corridors, lobby, common areas like cafeterias, break areas, lounges or common room, conference/seminar room, tea room, rest room, entrances porches, open spaces such as courtyards, garden, rooftop garden, (Knoll, 2013; Kilic-Calgici, Czerkauer-Yamu & Cil 2013; Lansdale, 2011). Other informal interaction spaces in research institutes are places where coffee machine, photocopying machine are strategically placed.

A hub of different activities happens within these spaces. According to Sailer and Penn, (2009), these are usually for the purpose of interaction and collaboration. This explains why the design of the space for interaction should not be made formal with rigidity. According to Rashid, Kampschroer, Wineman, & Zimring, (2006), informal interaction spaces in buildings should be designed in such a way that they are interconnected with high possibility for visibility, accessibility and openness to encourage and increase informal encounters which is an element for informal interaction. These spaces should have provision for seating and should be in such an arrangement that allows for informal discussions.

RESEARCH METHOD

This study is a descriptive one utilizing qualitative method of data collection. A sample frame of eight research institutes were selected from the seventeen available research institutes in the federal capital territory. Table 1.0 shows the list of research institute visited. The Choice of these institutes is due primarily to the fact that they are Federal government owned research institutes located within the federal capital territory and as such a place of convergence of people from different cultural backgrounds.

Table 1.0: Names of research institutes visited

S/N	Names of research institutes
1	National institute for pharmaceutical research and development (NIPRD)
2	National agency for science and engineering infrastructure (NASENI)
3	National space development and research agency

4	National agency for food and drug administration and control (NAFDAC)
5	Agricultural research council of Nigeria (ARCN)
6	Raw materials research and development council (RMRDC)
7	Nigeria building and road research institute, Abuja
8	Institute of human virology, Nigeria

Source: Author's fieldwork, 2017

In the collection of data, two research tools were employed, firstly, observation schedule was used to determine and map out informal interaction spaces. Secondly, one hundred and sixty questionnaires were distributed to the staff of these institutes utilizing stratified random sampling method, a hundred and thirty questionnaires were returned out of the one hundred and sixty, these allowed for opinions to be drawn from a cross section of the staff within these organisations. The data obtained was thereafter analysed using SPSS to obtain a descriptive statistics about the staff perception on their informal interactive space.

RESULTS AND DISCUSSION

Personality of Individual and Social Interaction

An individual's disposition has an impact on the way they will interact with their colleagues. An outgoing individual is a sociable person who will easily engage in informal interaction than a reserved person who is a reclusive individual and needs an extra drive to socialize. For individuals with both personalities, they are always ready to socialize. It is paramount to blend the different personalities in a research environment so as to have the different individuals having an influence on the other and one of the ways to do this in through creation of interactive spaces. Table 2.0 indicates that 43.8% of the staff are reserved, 22.3% are out going while 33.9% have a bit of both personality.

Table 2.0: Staff Personality

	Frequency	Percent	Cumulative Percent
Reserved person	57	43.8	44.6
Outgoing person	29	22.3	66.9
A bit of both	44	33.9	100.0
Total	130	100.0	

Source: Author's field work, 2017

Activities Engaged In During Break Period

Table 3.0 illustrates that 6.9% of the staff watch movies during their break time, 14.6% chat with their colleagues in the office, 17.7% utilize such opportunity to visit colleagues while 60.8% go out to eat. From the table it can be deduced that majority of the staff go out of their office environment to have their lunch. Provision of interactive spaces such as cafeteria, food court or restaurant within the research building can help bring such individuals together increasing their chances of encounter, which can lead to interaction.

Table 3.0: Activity during break time

	Frequency	Percent	Cumulative Percent
Go out to eat	79	60.8	61.5
Visit colleague	23	17.7	78.5
Watch a movie	9	6.9	85.4
Chat in the office	19	14.6	100.0
Total	130	100.0	

Source: Author's field work, 2017

Spaces where informal interaction happen the most

This data is to illustrate the spaces where staff usually engage in informal interaction most in the research organisation. Table 4.0 reveals that 16.9% interact at the restaurant, 6.2% at the staircases, and 20% on the corridor, while 51.5% interacts in their offices. This indicates that informal interaction mostly ensues in their offices as they lack dedicated spaces for this scenario.

Table 4.0: Places of informal interaction

Informal interactive spaces	Frequency	Percent	Cumulative Percent
Office space	67	51.5	54.6
Corridor	26	20	74.6
Stairs	8	6.2	79.2
Restaurant	22	16.9	95.4
Others	7	5.4	100.0
Total	130	100.0	

Source: Author's field work, 2017

The Size of Corridor and Its Influence on Interactions

Corridors in the context of interactive space is either a hallway or pathway that connects between buildings and within the building itself. Corridors of varying sizes in research institutes are not only important for movement but also displays the spatial variation of the research environment. Figure 2.0 shows that 36% and 43% of the sampled research institutes have corridor sizes between 1.5m-1.8m and 1.2m-1.5m respectively. A wider corridor provides room for seating arrangement to enhance face-to-face interaction.

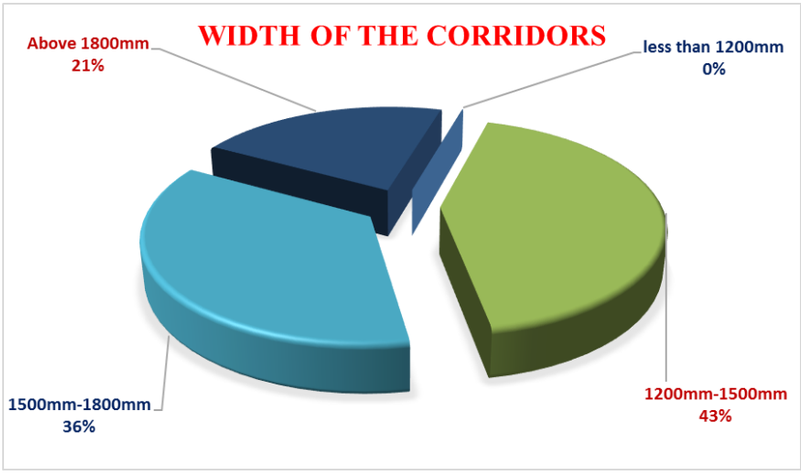

Figure 2.0: The width of corridors Source: Author's fieldwork, 2017

Staircase as an Element of Social Connection

Staircases are infrastructural components that connect the various elements of a building such as the different floors in a building. It serves as a vertical conveyance and influence the social nature of human behaviour in the sense that for people to gain access to different floors in a building, the staircases serves that purpose in the absence of mechanical conveyance such as lift, so as such the existence and position of these elements have a great influence on people's movement patterns because it brings a pool of large people to its self at a particular time which can lead to interaction between persons of similar interest. The. Figure 3.0 illustrates that 70% of staircases within research institutes within the context of the study range between 1.2m to 1.5m. Knoll (2013) and Lansdale (2011) have shown that these common areas are attractor of informal interactions, therefore a wider staircase increases the traffic level of people creating a greater chance of encounter.

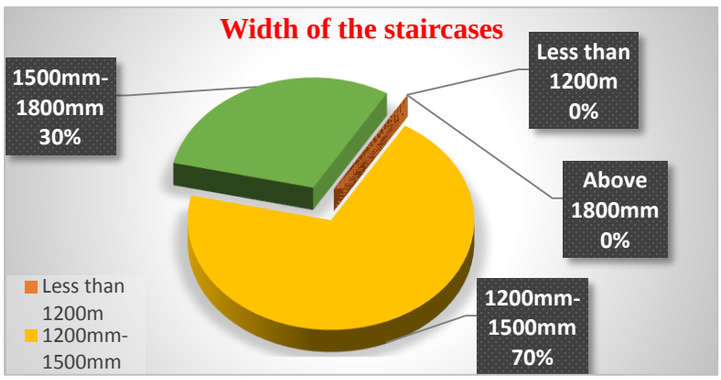

Figure 3.0: The width of Staircases
Source: Author's fieldwork, 2017

The Size of Entrance Porches and Influence on Interaction

A building's core entrance is akin to a front porch. The entrance porch of a house bids an important physical and psychological transition from the public life of the community to the more private life of the smaller social group, the main entrance of a research building can offer a similar transition. Figure. 4.0 indicates 63% of research institutes in the FCT have entrance porches between the ranges of $15m^2$-$18m^2$. If entrance porches are to best meet employees' need for interaction should include spaces for social, learning, meeting, and eating.

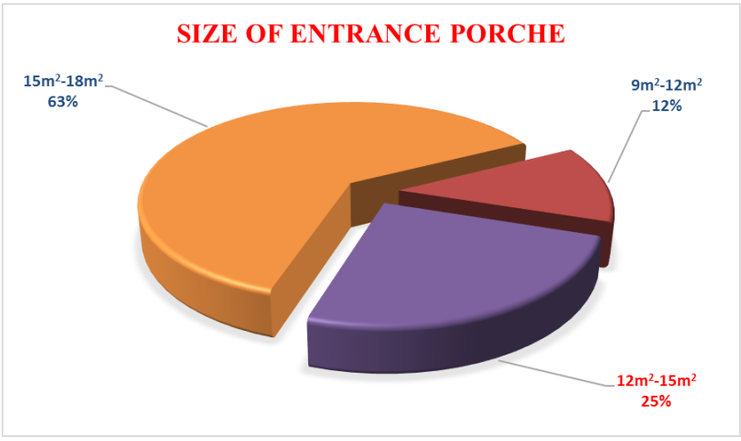

Figure 4.0: The size of Entrance porches
Source: Author's fieldwork, 2017

Informal interactive spaces available within research institutes

New research establishment should have an increased number of informal interactive spaces to accommodate a substantial number of the staff because Hua *et al.* (2010) opined that these spaces have an impact on the general performance of employees by fostering office related collaboration as such these spaces are highly required in these institutes. Figure 5.0 demonstrates the informal interaction spaces available within these research institutes and their percentage of occurrence; 36% have relaxation lounges, 14% have relaxation parks, 21% have other forms of interactive spaces, while 21% have no form of interactive spaces. It was also observed during the course of the fieldwork that where this facilities were made available it lacked the necessary equipment such as seats, canopies etc.

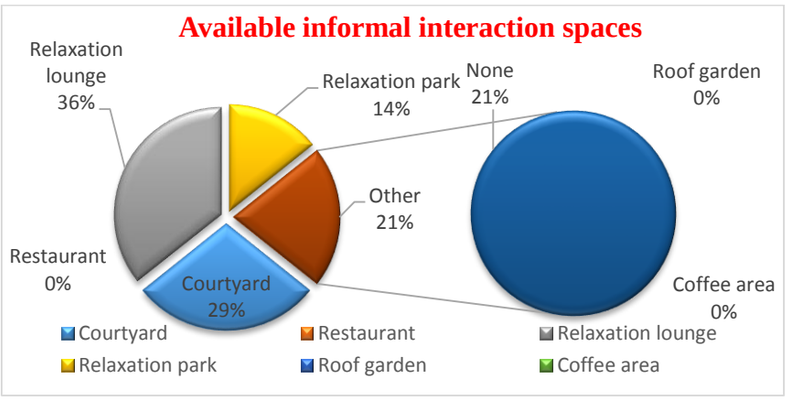

Figure 5.0: Available Informal interactive spaces Source: Author's fieldwork, 2017

CONCLUSION

Informal communication in workplaces particularly research institutes to a substantial degree can influence the level of staff efficiency. Research organization are knowledge based workplaces which entails staff rubbing minds together in other to share information. This examination demonstrated that the spaces and amenities within these research institutes were insufficient, consequently this would have some type of negative impact on the users in terms of informal interaction. It was likewise seen from the assessment that the majority of the staff take part in informal interaction in their office space as there are no or lack of devoted spaces for it in their establishment. This study has shown that to achieve a better and effective research institute that promotes social cohesion, it is imperative that different forms of dedicated informal interactive spaces are provided for unconstrained casual interaction among staff. This study also discovered that this spaces could be wide corridors, large lobbies, lounge, expansive frontal porch, beautifully landscaped courtyard, café, and restaurants. It therefore means that conscious effort have to be made in providing such spaces in building that do not have them while future designs of research institutes should incorporate the informal interaction spaces right from the design stage.

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TRENDS, PROBLEMS AND PROSPECTS OF COMPUTER & ICT IN ARCHITECTURAL EDUCATION AND PRACTICE IN NIGERIA

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The inclusion of Computer & Information and Communication Technology (ICT) into the architectural educational curriculum in Nigeria has been acknowledged as a key step in bridging the digital divide and its advancement are in no doubt reshaping the architectural design studio teaching and practices. The trends in design computing in the last two decades have been extraordinary and what the next decade will bring can only be imagined. As this development portrays enormous benefits and prospects for the architects and the profession, it is not without problems and challenges. This has put architecture education and practice in Nigeria in a challenging situation with issues ranging from decreasing creative design ingenuity and imaginative ability of students leading to low quality design, inadequate literature follow, less personal contact and interaction between students and lecturers, preference for better visual outputs against better design etc. It is against this background therefore, that this paper attempted to examine the impacts of this development on architectural training and practice in the Nigerian (IT) information technology world. The method adopted for this study involves oral interview in five randomly selected universities in Nigeria and in-depth review of related literature. The paper has been able to establish the impact of computer application and ICT in architectural educational setting as a veritable mechanism which has radically changed teaching and learning concepts in the field of architecture, and therefore, the learning environments in schools of architecture should be realigned to encourage a more collaborative and supportive culture so that students develop sensitivity to others and form sense of information technology community.

Keywords: Architectural Education, Computer, Design Studio, ICT

INTRODUCTION

In the last two (2) decades, a number of reports and studies have described how advancement in the information technology has changed the society and other construction professions. Until recently, design studio activities have been carried out using manual sketching, drawings and physical modelling. ICT originally is applied to serve as means of improving efficiency in the educational process (Jones And Knezek, 1993). Since the late 1980s architecture and architectural education have witnessed an important revolution with the introduction of computers and information and communication technology (ICT) in which they have become pervasive in all aspects of practice and education. The pervasiveness of information and communication technology in architectural education and practice has been manifested in the growing proportion and importance of IT related courses in the curricula of architectural schools. It has been shown that the use of IT in education can help improve memory retention, increase motivation and generally deepens understanding (Dede, 1998). IT can also be used to promote collaborative learning, including role playing, group problem solving activities and articulated projects (Forcheri and Molfino, 2000). Many schools have included IT content in their curriculum and are investing to acquire computing resources to ensure that they provide their students with the necessary skills and competitive advantage. Modern information and communication technology and digital tools have been adapted in the architectural education and practice since the 1990's.

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However, a lot still need to be covered as many university undergraduates are lagging behind in this field. Adomi and Anie (2006) reported that Nigerian industry asked universities to deepen the current existing knowledge levels of ICT skills of university graduates. According to them, industry was concerned about levels of graduate skills in online / Internet searching, systems management and computer keyboarding. Even though architectural practice and education has always been seen by architects and students of the discipline as a tough and demanding terrain. This may be connected to the obvious demands of the training of architects, characterized by long hours of design, drafting, and modelling. This does not end at the schools of architecture but continues through the practice journey. However, some veterans of the profession argue that this is the sure pathway towards success in architecture. While the use of computer applications in architecture has become a veritable tool towards success in the profession, it is however, known that this advancement in Computer and ICT are in no doubt reshaping the architectural design studio teaching and design practices.

The design studio has undoubtedly been at the core of architectural design education since its inception in the 19th century (Schon, 1985). The education of the architect ultimately affects the quality of practice and services provided in the real world, and as such, the need for the digital switch over. The digital-imperative to switch from analogue to digital mode has already begun to manifest itself at the schools of design and architecture. Design and architecture students routinely use the best of new technologies that provide information-rich and fully networked multimedia environments (Muir & O'Neill, 1994). The developments in design computing and digital media in the last decades have been phenomenal and what the next decade will bring can only be imagined. However the advancements in digital design and communications are already reshaping architectural design studio teaching and design practice. This is crucial in view of the changing roles of the architect and the need to maintain leadership in the industry. Education is not complete without the infusion of appropriate values which help to sustain relevance and growth. Involvement in the activities of the professional bodies helps in building useful networks while the platforms available through ICT complement to provide avenues for disseminating the services and products of professionals and firms. Investment in staff training is surely rewarding in the long term and attempts should be made towards the development of appropriate strategies for follow-up on clients for remuneration for services rendered. A partnership between education and practice develops a convergent ideological framework that promotes interactions between the two sectors.

Since the late 1980s architecture and architectural education have witnessed an important transformation with the introduction of computers and information and communication technology (ICT) in which they have become pervasive in all aspects of practice and education. According to White (2005) in Leslie, IISD Associate (2008); “The use of ICT in education and training has only begun as access to ICT services and higher bandwidths become more available to learners. In order to best use these technologies in education, new pedagogies and learning assessment methods may, and probably will be required. The popularity of information and communication technology in architectural education and practice has been manifested in the growing proportion and importance of IT related courses in the curricula of architectural schools. Many schools have increased IT content in their curriculum and are investing to acquire computing resources to ensure that they provide their students with the necessary skills and competitive advantage. Modern information and communication technology and digital tools have been adapted in the architectural education and practice since the 1990's.

Statement of Problem

The trends in design computing in the last two decades have been extraordinary and what the next decade will bring can only be imagined. As this development portrays enormous benefits and prospects for the architects and the profession, it is not without problems and challenges. And this has putting architecture education and practice in Nigeria in a challenging situation with issues ranging from decreasing creative design ingenuity and imaginative ability of students leading to low quality design, inadequate literature follow, less personal contact and interaction between students and teachers, preference for better visual outputs against better design etc and consequently determine the resultant quality of graduates produced with fight for relevance in the society, scarcity of commissions, increasing competition among practices for the few opportunities available and contentions over the traditional role of the architect.

Theoretical Framework

This review paper is situated around three theories. The first is the Systems Theory, while the second is Technological Determinism Theory, and the third, is the Technology Acceptance Model (TAM) respectively. They are used here because of their connections and applicability to architecture practice. The technological determinism theory is used here as the major theory while systems theory as a supporting theory to adequately explain the variables of architectural education and practice from the information technology standpoint. The technological theory as propounded by Mashal Mcluhan (1962) states that man's feelings, action and thoughts are shaped by evolving technologies. The theory sees technology (medium) as the messages we receive through the current technologies. This theory gives absolute power of influence to ICT. The way people now source and disseminate information are determined by evolving technologies (Computer and Information and Communication Technology. A systems theory is hence a theoretical perspective that analyzes a phenomenon seen as a whole and not as simply the sum of elementary parts. The Technology Acceptance Model (TAM) believes in an active audience or users who rationally take decision on whether or not to use a given medium depending on the benefits derivable from the medium. TAM looks specifically at the predictions of an information system. Davis (1989) developed the TAM whose purpose "is to predict the acceptability of a tool and to identify the modifications which must be brought to the system in order to make it acceptable to users". This model suggests that the acceptability of an information system is determined by two main factors: perceived usefulness and perceived ease of use. The significance of this theory to this study is that technology use depends on ease of use and usefulness of the system. This study was interested in examine the level of acceptability of computer and ICT, its use, merits and challenges bedevilling its use in architectural education.

Aim and Objectives

This paper sought to identify the trends, problems and prospects involved in the use of ICT instruments in Architectural education and its practice in Nigeria. And the above aim translates into the following objectives;

i. To assess the acceptability and use of computer and ICT to the profession of architecture in this 21st century.
ii. To evaluate the impacts level of the computer and IT on the architecture education and practice in Nigeria
iii. Determine the effect of computer application on the creative ingenuity that is usually gotten from the traditional studio practice
iv. To find the latest trends of computer software applications

METHODOLOGY

The method of study adopted is the qualitative research approach of sourcing data primarily and secondary through in-depth literature reviews, and oral interview. The study was carried out in five randomly selected universities in Nigeria where schools of architecture have long been established. These include Ahmadu Bello University Zaria, Federal University of Technology Minna- Niger State, University of Nigeria, Nsukka – Enugu State, University of Lagos. The oral interview was made possible via ICT (Mobile Telecommunication). While the contact persons were established in those schools, calls were put across to them, and the following questions were asked; what is acceptability level of computer and ICT for design presentation in your school? What are the impacts level of the computer and IT on the architecture education and practice in Nigeria? What is the effect of computer application on the creative ingenuity on students that is usually gotten from the traditional studio practice? Is computer aided design allowed for design presentations in your school?

Significance of Computer & ICT on Architectural Practice

Information technology (IT) – it's the application of computer and telecommunication equipments to store, retrieve, transmit and manipulate data often in the business enterprise, while ICT – umbrella term that includes the above and other applications such as radio, satellite systems, cellular phones, televisions, GIS. Adriaanse and Voordijk (2005) give explanation from the functionalist (positivistic, 'scientific') perspective that "ICT is a neutral provider of input for decision making". In this point of view communication is no more than

distribution of information. ICT may be adopted by specific groups of users within an organisation. For example, use of computer aided drafting (CAD) by architects or estimating software used by engineers or project managers. Emmitt and Gorse (2003) identifies the reality that, communication between construction industry participants and organisations are concerned with information exchange, dealings with drawings, specifications; cost data, programmes plus other design and management information. The use of computer applications and softwares like; Archicad, Chief architect, Punch software, Autocard architecture, Vector work architecture, Autodest revit, Soft plan, Revit architecture, Sketchup, Microstation, BIM (Building Information Modelling) has not just made this information exchange possible but also easy and flexible.

Merits of Computer & ICT on Architecture

i. Cad software has aided draughting and design by making it a faster and accurate especially line drawing, shape drawing, modification tools, shading & rendering, repetitive actions and capabilities, furniture and fittings, measurements of quantities, 3-D advantages like animation, landscape features abilities, layer creation advantage, window and door schedules generation, simulation
ii. It brought about faster design stages, easy storage, sharing, remote control and time saving, sending of drawings on-line, shopping and selecting materials & products on-line
iii. With computer, it is easy to draw more alternative designs, easy to make revisions on the design, better understanding, evaluation and reproducing for design environment and purposes, and more precise and accurate design
iv. Better and faster communication with projects like structural, electrical, landscape, interior design etc, and avoid coincidences of improper structural, mechanical and electrical equipments
v. Computer has an advantage of 3D visualization, and 3-D printing
vi. Video conferencing – means conducting a meeting between two or more participants at different sites by using computer networks to transmit audio and video data e.g. a point to point (2persons) video conferencing system works include video telephone

Demerits of Computer & ICT on Architecture

i. Security problems – computer hacking and stealing of design ideas, computer crash and lose of data
ii. Technology addiction, and computer taking over draughtsman's job
iii. Encourages prototype and standardised drawings sold on-line thereby reducing importance of architects
iv. Decreasing creative design and imaginative ability of students leading to low quality design
v. Inadequate literature follow, less personal contact and interaction between students and teachers
vi. Instead of better design, better visual outputs are preferred

Benefits and Prospects of Computer and ICT on Architectural Practice in Nigeria

i. Using computer aided education methods; students can state and explain the basic concepts in the subject easily and are able to participate in discussions of advanced concepts related to the subject content.
ii. Traditionally, professional ethics do not permit traditional forms of advertisement for architectural services but information and communication technology (ICT) provides platforms such as websites, blogs, social media and online exhibitions to disseminate the capacity and services of firms and professionals.
iii. Print and Electronic media has become a powerful tool for attracting clients and business opportunities. This is in line with the thoughts of Haruna (2008) who suggested that for a practice to survive the pace of development in Nigeria, it must reposition itself in the most competitive state.

Trends in Architectural Education in the ICT World

i. Advances in technology are continuing to place new demands on the construction industry. These include advances in computer software, construction and assembly

methods, materials. Architecture practices must adapt to the changing context of technology, to work more effectively.

ii. The rapid developing virtual education and distance learning methods are replacing today the classical education methods. The rapid growing visualisation techniques are one of the important factors of these developments. With the help of visualisation techniques we are able to create computer graphics that display data, particularly multidimensional scientific data, for human interpretation.

iii. Building information technologies present new opportunities and challenges to the architectural profession (Andenas, Livingston and Nelson, 2012). The increased use of Building Information Modelling (BIM) programs is altering the way in which many architectural practices are working.

iv. As sustainable design advances, the search for computer software that can exchange information continues. Building information modelling (BIM) introduces an alternative form of design process, procurement and construction, and changes the responsibilities of different consultants within the design team. Stakeholders including the client, architect, engineer, contractor and subcontractor, will be able to access the building information model. It will require adaption, investment and greater teamwork between the core trades (Guney, 2015).

v. The emergence of ICTs as learning technologies has coincided with a growing awareness and recognition of alternative theories for learning. The theories of learning that hold the greatest way today are those based on constructivist principles (Duffy & Cunningham, 1996). These principles posit that learning is achieved by the active construction of knowledge supported by various perspectives within meaningful contexts.

The Impact of ICT on Education

i. Conventional teaching has emphasised content. For many years course have been written around textbooks. Teachers have taught through lectures and presentations interspersed with tutorials and learning activities designed to consolidate and rehearse the content. Contemporary settings are now favouring curricula that promote competency and performance. The moves to competency and performance-based curricula are well supported and encouraged by emerging instructional technologies (Stephenson, 2001). Such curricula tend to require: access to a variety of information sources, access to a variety of information forms and types, student-centred learning settings based on information access and inquiry, learning environments centred on problem-centred and inquiry-based activities, authentic settings and examples, and teachers as coaches and mentors rather than content experts.

ii. Contemporary ICTs are able to provide strong support for all these requirements and there are now many outstanding examples of world class settings for competency and performance-based curricula that make sound use of the affordances of these technologies (Oliver, 2000). For many years, teachers wishing to adopt such curricula have been limited by their resources and tools but with the proliferation and widespread availability of contemporary ICTs, many restrictions and impediments of the past have been removed. And new technologies will continue to drive these forms of learning further. As students and teachers gain access to higher bandwidths, more direct forms of communication and access to sharable resources, the capability to support these quality learning settings will continue to grow.

iii. Another way in which emerging ICTs are impacting on the content of education curricula stems from the ways in which ICTs are dominating so much of contemporary life and work. Already there has emerged a need for educational institutions to ensure that graduates are able to display appropriate levels of information literacy, "the capacity to identify and issue and then to identify, locate and evaluate relevant information in order to engage with it or to solve a problem arising from it" (McCausland, Wache & Berk, 1999, p.2). The drive to promote such developments stems from general moves among institutions to ensure their graduates demonstrate not only skills and knowledge in their subject domains but also general attributes and generic skills.

iv. Just as technology is influencing and supporting what is being learned in schools and universities, so too is it supporting changes to the way students are learning. Moves from content-centred curricula to competency-based curricula are associated with moves away from teacher-centred forms of delivery to student-centred forms.

Through technology-facilitated approaches, contemporary learning settings now encourage students to take responsibility for their own learning. In the past students have become very comfortable to learning through transmissive modes. Students have been trained to let others present to them the information that forms the curriculum.

Challenges of Computer & ICT on Architectural Education

There have been a number of factors impeding the comprehensive uptake of ICT in architectural education in all the schools of architecture in Nigeria, and these includes;

i. **Lack of Fund:** The overall educational system in the country is underfunded. Consequently, available funds are used to solve more urgent needs of the institutions. Lack of funding to support the adequate procurement of the information technology equipment for architectural education training has been a major constraint to making architectural educational institutions ICT compliant

ii. **Epileptic Power Supply and Reliance on Diesel:** And even where they are acquired, running it becomes difficult due lack of steady and available power supply. A good case at hand now, is the conversion of the ABU Zaria School of Architecture studio into computer workstations, flooded with computers and other imported ICT hardware's that are begging to be used

iii. **Inadequate Training:** Lack of training among teaching/lecturing practitioners, and lack of motivation and need among teachers to adopt ICT as teaching tools (Starr, 2001).

iv. **Inadequate IT Infrastructure Policy:** Lack of vision and mission for the development of adequate and sustainable information technology policies in the country. ICTs in education programs require large capital investments and Nigeria need to be prudent and proactive in making policy decisions about what models of ICT use will be introduced to be conscious of maintaining economics of scale.

CONCLUSION

ICT education is now widely been used to develop teaching possibilities. Hence, the growing use of ICT in universities and schools as an instructional medium is changing and will likely continue to change many of the strategies employed by both teachers and students in the learning process. The seeming impact of the computer application and IT architectural education, architectural practice must take advantage and exploit advances in technology to the fullest so as to sustain the growth of architectural education and practice in Nigeria. The use of ICT in educational settings, by itself acts as a catalyst for change in this domain. ICTs by their very nature are tools that encourage and support independent learning. Teaching and learning concepts have changed radically.

Key Findings & Recommendations

i. The learning environments in schools of architecture should be realigned to encourage a more collaborative and supportive culture so that students develop sensitivity to others and form sense of information technology community

ii. It was found out that IT learning and utilization is one of the most concerns of educational issues around the world and for a number of years there has been evidence in the training and development area (Edwards, et al, 2007). Therefore, it is critical that the pedagogy of IT becomes the main focus of staff development and this will have to build upon in a constructive manner in order to allow architectural instructors and lectures to achieve the full benefits of using IT in their daily tasks

iii. While computer aided design and the use of ICT is encouraged in most of the architectural schools in Nigeria, it is yet to be fully accepted for design presentation for fear of complete erosion of creative ingenuity e.g. Futminna, UNN, Unilag. However, ABU Zaria School of architecture only allows the M.sc students to design and present computer aided design work while the undergraduate students are taken through the traditional design studio. Nevertheless, it should not be the foundation of the school of architecture rather their foundation should be the mind of each aspiring architect and the ability to create.

iv. As new applications and online resources are been developed to support learning and business objectives in all discipline, the architecture profession and training is not in

isolation, and therefore, the Nigerian architecture schools and architectural educators and practitioners should key into this development to reach out socially through all available media within the ambits of the law to promote successful business of architectural practice.

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PROPOSED ARCHITECTURAL CURRICULUM FRAMEWORK FOR SUSTAINABLE DEVELOPMENT

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The graduates' joblessness does cut across every field of study and construction industry is more affected by the current Nigerian economic depression. One of the reasons for low employment opportunity is the lack of fundamental cognitive, technical and entrepreneurial soft skills knowledge. Many scholars have reported that ineffective integration of soft skills in the universities' curriculum structure and use of inappropriate pedagogical approaches have largely contributed to graduates inability to acquire the required skills to create job after graduation, and architecture students are no exception. It is accepted that architectural education is the foundation for the attainment of sustainable built environment and national economic advancement. The position of this paper is in agreement with positive opinion of several scholars on the integration of practical skills acquisition to provide students with the indispensable know-how for self-realisation and self-empowerment in the competitive labour market. Therefore, this study aimed at developing an architectural curriculum framework for the integration of soft and hard skills through a systematic literature review for the architectural curriculum that could facilitate the improvement and advancement of the architecture programmes for sustainable development.

Keywords: Architectural curriculum, hard skills, pedagogical approaches, soft skills sustainable development

INTRODUCTION

In the past few decades, Nigerian educational system has witnessed critical reform. In fact, Federal Government of Nigeria as the sole-provider of Higher Institution of Learning (HIL) is a thing of past. The educational system in Nigeria is fast becoming predominate private sector shortly, especially with the establishment of home-grown (federal, state and individuals) public/privately owned and foreign universities' outreach campuses. This development has resulted in the yearly increase of graduates competing for employment in the labour market, in fact, graduates' unemployment is one of the critical challenges in Nigeria today (Olotu, *et al*., 2015).

The graduates' joblessness does cut across every field of study and the construction industry is more affected by the current Nigerian economic depression. Olotu *et al*. (2015) reported that over 65 percent of graduates of the construction industry were unemployed several years after graduation and university's graduates ranked highest. One of the reasons for low employment opportunity is the lack of fundamental cognitive, technical and entrepreneurial soft skills knowledge (Ugwu *et al*., 2013; Shannon, 2012). Many scholars have reported that most graduates lack employability skills such as idea development and problem solving, analytical thinking and information computer technology–ICT as well as moral and professional ethics (Pavlova, 2008).

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In the same perspective, Pitan and Adedeji (2012) and Olotu, *et al*. (2015) noted that HLIs are responsible for students' soft skill deficiencies, and upgrading the standard of soft/practical skills in the Nigerian education system is still contentious. Aliyu (2014) stated that ineffective integration of soft skills in the universities' curriculum structure and use of inappropriate pedagogical approaches have largely contributed to graduates inability to acquire the required skills to create job after graduation, and architecture students are no exception. In fact, the primary goal of making architecture's graduates to be self-reliant and self-sufficient has not been achieved since a larger percentage of their population are among the topmost unemployed graduates (CBACS, 2010; BLS, 2012). More so, every year both the universities and polytechnics are still producing more graduates into the distressed labour market.

However, it is accepted that architectural education is the foundation for the attainment of sustainable built environment and national economic advancement. The position of this paper is in agreement with positive opinion of several scholars (Pitan & Adedeji, 2012; Ugwu *et al*., 2013; Shannon, 2012) on the integration of practical skills acquisition to provide students with the indispensable know-how for self-realisation and self-empowerment in the competitive labour market. Therefore, this study aimed at developing an architectural curriculum framework for the integration of soft and hard skills through a systematic literature review for the architectural curriculum that could facilitate the improvement and advancement of the architecture programmes for sustainable development.

LITERATURE REVIEW

The key to graduates' employability and self-empowerment is the development of soft and practical skills in the Higher Learning Institutions (HLIs). The vital soft skills are communication, problem-solving, creativity, information communication technology, teamwork and lifelong learning (Dacre Pool & Sewell, 2007). It has been established that both soft and practical skills are not just for getting employment but for developing graduates' potential for self-realization and sustainable employment. Other personal attributes like creativity; leadership; entrepreneurship; adaptability; honesty; commitment; capacity to cope with pressure; and motivation have also been attributed as essential employability skills for professional development. Basically, all these skills have been attributed as transferable skills and they are fundamental to field of jack of all trade like architecture (Bodine & Hilty, 2009 Gafar *et al*., 2012).

Several researches have been carried out to establish the issues related to graduates' unemployment in Nigeria. Some of the findings revealed graduates' low capacity in critical thinking, creativity and problem solving (Ezepue & Ezepue, 2008) and this is simply because the teaching approach is predominately theoretical and academic in nature which lacks the mixture of practical job market's skills required for sustainable employment (Brown & Sack, 2012). Other studies also established that majority of organisations preferred graduates that are creative/self-initiative; dynamic/flexible; enthusiasm and confident with good communication skill for employment (Shannon, 2012). At the same time, researches have showed that employers, graduates and graduating students shared the same opinion that universities' curriculum contents and teaching approaches used by the educators lack the critical skills require to gain employment/create job in the competitive labour market (Kennedy, 2011).

Aliyu (2014) and Audu (2013) noted that mainstream universities are failing, only because they are providing students with white-collar training as against the blue-collar experience required in this era. The time when governments are the primary employer of the university's graduates is over, in fact, employment opportunity in the government sector is more than saturated. At the moment, the majority are job seekers in the already saturated job market. As such, several scholars, non-governmental bodies and employers have called for both tertiary institutions to introduce sustainable soft and practical skills into their curriculum structure. Smith *et al*. (2007) also stressed the for universities and industries interconnectivity as an avenue to provide the students of HLIs with the practical workplace experience for nation's sustainable development.

In Nigeria today, desperation for employment among the larger population of universities graduates is extremely high but the greater percentage of them lack the necessary soft skills and entrepreneurial capacity to create the good jobs. Recently, the National Universities

Commission (NUC) launched compulsory soft-skills and practical entrepreneurial development in the National Youth Service Corps's campus (Ugwu, et al., 2013). The essence is for the graduates of tertiary institutions across every field of study to undertake training before going to the labour market. More so, the policy is to provide exposure and experience through learning by doing in a practical working environment, above and beyond is to improve the graduates' business and technical competence. However, the reality on the NYSC's campus is far different from the noble initiatives; in fact, the impact of the programmes is unclear as the graduates' unemployment is still on the increase.

Notable scholars have challenged the Nigerian universities curriculum structure, particularly, courses offered in some programmes of studies. In the case of architecture as a field of study, the courses offered in various schools of architecture are characterised by complex criticism (Adewale, 2014; Olotuah & Adesiji, 2005). Up till now the architecture graduating students' dominant training approaches are based on fragmentation rather than connection, linkages and innovative courses for sustainable development. From a practical perspective, Gafar *et al*. (2016) view architectural education as a value enhancer for the students' self-reliance, self-sufficiency and self-discovery in the quest for meaningful development of their potential and creating an innovative solution in the built environment. The problems in built environment are enormous and this is supposed to generate endless job opportunities but the reverse is the case in the Nigerian society.

However, unemployment challenge of the architecture graduates is not peculiar to Nigeria alone; in fact, architecture graduates are ranked among the highest unemployed graduates in United States of America (BLS, 2012; CBACS, 2010). In the case of Nigeria, accurate data on the number of unemployed architecture graduates is sketchy but Nigerian Bureau of Statistic recorded over sixty-eight percent graduates' unemployment in 2014. The current declining of Nigerian mono-economy is compounding the unemployment issue. Pitan and Adedeji (2012) noted that other major factors contributing to the graduates' unemployment dilemma are: The quality and quantity of the universities students' new intake; the standard of the curricula offered in the universities and its level of relevance to today's job market; and the educators' experience/exposures, skills/talent and commitment to work. More so, inadequate attention has been given to several sustainability dimensions of the relationship between education and skills development in HLIs.

The Development and Integration of Soft and Practical Skills in HLIs

The fundamental processes to develop and inculcate soft and practical skills on the students of HLIs could be achieved through course structure and content, campus/off-campus practical workshop practice and internship with support programmes such as multidisciplinary initiatives and industry-university collaboration. The primary essence of the HLIs' skills development is for the graduating students to be able to transfer the skills and knowledge acquired from the academic community to the real-life place of work for national economic development. Notable scholars have proposed diverse approaches on how to integrate soft and practical skills in the HLIs.

On one hand, the concept of Group Collaborative Learning Model (GCLM) was proposed by Gates (1997). The idea revolves around five fundamental intuitions. First, Gates believes that every group member in a collaborative learning is interdependence for success and progress. Second, he is of the opinion that hand-on-hand promote interrelationship for mutual learning. Third, he asserts that teamwork promotes equal distribution of involvement and responsibility that create knowledge-sharing. Fourth, diverse-inputs are generated from the skill's collaborative learning process. Fifth, every group member's reflection and feedback provides initiatives for effective improvement and advancement of learners' skills acquisition. On the other hand, the Contemporary Skills Partnership Framework was developed by intellectual scholars in 2007 (Smith *et al*., 2007; Salih, 2007). The idea revolves around the technological advancement of 21st century as the global economy is shifting from production-based to knowledge-based economy. Global economic paradigm shift called for flexibility, adaptability and diversity of the graduates of HLIs by the inculcation of added-value skills of communication; finance and marketing; entrepreneurship and commercial awareness. The model emphasised interdisciplinary teaching approach that reflects on reality of the competitive labour market. The simple reason is that the knowledge students' acquired in one field of study is not enough to provide the skills of strategies graduates require to overcome the challenges of job market. It is on

this account that NUC promulgated compulsory entrepreneurial development in 2012 for all the Nigerian tertiary institutions.

Generally, several scholars have established that university's graduates lack employability and essential skills to create their own business (Ugwu et al., 2013) and NUC identified relevant skills required to be developed in the Nigerian universities (see Figure 1.0).

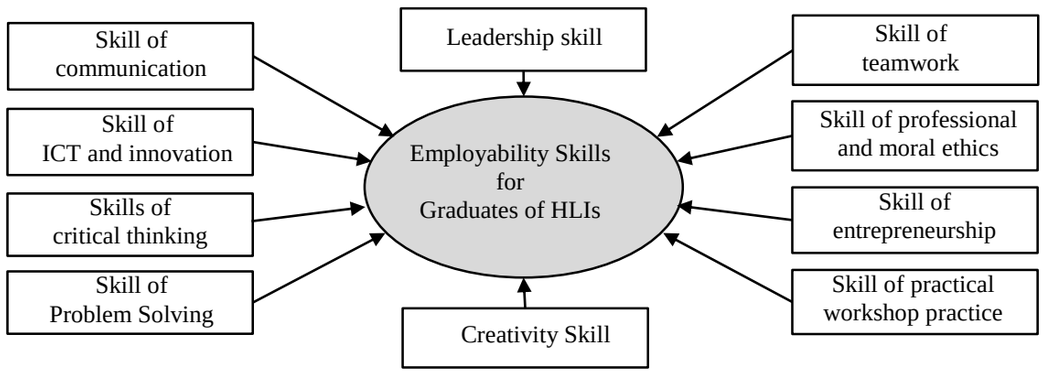

Figure 1.0: Graduates' Employability Skills (National Universities Commission, 2010)

Currently, the pedagogical approach and integration process is still contentious. Though, some universities are currently using single-course approach while others have employed embedded or a combination of both teaching methodological approaches. Regardless of the teaching and learning approach adopted/adapted by the universities there is need to establish the current level of students' knowledgeability on soft and practical skills which will serve as a feedback that is required for curriculum improvement on the most efficient integration approaches for the architecture students' skills gain.

Theoretical Foundation of Skills Acquisition in Architectural Education

Architects' education is a complex process that encourages learners to articulate different approaches on how to develop conceptual idea through critical thinking and create as a capable and competent designer of the built-environment. It is an education that is practically involved with the advancement of new intellectual concepts, skills and values. Hence, teaching is a process of acquiring knowledge/skills and transferring the same is the primary goal of any educational institution. So, architectural education is all about students' skills development that revolve around evolving their intellectual capacity building, physically and enthusiastically, socially and ethically, politically and economically prior to graduation from the tertiary institution.

The debate on architectural education is predominately on the need to provide students with a broad liberal training and the job-related/vocational requirement to prepare them fit for a professional career. Even though, the training is commonly project-based and course structure focused more on the design studio. By nature, architectural education should be rich, diverse and interdisciplinary in skill development. Aderonmu (2012) noted that inculcation of skills on to the students of architecture is essential in the current competitive job market and realisation of this noble initiative is best achieve when academic teaching instructions are synchronized with practical activities and repetition is imperative.

Dacre-Pool and Sewell (2007) outlined generic and practical skills as two essential modules of expertise required for technically related professions. Literature has shown considerable debate on generic/core/transferable skills. Sada *et al* (2012) stated that technological revolution has shown that skills of ICT (e-drafting; e-modelling and animations) in architectural education is unavoidable for the architecture students. Aliozor (2014) argued that ICT's skills are not enough for the students of architecture to survive and be relevant in the current competitive job market, so, practical skills in building technology, metal-work and wood-work are also indispensable. Gafar *et al*. (2012) are of the opinion that e-studio and practical workshop/laboratory should be complementary platforms for the students to demonstrate/practice the skills taught in a condition that is close to job market. They further explained that laboratories were provided for the science students, simply for them to demonstrate and understand the practical aspect of the subject taught in theory. So, architecture students' skill development is incomplete without a platform for practical workshops practice and entrepreneurship. In addition, inculcation of those skills on the

architecture students practically involves four fundamental stages: observation, imitation, repetition and participation. Therefore, it is combination of these four stages that could provide the true education for the creation of dynamic entrepreneurial-architects require in the current Nigerian economic dispensation.

However, HLIs' objective to produce architecture students that are self-reliance and self-sufficient in the job creation/market has not been fully attained (Awogbenle & Iwuanmadi, 2010). It is also a common knowledge that university graduates are not well equipped with employability skills and job creation proficiencies, despite the fact that more students are graduating every year. So, graduates' job placement and employment opportunity in both public and private is becoming more problematic. Possible area for employment re-fertilization such as university-industry partnership, innovation in hand-on skills development have not been fully harnessed/developed. The improvement on pedagogical approaches for course delivery in the Nigerian universities is still orthodox, knowing that the 21st Century requires innovation and capacity development in every aspect of architecture education in Nigeria.

CONCLUSION

For more than a decade, unemployment rate has been growing and the larger percentage of the Nigerian graduates lack employability/entrepreneurial skills. The reality is, what can they offer? Therefore, in this 21st Century, university graduates need to be distinctive, creative and innovative. In fact, they have to synchronise their passion with their inherent abilities. Furthermore, it is important to note that educators could teach, counsel and guide in graduates' skills development but their ultimate occupational choice must be born out of his/her personal aptitudes, passion and conviction. It is such drives and efforts required to successfully practice architecture that has become so innovative and competitive than ever before. On a practical note, fundamental problem calls for fundamental solution, this implies that there is critical need to call for shift in the architectural curriculum design for sustainable development.

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BUILDING INFORMATION MODELING

BUILDING INFORMATION MODELLING: A TOOL FOR DIFFUSION OF INFORMATION IN NIGERIA

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Building information modelling (BIM) technology has now reached maturity level in several countries around the world. The construction industry internationally is realising potential benefits of using collaborative process in construction, and the increasing return on investment; and the potential benefits of integrating the industry is not fully realized in Nigeria. A quantitative approach was adopted to x-ray the Nigerian construction industry; a structured questionnaire was used across the AEC to evaluate BIM awareness and adoption in Nigeria through the line of enquiry known as the 'diffusion of innovations'. The result revealed that 59.5% are aware of BIM technology; 22.8% are aware and currently using BIM and the remaining 17.7% neither aware nor using BIM; consequently, the industry was evaluated just within the *Late Majority* in terms of awareness and just entered the *Early Majority* in terms of BIM technology adoption. The country's adoption pattern was compared with three other countries where BIM is at advance stage; consequently, Nigeria is at least five years behind US, UK and South Africa. The industry is likely to take the UK pattern to adopting the BIM.

Keywords: adoption, BIM, collaboration, diffusion of innovations, integration

INTRODUCTION

Engineering businesses are recognising that the effective and integrated management of design information is a vital component to achieving engineering and business goals. This project is an opportunity to contribute to setting the agenda of research and industrial practice in this key area: Building Information Modelling (BIM). BIM has a development approach to design and construction (Memon, *et al* 2014); NBS, 2016 defined BIM as a way of working and also the means by which everyone can appreciate a building via the use of a digital model which draws on an array of data assembled collaboratively, throughout the stages of procuring a building and its lifecycle. BIM is the most significant information technology development and a paradigm shift in Architecture, Engineering and Construction (AEC), therefore gaining recognition as a powerful tool to deliver benefits across the construction industry and Facility Management (Hammad, Rishi & Yahaya, 2012). Moreover, BIM is a tool or system of visualisation and documentation/communication (Sabol, 2008; Hammad, Rishi & Yahaya, 2012).

BIM potentiality as a system is not limited to the effective management of primary data, but also offers effective and detailed monitoring, and facility performance analysis that can support innovative and more cost effective management of complex facilities (Matchell & Schevers, 2006). It can be realized that many *countries are increasingly using BIM for innovative approaches to construction relationships, which is likely to give them a competitive advantage in an increasingly globalised economy* (Froise and Shakantu, 2014).

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The primary data of this research were gathered through questionnaire survey and aimed at Nigerian contractors and consultants (architects, engineers and quantity surveyors); the approach to the research was quantitative in nature. The results were analysed and compared with surveys conducted independently in other countries that studied BIM adoption rates. The adoption rates were examined in terms of the line of enquiry known as the 'diffusion of innovations' to produce status in Nigeria.

LITERATURE REVIEW

Building Information Modelling

Considering BIM as a complete 3 dimensional digital depiction of a building system or subsystem, and a sophisticated technology comprising both accurate building model and incorporated information (in database) of the building components, requires recognition beyond a 3D of it being sample representation of a building or its components (NBS, 2012; Memon *et al*, 2014; NBS, 2015). BIM remains the most potential development in the world of construction industry (Chan, 2014).

BIM has gone beyond being just a drawing and documentation tool. It is not solely about software, but represents a more collaborative method of working (NBS, 2015). This process is also transforming the way cities are designed, and life cycle performance of buildings and systems (Beaven, 2012). The benefits of using BIM during the building design stage have been well-publicized and are fuelling its adoption rate among architects worldwide - transforming their drawing-based processes to model-based processes. Even though as adopted at design and construction stages in countries like United States (US), UK, Finland, Germany and Norway; BIM effective usage still remained unaware especially as a platform for facility management which along inclined to the entire facility life cycle. Beaven (2012) stated that,

"The benefits of using information from a building model for facilities management are likewise compelling - fuelling the discussion surrounding building lifecycle management and nudging facilities management towards model-based processes".

BIM is the latest software technology being introduced throughout the built environment and related manufacturing industry. Manufacturing industry has long realised the benefits of use of BIM, i.e. automobile industry recorded significant success from its adoption (Egan, 1998). However, the construction industry is generally known to be resistive to changes; and most constructors are not ready for new innovations, preferred to sticking to the traditional way of doing things (Latham, 1996; Walasek & Barszcz, 2017).

Abubakar and Ibrahim (2014) found that education and training, software availability and enabling environment are the most important factors that will aid the adoption of BIM technology in Nigeria; while social and habitual resistance to change, legal and contractual constraints as well as high cost of training were found to be the main barriers to BIM adoption in Nigeria. Moreover, adoption rates in Nigeria lag behind considering other nations where BIM implementation evolve. The industry professionals need more awareness to these trends in order to stay competitive in this changing environment.

BIM adoption in other countries

In spite of progressive adoption of BIM in US, UK and some developed nations, the construction industry is known to be a very conventional/bound by tradition and rigidity group to bring on board (Walasek and Barszcz, 2017). There is however, significant development in the Hong Kong construction industry and, considering the support by the Chinese Government on BIM adoption and implementation, there is still considerably low or slow adoption of BIM in the industry (Chan, 2014). Moreover, Chan (2014) study discovered that about 33% of the study responders believed a lack of training to be a significant reason for insufficient use of BIM; while two-third (67%) felt that use of BIM is not necessary; 2D is sufficient to meet their need. This shows a clear lack of understanding (awareness) of BIM. Similarly, in addressing individual perceptions to this great tool in the UK, some perceived BIM as an unrequited addition to the existing work process (Haward, Restrepo & Chang, 2017); this is more of remnants to the high initial cost (Walasek and Barszcz, 2017). Thus, design cost/fee will most likely increase in order to reward BIM usage. Success in terms of positive return on investment (ROI) also encourages the use of BIM.

In the UK and US, much research has been carried out on BIM, especially regarding potential benefits as well as streamlining the stages of its full adoption in their construction industries. However, the 2015 NBS National BIM Report lamented the limited expertise and resource that can research and educate the industry in this innovative field (i.e. BIM). Moreover, more countries are building up to BIM adoption (i.e. Ireland, Germany, Finland, Denmark, Norway, France, Canada, Malaysia and China); where nearly 60% of western European countries are frequent users of BIM and 74% of them perceived positive return on their overall investment on its adoption (McGraw & Hill, 2010).

South Africa is considered more developed than most African countries, including Nigeria. Their level of BIM adoption is higher than any other country in the African continent as a whole (Froise & Shakantu, 2014). However, South Africa has also encountered setbacks to its implementation, with contractual issues (i.e. procurement route) being one of the major barriers to BIM implementation (Froise & Shakantu, 2014; Kekana, Aigbavboa & Thwala, 2014).

The diffusion of innovations

Rogers (1983) discusses what he has called the 'diffusion of innovations' and demonstrates in what way an innovation takes some time to feast, even if it is demonstrably better.

Africa are amongst the contributory factors that slow the BIM adoption process. Considering low infiltration level of BIM technology in developing countries, the technology diffusion level need to be established by the help of diffusion of innovation model.

Rogers (2003) described the cumulative diffusion of innovation in an S-curve model, and any adopter falls under one of the following categories: Innovators, early adopters, early majority, late majority and laggards. The graphs below fully described the categories of adopters.

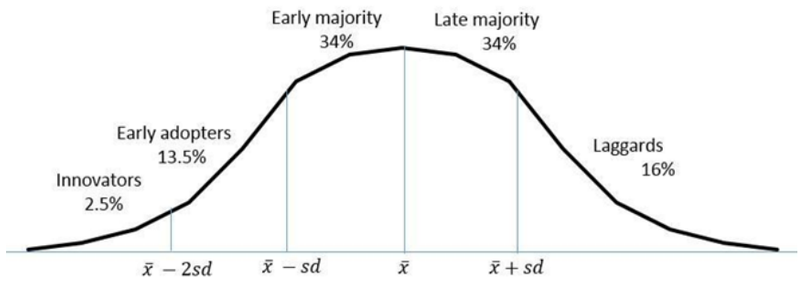

Figure 1: Innovation diffusion categories (Rogers, 1983)

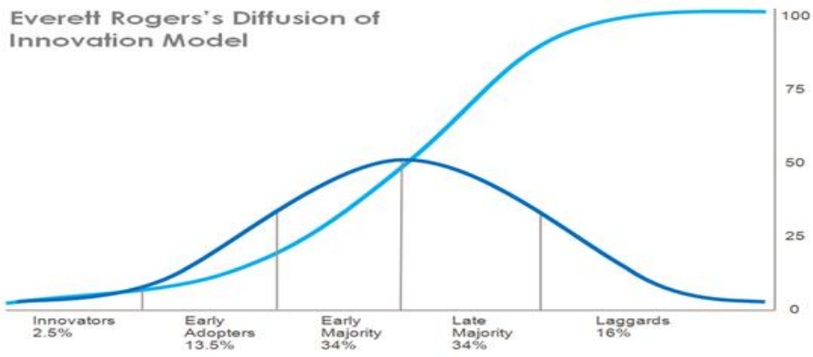

Figure 2: The diffusion of innovation (Rogers, 2003)

Going by the diffusion of innovation model, Jung and Lee's (2015) survey revealed that the main BIM users worldwide were in third phase (early majority), but those in the Middle East, Africa and South America were found to be in second phase (early adopters).

Africa recorded low and slow awareness and adoption of BIM with about 16% in the second phase (Jung & Lee, 2015). However, South Africa can be considered to be in the fore front of this collaborative innovation with a status of "early majority" i.e. third phase (Froise & Shakantu, 2014), but this status was recorded in what can be referred to as a 'lonely BIM' or 'small BIM' (mostly at organisational level); hence, the collaboration is quite limited. Thus, the country also has major barriers to the BIM adoption, these include: procurement

process, lack of awareness by the government, lack of awareness by the industry itself, and confidentiality of information.

Cox and Alm (2008) discuss the idea of inventive destruction (this involve innovation phasing out traditional way of working) and observe that the sustenance of producers depends on their capability to streamline production by introducing newer and better tools that increase productivity. Companies that do not deliver client requirements at competitive prices will eventually lose clients and die.

RESEARCH METHODOLOGY

The purpose of the survey was to determine the level to which CAD technologies and integrated construction process are currently being used by the construction industry in Nigeria. These results were then compared to the status and uptake of these technologies in some of examined countries in the literature review (US, UK and South Africa).

Precedents

In order to gather comparable results, the questions were aimed at gathering similar information to that available from other countries. The NBS survey has done extended research on BIM report in the UK and surveys by Froise & Shakantu, 2014 in South Africa. Figure 1 below described adoption rate of three different regions:

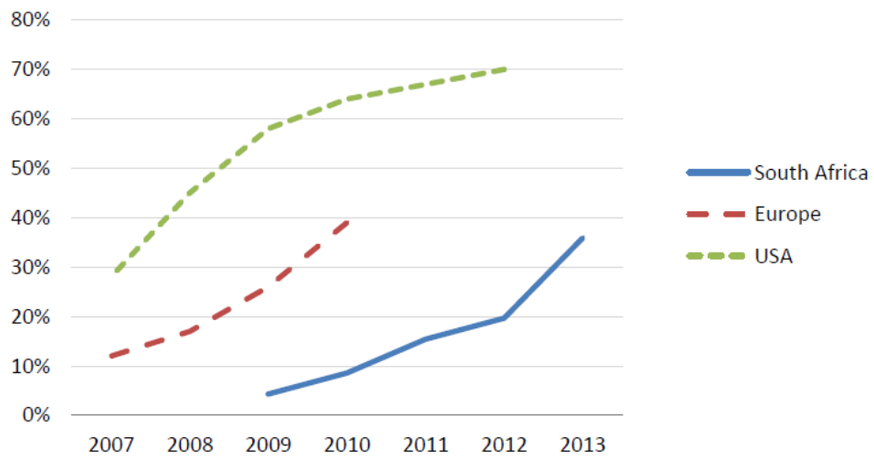

Figure 1: BIM adoption (Froise & Shakantu, 2014)

Two modern precedent studies are relevant to this research so as to match the Nigerian situation with those of other countries. Firstly, is a survey piloted by the NBS in the UK in 2011, then in 2012 …2017 which analysed sequential BIM use and perceptions of professionals in the industry. Secondly, is a Froise & Shakantu survey that compares the Europe, USA and South Africa markets and looks at BIM awareness, usage and perceptions levels, and take-up among architects and contractors, this was conducted in 2014.

The United Kingdom (UK), the United States (US) and South Africa are selected as sample countries to test BIM awareness and adoption. This selection is a reflection of two main principles or measures (Kassem, Succar and Dawood 2013): (a) the resemblance between the two developed nations (UK and US) in their construction markets in terms of applicable technologies and terminology; and also the two developing nations (South Africa and Nigeria), (b) the availability of reasonably wide BIM adoption surveys (BEIIC, 2010 in Australia, NBS survey from 2011 to 2017 in the U.K. and McGraw-Hill Construction, 2013 in the U.S.)

Survey questionnaire

The type of questions used were generally closed-ended and multiple choice, although there was also an opportunity to answer an open-ended question especially where further information may be required or the respondent may want to provide different or additional information.

The following section shows the result of a survey that examined different aspects of the use of BIM in Nigeria. The questionnaires were sent to contractors and consultants mostly from general building category in Nigeria predominantly from the following zones: North-west,

North-central and South-west in descending order of quantity followed by very few from North-east and South-east; due difficulty in gaining contact information for the North-east and South-east, therefore the result may not reflect the true picture of the industry in those regions.

The surveys were set up in a word document format (as an attachment) as well as *'google doc.'* (as a link) and sent via established personnel emails, the questionnaire could be accessed over the internet on PCs and Android phones. A total of 133 mails were sent, out of which a total of 80 responses were received (some by email and some by completing the online version); this represents approximately 60.2% response rate, hence this vindicated both the 55% for paper-based response rate and 47% for online response rate according to Ballantyne (2005). The responses received from contractors were 5 which represents 6.3% of the responses, architects returned 30 (37.5%), quantity surveyors returned 6 (7.5%), engineers returned 36 (45%) and Clients returned 3 (3.8%).

ANALYSIS AND DISCUSSION

Survey findings

The survey results were analysed and the findings are presented below. An initial observation was the substantial difference in the response rates for the surveys, where same method of notification and delivery was used. The difference may potentially credited to the awareness levels of the five different groups, where architects were substantially more aware than other professionals of the BIM concept considering architects as a single entity, however engineers recorded higher numbers, but this is associated with number of disciplines involved in the engineering (civil, electrical and mechanical) profession. The chart below (*figure 2.*) presented the response distribution.

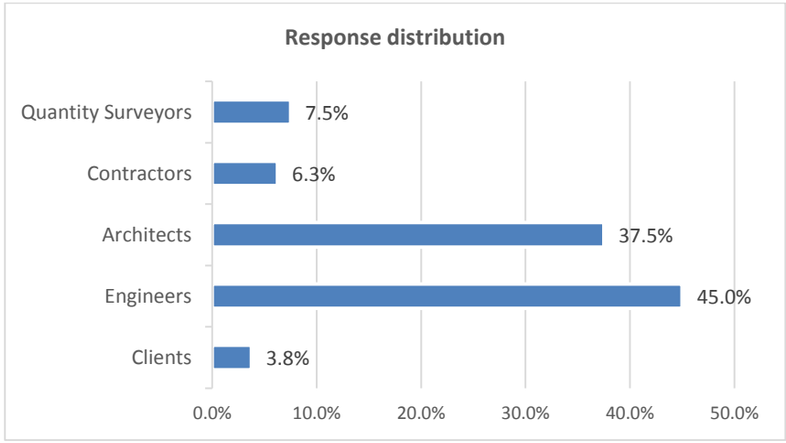

Figure 2: Response distribution

Awareness of BIM

It can be noticed that there is a significant dissimilarity amongst architects and engineers, and the rest (especially, the contractors) when it comes to BIM awareness. 34.8% of those aware are architects and 51.5% of those aware are civil, electrical and mechanical engineers, while only 6.1% is the contribution of the contractors in terms of BIM awareness. Below (figure 2) is a chart presenting BIM awareness.

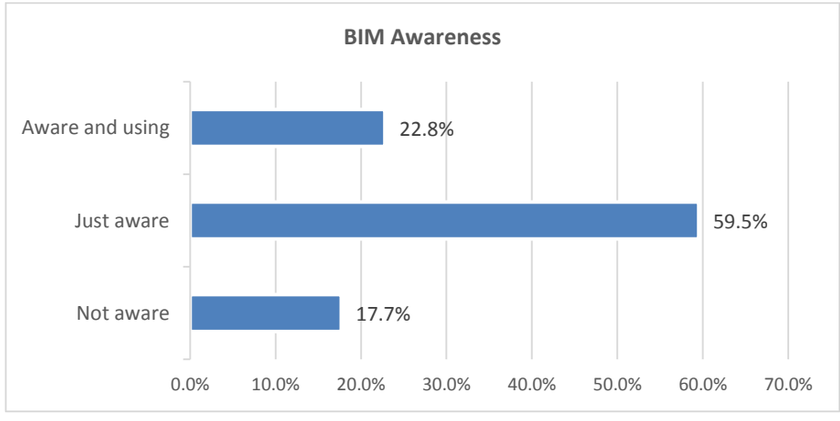

Figure 3: BIM awareness

Generally, refer to the above (figure 3), the awareness level is in the late majority (59.5% + 22.8% = 82.3%); but the adoption is just in early majority (22.8%).

Use of BIM

Most architects (61.9%) are aware of BIM, but only 26.9% use some form of BIM. Other than the clients, all the professions are at least aware of BIM to reasonably 50% but the adoption has a lot of disparities; the awareness to adoption are 57.5% to 27.5%; 60% to 20%; 66% to 0% for engineers, contractors and quantity surveyors consecutively. Figure 4 below is presenting the awareness and adoption percentages independently.

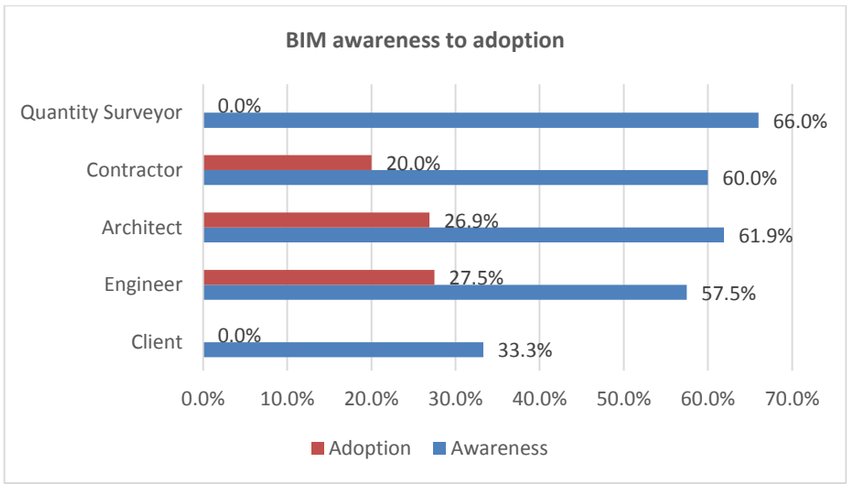

Figure 4: BIM awareness and adoption

The results were compared with surveys conducted in other countries. The most recent is the National BIM survey, conducted for 2017 (NBS, 2017) which reveals 97% BIM awareness (nearly universal) and 62% adoption; therefore, the gap is too wide to be compared, therefore the nearer survey findings is the 2012 NBS report where 79% BIM awareness was recorded and 31% adoption.

Considering 2012 survey in the UK, 2012 survey by McGraw-Hill was also considered, where McGraw-Hill (2012) found that BIM adoption recorded up to 71% in the USA, which demonstrates how fast BIM is being adopted especially considering 49% adoption in the year 2009.

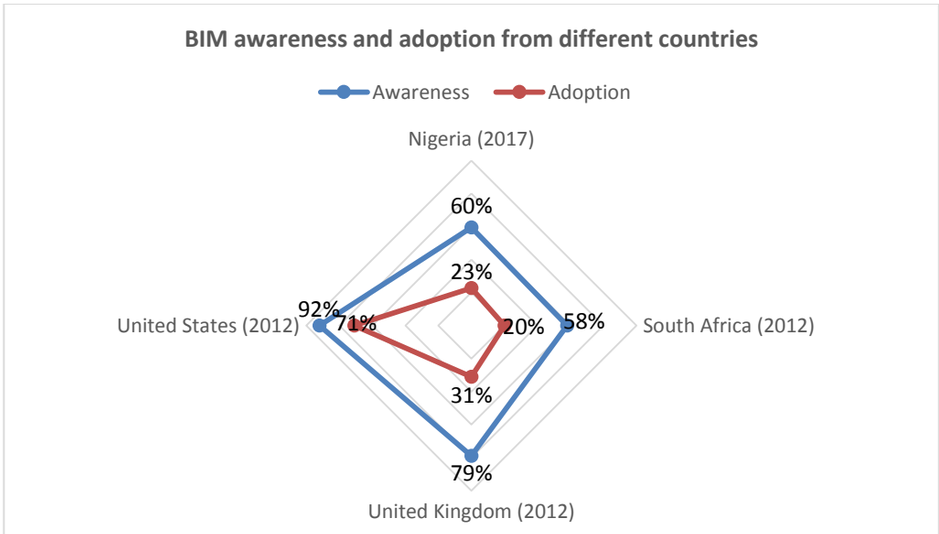

Figure 5: BIM awareness and adoption variations

Thus, the last country is South Africa, the findings by Froise and Shakantu (2014) reveals that 58% were considered to be familiar with BIM with an average of 20% adoption. With the above findings, the chart below (figure 6) presented combination of the surveys' results.

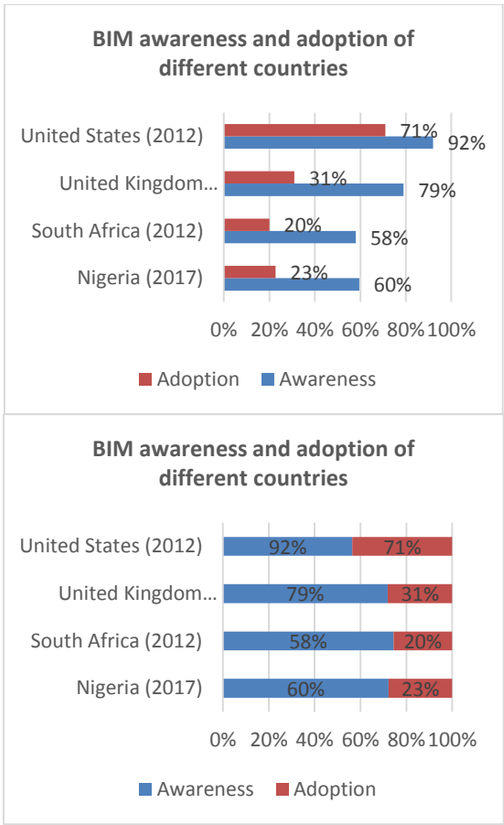

Figure 6: BIM awareness and adoption from different countries

Refer to Rogers (1983) that adoption of innovation generates self-pressure towards the rate at which the innovation diffuses. The adoption rate is expected to progress (faster) since it is still below 50%, although it will keep on slowing down before the adoption reaches 50% (where the adoption curve flattens), at the same time the awareness level becomes extensive through the adopting group.

As of 2012, Nigeria is five years behind United States plus 50% of adoption (71%, US-2012 against 22.8%, Nigeria-2017). While UK BIM adoption in 2012 was 31% which is 8.2% more than its adoption today (2017) in Nigeria (31%, UK-2012 against 22.8%, Nigeria-2017); hence Nigeria is more than five years behind UK. For a developing country closer to Nigeria (South Africa), Nigeria is approximately five years behind South Africa in BIM adoption (20%, South Africa-2012 against 22.8%, Nigeria-2017).

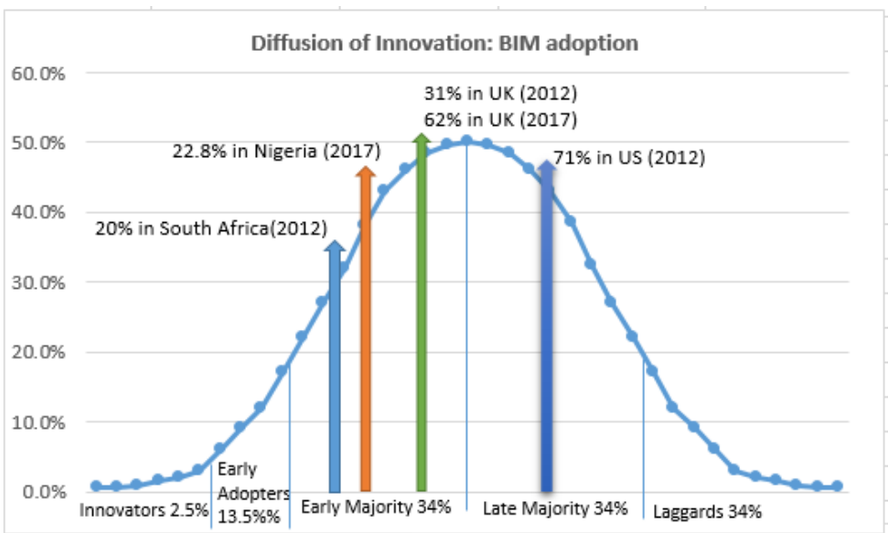

Figure 7: Innovation adoption curve: Summary of BIM adoption

CONCLUSION

The investigation reveals that there is reasonable awareness on BIM technology, although many are aware of the tools without knowing it as BIM, and without knowing it as a process; therefore the awareness of BIM as a process is lacking.

It can be seen that BIM adoption in Nigerian construction industry is lagging behind all the three countries (US, UK and South Africa) by at least five years. Moreover, the adoption to awareness pattern of Nigerian construction industry is more like that of the UK and South Africa, but followed nearly like the UK's pattern of 31:79 in 2012 while Nigerian pattern of 23:60 in 2017 (approximate adoption to awareness ration of 2:5).

Finally, Nigerian construction industry has just entered the *Early Majority* in adopting BIM technology and just entered the *Late Majority* in its awareness. The industry is expected to follow the UK trend, but the adoption process need to be streamlined to achieving the adoption rate of 6% (average) achieved by the UK construction industry yearly. All these came up due to a streamlined process to achieving BIM mandate in the UK, and also the UK's major clients are progressively insisting on a BIM platform for their new facilities, while the government is driving the process by creating a conducive atmosphere to the BIM utilization and requiring that new public buildings are produced in a collaborative environment using BIM.

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AN OVERVIEW OF THE KM TOOLS AND TECHNIQUES ESSENTIAL FOR THE DEVELOPMENT OF A BIM-KNOWLEDGE FRAMEWORK

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The construction industry is a knowledge-intense and a knowledge generating industry. Challenges exist in terms of capturing and sharing knowledge of best practices and lessons learned on projects, and from project to project. These challenges, in parts, arise from the fragmented and/or transient nature of construction projects. Hence, the knowledge tends to remain with individuals or get lost during the process. Knowledge has been identified as one of the most important assets of any organisation, especially a knowledge-intense industry like construction. The need to capture and share abundant knowledge from the industry becomes critical for effective decision making to prevent repeating avoidable mistakes. Building information modelling has emerged as a popular and veritable tool for repository of shared digital building information. But the current BIM models are information-based with little consideration for knowledge. This paper is set to propose how knowledge can be infused into BIM implementation through appropriate knowledge management tools and techniques. The paper, part of an ongoing PhD research, will adopt a literature review method to identify relevant KM tools and techniques necessary for infusing knowledge into BIM implementation. It will highlight some critical factors for the development of a BIM-infused Knowledge framework and present a schematic diagram of the proposed framework. The paper concludes by advocating the need for the development of a BIM-infused knowledge framework that could support BIM implementation for impactful decision making.

Keywords: building information modelling, BIM-infused knowledge, construction industry, knowledge management, tools and techniques

INTRODUCTION

Fragmentation of construction information and knowledge has been identified as one of the major challenges facing the AEC/FM (Architecture, Engineering, Construction and Facility Management) industry for a long time. This fragmentation of knowledge and the temporary nature of construction projects, which makes communication of information and knowledge difficult among project participants, have been reported to be a major contributing factor to knowledge loss within the industry (Liu et al, 2013). The AEC/FM industry is a knowledge intensive industry where abundant knowledge is generated. Knowledge has also been identified as a major asset and most competitive resource within the construction industry (Rowley, 2007).

The present BIM is an information-integrated tool. One of the weaknesses around BIM is the focus on data and information with little consideration and exploitation of knowledge which arguably is higher in hierarchy when compared with information (Boyes, 2016). The current BIM approach is not mature enough to generate and capture knowledge; and knowledge management is a stand-alone process separated from BIM implementation (Liu et al, 2013).

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A number of researchers have identified the need to integrate knowledge into BIM. Boyes (2016), while reviewing recent researches that have been conducted between 2011 and 2016 on BIM-based knowledge management, asserted that only very few researches have been conducted on managing knowledge throughout the project lifecycle. He submitted that there is potential benefit in integrating BIM with knowledge management to facilitate sustainability. In a similar research, Wang and Meng (2016) also advocated the need for future research to focus on how to integrate the knowledge from each phase of construction project through the use of BIM. Infusing knowledge into the present BIM could help construction organisations to make better informed decision during BIM implementation.

METHODOLOGY

The conceptual framework presented in this article was drawn from the review of literature from relevant fields. A critical and comprehensive review of relevant literature on knowledge management (KM) was conducted, documenting appropriate knowledge management tools and techniques commonly used in the construction industry with a view to identify those that are appropriate for the integration of knowledge into BIM. A review of the current status of BIM was carried out to justify the need for a BIM-infused knowledge as a means for making impactful decisions in BIM implementation. The study identified five factors that are critical to the integration of knowledge to BIM and proposed a conceptual framework for the integration.

LITERATURE REVIEW

Knowledge Management and the Construction Industry

Over the last decades, knowledge management has received a significant attention from researchers in the construction industry (Deshpande et al. 2014). A framework (IMPaKT) that enables AEC organisations to understand the business impact of their knowledge management was developed by Carrillo et al (2003). Others researches were focused on structured approach to KM problem definition and strategy formulation for an AEC organisation (Cheng et al. 2003), activity based KM system for capturing the knowledge generated in the construction phase (Tsreng & Lin 2004), development of web-based KM system which allows for knowledge capturing for subsequent use in the same project as well as other project (Tan et al. 2007).

Some other researches were focused on issues of ontologies and taxonomies for construction organisation and knowledge retrieval (El-Gohary et al. 2010; Wang et al. 2011; El-Dirabi 2013) while others studies are directed at the people, state of the practice, and implementation aspects of KM (Javernick-Will 2012; Xi et al. 2013). While the work of Tsreng and Lin (2004) is activity based and limited only to the construction stage, the study carried out by Deshpande et al., (2014) encompasses both the design and construction stages. The present research identified a gap in the inability of these researchers to capture the tacit knowledge specifically and their failure to capture the whole life-cycle of the project.

There are two concepts from KM which are useful when considering the implementation of BIM: the knowledge hierarchy and the distinction between explicit knowledge and tacit knowledge (Malone 2013). While explicit knowledge refers to knowledge which can easily be written down, captured in a database, and codified; tacit knowledge is more difficult to write to down and codify. It is the knowledge which usually exists in the mind of the 'knower' and can often be learned through experience or informal training and education (Nonaka 1997). Tacit knowledge, which remains vital to the successful delivery of projects, can still not be effectively captured by the existing BIM approach (Malone 2013). KM tools and techniques can provide useful insights on how best to capture and infuse knowledge into the present BIM for impactful decision making.

To facilitate effective knowledge management, Abdullah et al. (2002) argued that both explicit and tacit knowledge can be represented as models. While explicit knowledge can be managed more easily because of its tangible nature; tacit knowledge will need to be converted to explicit knowledge for it to be managed. Knowledge conversion, according to Nonaka and Takeuchi (1995), can be achieved through the process of: socialisation, externalisation, combination and internalisation. *Socialisation* is the process of sharing tacit knowledge, while *combination* is about the dissemination of explicit knowledge. *Externalisation* is the process of making tacit knowledge explicit, while *internalisation* is the process of taking explicit knowledge and using it to develop tacit knowledge (Nonaka & Takeuchi, 1995; Wickramasinghe et al. 2009).

A Case for BIM-Infused Knowledge

The quest and demand by clients for quality jobs that are sustainable at a reduced price within the shortest possible time have become a serious challenge to professionals and stakeholders in the construction industry. This challenge may best be addressed if they can collectively and collaboratively make prompt informed decisions based on knowledge. While BIM allows such collaboration, there is still the need to infuse it with knowledge for the decision made to be very impactful for the sustainability of the project.

BIM is characterised by its ability to create and operate on digital database for collaboration. It helps manage changes through databases such that a change to any part of the database is coordinated in all other parts, and capture and preserve information for reuse by additional industry-specific application (Autodesk 2002). The need to capture and manage the vast large of information and knowledge that is been generated in the construction industry has been recognised by researchers (Deshpande et al. 2014). Throughout the different phases of construction projects, the stakeholders involved collaborate to achieve the required outcome by bringing to fore their different expertise and knowledge to ensure that the project is delivered. Unfortunately, the teams are usually disbanded after each project without adequate capturing and storage of the abundant knowledge generated in the course of the project for future use and reuse.

The unique nature of every design and construction processes requires creativity and innovation on the part of the designers and constructors to ensure success (Deshpande et al. 2014). These creativity, ingenuity and experimental knowledge (usually tacit) play a vital role in the decision making regarding construction means and methods, identification and implementation of solutions to the problems encountered in the process of the project delivery (Ferrada & Serpell 2014). One of the greatest assets of a construction organisation, which puts it at a very competitive advantage is the amount of knowledge generated throughout the life-cycle of a project. Effective capturing, storage and sharing of this knowledge for future use and reuse are critical to successful execution of construction projects and vital for competitiveness and survival of the organisation (Ping & Yu-Cheng 2004; Deshpande et al. 2014).

Knowledge management is an emerging management approach to help solve the current business challenges in order to increase efficiency and efficacy of core business processes while incorporating innovation at the same time (Wickramasinghe, et al. 2009). The present paradigm shift in the business environment where knowledge is now seen as central to organisational performance and survival further justifies the need to infuse knowledge to the present BIM for impactful decision making in the construction industry. KM activities help focus the organisation on generating, capturing, storing and utilising knowledge for problem solving, dynamic learning, strategic planning and decision making (Charlesraj 2014). The major goal of knowledge management is to increase the productive and the behaviour of team work through a knowledge sharing platform (Ribino et al. 2009). The development of a BIM-infused knowledge approach through the integration of knowledge and BIM will help improve the quality of decisions making process in the construction industry.

Building Information Modelling (BIM)

Building information modelling (BIM) is fast replacing the traditional ways of designing, building and operating facilities by more streamlined and collaborative work process, heavily supported by data-rich, parametric software applications (Niemeijer 2015). HM Government (2015) document of Digital Built Britain on Level 3 BIM Strategic Plan defines Building Information Modelling as "a collaborative way of working, underpinned by the digital technologies which unlock more efficient methods of designing, creating and maintaining built assets". Building Information Modelling (BIM) is defined by the National BIM Standard as "a digital representation of physical and functional characteristics of a facility", and it is a "shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition" (BSA 2012).

Appropriate Knowledge Management Process, Tools and Techniques in Construction Industry

Essentially, knowledge management is about planning, organizing, motivating and controlling individuals and organisational information systems to improve their knowledge assets and productivity (King 2007). The importance of knowledge management within the construction industry has been acknowledged by researchers (Elgobbi 2010; Tan, et al. 2010). Udeaja et al. (2008) confirmed that knowledge management has become a major field for business thinking and decision making.

For the sake of this paper, the four processes identified by Bigliardi (2014) are useful in our understanding of knowledge process. The four processes are: 1. Knowledge Creation, Search and

Capture; 2. Knowledge Organisation, Storage and Preservation; 3. Knowledge Distribution, Transfer and Sharing; 4. Knowledge Use, Reuse and Feedback. The appropriate KM tools and techniques necessary for each process during BIM implementation shall be identified and discussed later.

There are few definitions for KM tools in the literature. Most authors use the term to refer to IT tools (Egbu et al. 2003). However, Ruggles (1997) describe KM tools as the technologies used to enhance and enable the implementation of the sub-processes of KM (e.g. knowledge generation, codification, and transfer). He submitted that not all KM tools are IT-based. While most authors use the term KM tools to refer to both IT tools and non-IT tools, Al-Ghassani (2002) made a distinction between IT and non-IT KM tools. He used the term KM techniques for for non-IT tools and KM technologies for the IT tools (Egbu et al. 2003). Bigliardi et al. (2014) identified two different strategies to KM implementation, namely: an IT-centric strategy and a people-centric strategy. The IT-centric strategy focuses on the use of IT tools such as electronic databaded, ERP, internet and intranet to facilitate the main KM process. On the other hand, the people-centric strategy focuses on non-IT techniques as means to motivate and facilitate knowledge workers to develop, enhance and use their knowledge to achieve organisational goals. Examples of people-centric strategy include: brainstorming, meetings, direct observation, lessons learned on previous projects, etc (Bigliardi et al. 2014).

Critical Factors for Developing a BIM-K Framework

There are a number of factors that can influence the development of a BIM-infused knowledge framework. These factors can positively or negatively affect the development and the implementation of the framework. They are referred to as incentives when they have positive influence. But when they negatively affect the system, they are known as barriers or impediments. . According to Carrillo et al (2004), these obstacles are compounded by the lack of standard work processes, time and money constraints, poor information technology infrastructure, limitations to oral and paper communication modes, complicated information flows among the increasingly diversified stakeholders, and lack of common language to communicate information and knowledge (Zhang & El-Diraby 2012). Other authorities have also identified lack of standard work processes within organisation, lack of management support, poor organisation culture, poorly articulated strategy and difficulty in evaluation benefits (Robinson et al. 2005).

There are five critical factors that can be identified from the literature as shown in figure 1 and discussed below:

1. *Individual Factors:* These factors that have to do with the individuals within the system are responsible for the development and implementation of the system. These factors include: personal culture (values and behaviours), willingness to accept solution from others; perception of knowledge as flow or stock; level of trust among members; motivation, incentives and support; level of skills and knowledge; and experience in IT system.

2. *Organisation Factors:* These are factors such as management support, commitment and awareness; level of competition with other organisations; process problems; type of ownership; organisational structure and policy; and organisational culture.

3. *Economic Factors:* Among these factors are: high cost of software procurement; high cost of hardware, desktops and networks; cost of training and operations; and financial ability of the organisation.

4. *Technological Factors:* The factors under technology include: IT infrastructure and support systems; hardware specifications (availability and usability of software packages, data capturing and analysis tools, and data integration tools); availability and specification of information and communication technology (ICT); continuous change and advances in the industry; and methods and tools available for KM.

5. *Client/Customers Factors:* These are factors that have to do with the increasing clients' demands for: values for money; lesser time and cost of project; improved quality of products; improved supply chain management; and improved customers relationship management.

These factors have to be considered while developing a BIM-infused knowledge framework that can integrate knowledge and BIM to fully capture knowledge contribution to BIM implementation for impactful decision making. The implementers of the BIM-infused knowledge are the people working daily in the organisation. It is critical, therefore, to address the human factors as it affects the development and implementation of BIM-Knowledge framework. For successful development and implementation of the BIM-infused knowledge, adequate attention must be paid to the individual cultural frictions within an organisation.

For individual to share knowledge, it is important to build trust among members through interaction. Those who are ready to share their knowledge must also be motivated with incentives while opportunity for learning must be encouraged. Innovative thinking must be encouraged and colleagues need to be encouraged to solve problems through brainstorming. The organisational policy and culture must be one that encourages members to learn and share their knowledge freely either through job rotation, meeting and/or face-to-face interaction.

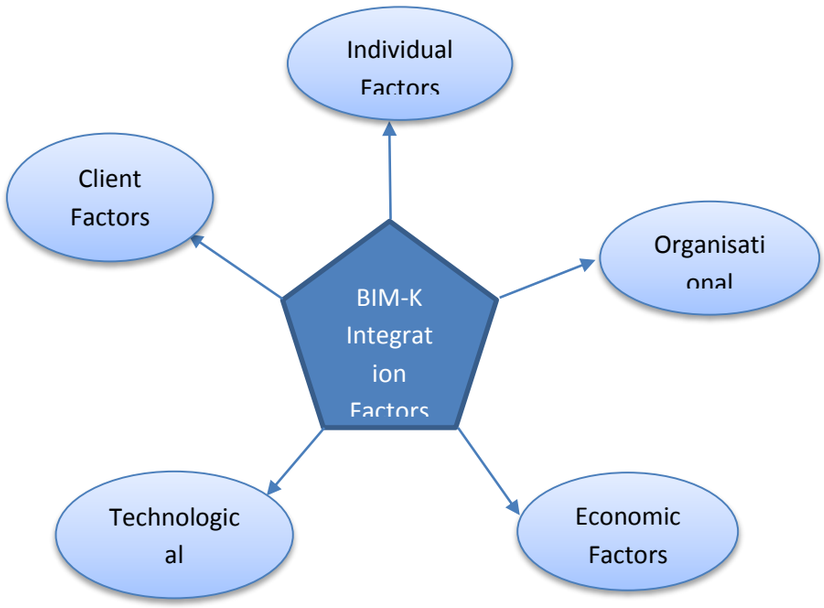

Figure 1: Framework of the Factors affecting the integration of Knowledge and BIM.

Towards a BIM-Infused Knowledge Framework

The current BIM applications are information-assisted building modelling technology. Knowledge management system and BIM implementation are, to a large extent, separate and independent processes. The need to infuse knowledge into the present BIM to fully capture knowledge contribution to BIM implementation for impactful decision making in sustainable development project is the core aim of the ongoing PhD research, from which this paper is extracted.

Chen et al. (2009) conducted a research on visualisation process to develop a knowledge-based system. In the system, stored experts knowledge is inserted to facilitate the process by enabling domain knowledge sharing and reuse between different users. Liu et al. (2013) adopted the same principle to develop a building knowledge modeling (BKM) framework for improving BIM, by expanding information exchange into knowledge sharing with the integration of a fully functional knowledge management system (KMS).

This research is also meant to adapt and advance the BKM framework by proposing a BIM-infused knowledge (BIM-K) framework. The proposed BIM-K framework will be an integration of BIM and KMS using appropriate KM tools and techniques to capture, store, share and reuse knowledge generated during BIM implementation for impactful decision making in sustainable development

projects (SDP) (as shown in figure 2).

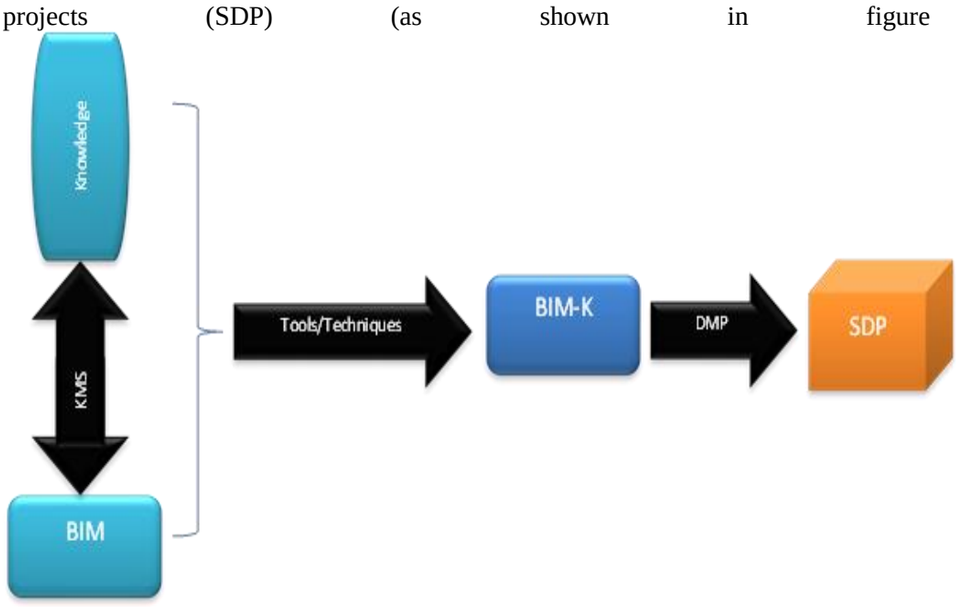

Figure 2: Conceptual framework for the integration of knowledge and BIM

The process of infusing knowledge into BIM is a continuous process, using appropriate KM tools and techniques, throughout the various stages of BIM implementation. The BIM-infused Knowledge (BIM-K) will be used to make decisions, through appropriate decision-making process (DMP), that will impact on sustainable development project (SDP). A case of BIM implementation at design stage can be used to demonstrate how appropriate tools and techniques can be employed to infuse knowledge into BIM within the four KM processes earlier identified.

Table 1: Appropriate KM Tools and Techniques for BIM-K Implementation Design Phase

BIM-K Implementation in Design Phase	KM Process	Appropriate KM Tools and Techniques
DESIGN STAGE	Knowledge Creation, Search and Capture	Experience (personal & company), brainstorming, Coaching and mentoring, lessons learned, best practices, job rotation, meetings, innovative practices
	Knowledge Organisation, Storage and Preservation	Minutes of meetings, computer files, knowledge bank (databases), internet, virtual libraries
	Knowledge Distribution, Transfer and Sharing	Mentoring, daily interaction, expert input, on-the-job training, chatting and storytelling, meetings, best practices,
	Knowledge Use, Reuse and Feedback.	Knowledge/experience from previous jobs, feedback meetings, face-to-face interaction, intranet

For implementation of BIM-K at the design phase of a project, table 1 shows the four KM processes and the appropriate tools and techniques for each of the process. To create, search and capture knowledge at the design phase, members will rely on their personal and company experience, brainstorm together, discuss lessons learned from the past and present projects, discuss best practices, and rotate jobs. The experts and the experienced project members will have to coach and mentor the new and younger ones through *socialization*. Essentially, non-IT tools (techniques) are recommended here to create, search and capture knowledge, especially tacit knowledge. That captured knowledge can then be converted to explicit through *externalization* for organization, storage and preservation. Minutes of meetings, knowledge and skills inventory (databases), computer files and internet are used for these purposes.

Knowledge can be distributed, transferred and shared among project team members through mentoring, daily interaction, expert input on specific project, chatting and storytelling, and meetings. Through this process, new knowledge is also created. The new knowledge generated and the stored knowledge can then be infused into the BIM implementation process to take informed decisions on the project or future projects to achieve sustainable development. Feedback is then taken and evaluated, and lessons learned and best practices from the decision become part of the organisation knowledge that can be organised and stored again. This scenario leads to circular process rather than a linear process. The process described for the design phase can be applied in all the phases of the project.

CONCLUSIONS

The construction industry is a knowledge-based industry and knowledge is one of the major assets of any construction organisation that gives it an edge over other competitors. To minimize the amount of knowledge lost, there is the need to capture, store and share the abundant knowledge that is being generated within the construction industry. Appropriate knowledge management tools and techniques can help achieve this. BIM is increasingly being adopted in the construction industry as a veritable tool for decision making. However, the quality of any decision made is a function of the amount and quality of knowledge at the disposal of the decision maker. To ensure that impactful decisions are made based on knowledge, the paper advocates for a BIM-infused knowledge framework that will help integrate knowledge, especially tacit knowledge, and BIM to fully capture knowledge contribution to BIM implementation. It highlighted the critical factors for the development of the BIM-infused knowledge framework and presented a schematic diagram of the framework. Since this is an extract from an ongoing PhD research, future research areas include the development of the actual framework and validation of the developed BIM-K framework in real life project.

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APPRAISAL OF THE EXTENT OF BIM INTEGRATION IN FACILITY MANAGEMENT PRACTICES IN ABUJA, NIGERIA.

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The success of organizations in current business environment era depends to a large extent on their information technology power base which they incorporate in their daily processes. Recent studies indicated that facility operations data are maintained separately from design and construction data. BIM, is a concept which creates a physical representation of physical and functional characteristics of a building in an electronic model. BIM plays a very important role in the FM practices such as space planning, asset management etc. as it is becoming a better known established collaboration process in the construction industry. As affirmed by researchers, the ideal situation for the facility management industry to fully adopt the BIM, thus, this research investigates the extent of integration of BIM in FM services and procedures. Data for the study were gathered through review of related literature for secondary data and questionnaire administration as primary data, to assess the extent of integration of BIM in Abuja FM practice. Research findings indicated that most respondent's staff have "fair" knowledge of BIM. Recommendations include; calling for the effective utilization of BIM technology in FM services and procedures while firms should also imbibe the culture of training staffs to acquire the capacity to match these technology. The researchers recommend the correlation of facility management BIM application arears with sources of data and file formats so as to boost interoperability factors.

Keywords: Built Environment, Building Information Modelling, Facility Management, Information Technology, Operation & Maintenance

INTRODUCTION

International Facility Management Association (IFMA) defines Facility Management as a profession that encompasses multiple disciplines to ensure functionality of the built environment by integrating people, place, processes and technology. The multi-disciplinary nature of facility management firms confines the scope of cooperation between work contractors and property owners. Facility management firms habitually drown in waves of documents which are regularly paper based and not often presented in electronic formats. FM include various functions such as strategic planning and asset management, to planning and design, construction management, operations, maintenance and general administrative services (Ellethorpe, 2000).

Building Information Modelling (BIM) is the use of computer generated models to simulate planning, design and construction of projects. BIM as categorised by Associated General Contractors of America (2005) is a data-rich, object-oriented, intelligent and parametric digital representation of a building from which views and data needs can be extracted and analysed to generate information that can be used in decision making and improve service delivery process.

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Building Information Modelling was considered to remedy the problem of defragmentation and error by creating a system to manage building related information. Furthermore, as opposed to traditional data representation formats, Building Information Modelling provides one model for storing all building information and hence enables integrated views which has the prospective to support visualisation and spatial analysis of various maintenance activities occurring in any building (Lee, An & Yu, 2012). Building Information Modelling is one of the most promising recent development in the construction industry and representing a new paradigm in Facility Management practice (Azhar, 2011). The researcher further acknowledged that Building Information Modelling technology enables an accurate virtual model which can be used for planning, design, construction and operation of a facility.

Building Information Modelling is increasingly getting the attention of organisations involved in architecture, engineering and construction as well as the owners and operators of buildings (facility managers and real estate managers inclusive). In a nutshell, it is defined as a digital model representing physical, technical and functional characteristics of a building.

The revolution in building Operation and Maintenance (O&M) is being fuelled by a parallel revolution in Information Technology. These, new technologies have been identified to bring opportunities for optimising facility performance. According to Arayici, Coates, Koskela, Usher & O'Reily (2012) Building Information Modelling is not just a tool but it is a process and software which implements a new way of thinking. Complex building systems and controls increasingly offer opportunities as well as challenges for the profession (Ghosh, Chasey & Mergenschroer, 2015). Thus, the skill of a Facility Management team has to expand to include knowledge about complex system, technology and organisational impacts of BIM. Previous studies have stated the adoption of BIM technologies in many developed nations of the world such as USA, UK, Australia, Singapore, Denmark, Hong Kong (Yan & Damian, 2010; Sebastian & Berlo, 2011) with impressive outcomes, regardless of some challenges. In Nigeria, researchers such as, Olatunji, Gu & Ogunsemi (2010) stressed the need for the full adoption of BIM technologies across all disciplines and geographical boundaries. As affirmed by Sebastian & Berlo (2011), the ideal situation for the facility management industry to fully adopt the BIM process along with sufficient supply of BIM practitioners with various knowledge and skill levels to service the entire industry. Thus, this research seeks to assess the extent of BIM integration in facility management practices in Abuja. The objectives of this study is limited to identifying current BIM application areas in FM and to determine the level of BIM expertise within FM firms.

LITERATURE REVIEW

As BIM becomes widely adopted by the construction industry, it bears undeveloped possibilities for supporting Facility Management (Liu & Issa, 2013). Moreover, they further declared that the Architecture, Engineering, Construction (AEC) industry has raised a good deal of interest surrounding the use of BIM for Facility Management. Although, Akamete, Akinci & Garrett (2010) stated that the opportunities of leveraging BIM for facility operations are compelling but its utilisation in Facility Management is lagging behind if compared to BIM implementation in both design and construction phases.

All facility owners as ascertained by Ghosh et al. (2015) share a common theme in their organisational goals which is ensuring the end users effectively receive the services for which the facility has been designed. Thus, the key role of the Facility Management team is to maintain the facility, optimise operational cost and efficiently manage all systems while assessing its impact on people, and processes within the facility.

According to Yan & Damian (2010) digitalisation of building management information is accompanied with the hope that it is more accessible, accurate and easily communicated. Most of the documented and qualitied benefits of BIM are related to design and production of buildings and there is relatively little hard evidence of Building Information Modelling in Operations and Maintenance (O&M) activities. Ghosh et al. (2015) identified BIM as a medium which supports open access to information when and where required across the Facility Management organisation. Furthermore, it allows the Facility Managers access to information about the facility within minutes, when previously it could take hours of research to obtain same information.

Facility Managers involvement at the design phase of building projects cannot be over emphasized. Furthermore, Liu & Issa (2013) ascertained that in reality, the Facility Management team may not have been set up during the design stage. The integration of BIM to the Facility Management stage of buildings lifecycle cannot be downplayed as it portends a significant boost to maintenance and operations procedures (Torreno, Anumba & Dubber, 2016).

According to Trivedi (2014), BIM experts ease Facility Management by;

i. Identifying the parameters that are needed to keep a track of the lifecycle of a building and its elements.

ii. Create a new parameter and add them to the Building Information Modelling model elements such as different fixtures, rooms, equipment etc.

iii. Now, formulas are built to calculate, keep a track and report the identified Facility Management matric.

iv. Schedules for reporting and easy entry of parameter values for model elements created.

v. When the aforementioned steps are implemented (successfully), the model is now ready and it displays the facility management plan.

Application of BIM in FM

Utilizing BIM for Facility Management, users can successfully explore, record and resourcefully manage the information regarding a facility. The adoption of BIM has been limited to both design and construction phases, Edirisinghe, Kalutara & London (2016) noted less emphasis on its integration with FM services and procedures which is as a result of associated challenges outweighing external and internal motivators. Furthermore, they highlighted most organisations are in the value realisation phase of BIM-based FM practices. Facility Managers cannot only track the space or facility related data and evolving requirement, but also manage the inventory and lifecycle data, identify safety loophole and henceforth enforce occupant safety measures, perform analyses of evolving needs versus the related cost (Trivedi, 2014). BIM application areas in Facility Management are not limited to the following:

i. Access design performance in relation to spatial requirements

Using BIM¸ Facility Managers can analyse the existing spaces and compare them with complex spatial standards and regulations. Furthermore, grave decisions regarding the spatial improvements and other design related improvements that upset the operations and management of the facility can be brought to notice and repeated after significant analysis and approval by all responsible stakeholders (Trivedi, 2014).

ii. Creating as-built physical conditions and assets of a facility

BIM is also used to record the structural, architectural and MEP details of a built facility to serve as a comprehensive documentation of these disciplines of an existing building. An as-built model for Facility Management is also created from the design, construction, 4D coordination models and subcontractor fabrication models (Torreno, Anumba & Dubber, 2016). This according to Trivedi (2014) makes BIM a treasured means which provides complete facility information that can be linked to operations, maintenance and asset data of a facility to enable better management of the facility. As the facility experiences repairs and renovation for changes are made to fulfil spatial requirements, these changes have to be updated in the BIM model to ensure that it contains accurate information about the maintenance history of the facility (Trivedi, 2014).

iii. Preventive maintenance

BIM facilitates tracking and maintenance of all information in relation to buildings structure, architecture and equipment (Torreno et al. 2016). Thus, BIM enables cost effective, timely and efficient maintenance program management.

iv. Analysis of energy utilization

The use of model permits Facility Managers to predict the performance of equipment and systems. It also facilitates the prediction of energy performance of a building while they can further compare such predictions with actual performance (Trivedi, 2014). If it is found that

the performance is not in tally with the prediction, BIM models supports the planning, repairs, modification in operations and proposing systems and material changes to ensure that system and energy performance of the building are at optimum levels (Torreno et al. 2016).

v. Asset management

BIM models can be linked to the building assets database and utilized to support decision-making and planning concerning facility management issues. The implications of upgrading or changing the building assets can be grouped accurately using BIM (Trivedi, 2014). Furthermore, quantity takeoffs of the assets can be produced for financial reports and cost estimation.

vi. Managing spatial requirements

BIM models can be used to efficiently manage existing and evolving spatial requirements of a building. Allocation and management of resources and space within a facility based on the requirements is a process enabled by BIM (Trivedi, 2014). This is due to its capabilities to furnish a Facility Management work detailed space information for both new and retrofit buildings.

vii. Disaster planning and management

Emergency responders such as fire fighters, technical rescue, police and emergency medical service (just to mention a few) can get access to critical information about a building using BIM models. These models can be utilized to enable informed decisions and hence deliver better response to situations and also reduce safety risk to occupants of a building (Torreno et al. 2016). BIM models can also be used to effectively locate emergency areas within a building and to gauge other surrounding dangers, thus it enables planning the best way to counter and contain disaster.

METHODOLOGY

The research is a quantitative study due to its aim, objectives and nature of data acquisition. A quantitative research is a type of research method that requires a quantifiable data involving numerical and statistical explanation. A well-structured questionnaire was used to collect data from respondents regarding the study area of interest. The population selected were facility management firms within Abuja. Non-random purposive sampling technique was adopted for this study due to the adequate knowledge of the samples in terms of FM services. Purposive sampling which is known as non-probability sampling was adopted for this research. This involves the deliberate selection of Thirty-three (33) facility management firms within Abuja, Nigeria, to constitute the sample size for this research work. Adding 10% of 30 for non-responsiveness = 3

30 + 3 = 33

The analysis of data collected from the questionnaire was done using Statistical Product and Service Solution (SPSS) tool. Descriptive statistical method of analysis i.e frequency distribution, pie chart, bar chart and percentage were extensively used in the analysis of the questionnaire. Aroha (2006), conferred that the employment of descriptive data analysis is useful in discerning patterns which are not apparent in the raw data.

RESULTS AND DISCUSSION

4a. Staff Level of BIM Knowledge

Staff level of BIM knowledge was measured against a scale of: 1-None, 2-Some knowledge, 3-Fair and 4-Competent. Results revealed that 30.8% of staffs from respondents firm poses a “Fair” knowledge of Building Information Modelling while 23.1% indicated “Competent” knowledge of Building Information Modelling. 26.9% and 19.2% indicated “Some knowledge” and “None” respectively. Results are as depicted in Table 1. This table reveals the average BIM knowledge levels of respondents firm.

Table 1: Level of staff BIM knowledge

Knowledge Level	Frequency	Percent	Cumulative Percent
None	**5**	19.2	19.2
Some Knowledge	7	26.9	46.2
Fair	8	30.8	76.9
Component	6	23.1	100.0
Total	**26**	**100.0**	

Source: Researcher's Field survey (2016).

4b. Number of Years of Firm's BIM Usage

As depicted by the Figure 1 above, 12 respondents indicated that they have been using Building Information Modelling within the past "0-5years". Eight (8) respondents ascertained to its usage within the past "11-15years". Four (4) and Two (2) indicated "6-10years" and "Above 15years" respectively. Akamete et al. (2010) stated that the opportunities of leveraging Building Information Modelling for facility operations are compelling but its utilisation in Facility Management is lagging behind if compared to Building Information Modelling implementation in both design and construction phases. This result clearly indicates that Building Information Modelling is an infant concept in terms of adoption and integration in Facility Management operations in Nigeria.

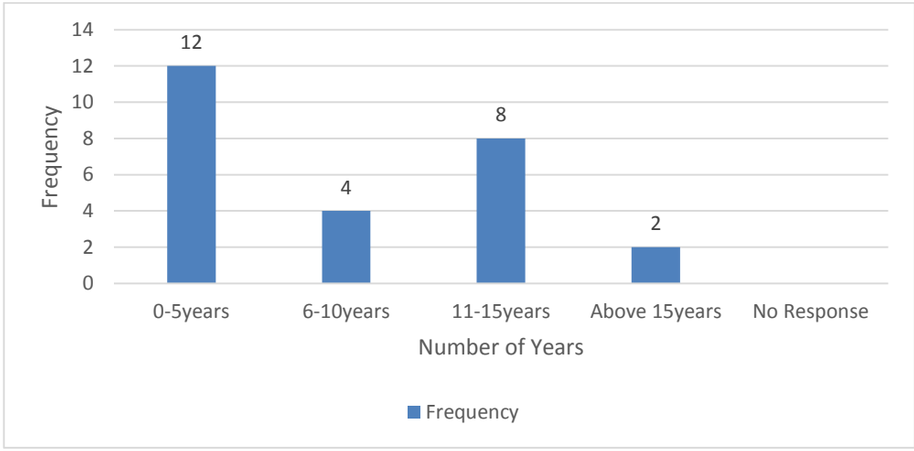

Figure 1: respondents Years of BIM Usage **Source:** Researcher's Field survey (2016).

4c. Facility Management Application Areas Integrated with BIM

The focus of Building Information Modelling is to create and reuse consistent digital information by stakeholders through the building's lifecycle. Although, researchers such as Akamete et al. (2010) argued that the utilisation of Building Information Modelling in facility management is lagging behind, one cannot downplay its integration in facility management as it means a noteworthy boost to both maintenance and operations procedures of buildings (as ascertained by Torreno et al., 2016,).

This research reveals that 42.3% of facility management firms utilises BIM to "Locate building components". 34.6% of respondents uses BIM in "Space management/planning" while 30.8% and 26.9% indicated its integration with "Asset management" and "Property management", respectively.

Table 2: Facility Management services integrated with BIM

Facility Management Application Area	Frequency	Percent
Locating building components	**11**	42.3
Checking maintainability	6	23
Emergency management	1	3.8
Space management/planning	9	34.6
Creating digital assets	3	11
Preventive maintenance	1	3.8
Property management	7	26.9
Support services	4	15
Asset management	8	30.8
Managing spatial requirements	2	7.7
Construction sequencing	2	7.7
Cost estimates	3	11
Project schedule	4	15

Forensic analysis	1	3.8
Material inventories	5	19
Geographic information	3	11

Source: Researcher's Field survey (2016).

4d. Building Information Modelling Proficiency Level

Building Information Modelling is not just a tool but it is a process and software which implements a new way of thinking. Complex building systems and controls increasingly offer opportunities as well as challenges for the profession (Ghosh et al. 2015). Thus, the skill of a Facility Management team has to expand to include knowledge about complex system, technology and organisational impacts of Building Information Modelling. Building Information Modelling proficiency training should be designed to meet the firms required skill levels. In addition, firms should adequately match their identified training programs with their staff(s) job description. Fifteen (15) respondents indicated "professional level" of training to be most suitable for their staff. While Eight (8) indicated "Intermediate level" and just a single respondent indicated "Learner level" and "Beginner level" respectively.

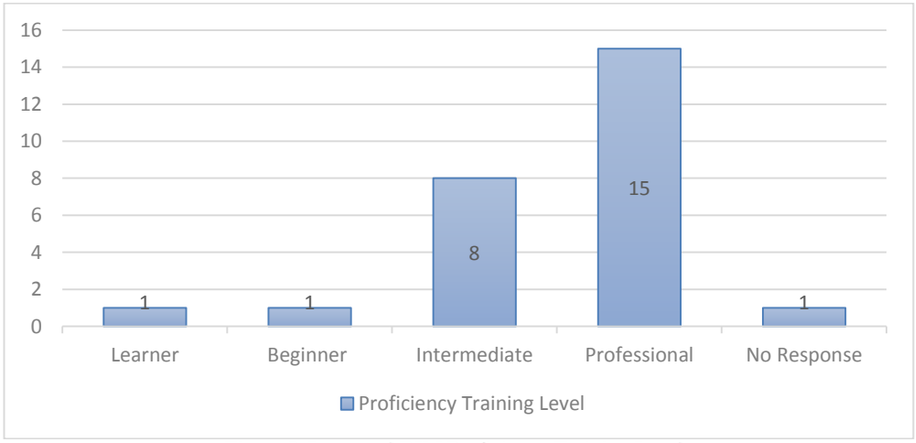

Figure 2 Suggested BIM Proficiency Training Levels

Source: Researcher's Field survey (2016).

CONCLUSION

Previous researches conducted by numerous researchers indicated the effectiveness of BIM technology in the design and construction phases of buildings. However the need to expand BIM utilization beyond these phases and integrate it with FM operations and procedures can not be over emphasized as BIM model is a real building information model which is data rich for different stakeholders and can be utilized at different phases of a facility's lifecycle. Based on the findings of this study, the researchers conclude that FM firms should constantly imbibe the culture of catching-up with technological trends in the industry. Research findings indicate a poor level of BIM integration in FM practices and lack of sufficient proficiency skill level. This research highlights that much work and effort still need to be put in place by industry practitioners for utmost utilization and benefits of BIM based FM practice as research findings indicated that most firms poses a fair level of BIM expertise. This can be achieved via matching appropriate FM application areas with software tools as well as train their respective staffs to acquire skills and expertise thus improving quality of services rendered and data management.

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EVALUATION OF BUILDING INFORMATION MODELLING (BIM) SOFTWARE CAPABILITIES THAT SUPPORT QUANTITY SURVEYING PRACTICES IN NIGERIA

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The accurate and computable nature of Building Information Modelling (BIM) provides a more reliable source for owners to perform quantity take-off and estimating and provides faster cost feedback on design changes. This is important because the ability to influence cost is highest early in the conceptual and preliminary phase of a construction. This paper was aimed at Evaluating BIM Software Capabilities that Support Quantity Surveying Practices in Nigeria. The research adopted a quantitative research approach with the use of questionnaires as instrument for data collection. The target population was Quantity Surveying firms in Abuja and Kaduna, of which we have 145 registered Quantity Surveying firms; 80 number of questionnaires were administered and a total number of 47 were retrieved (59% retrieved). The data were analysed using descriptive statistical analysis to obtain mean values. The research identified data storage, data updating, and automatic take-off as BIM features in Quantity Surveying practice that are completely supported by the various software. It was recommended that The Nigerian Quantity Surveying firms should adopt BIM-based software in project delivery because it helps the few firms that have adopted it in achieving some benefits that the traditional drafting tools could not help them to achieve.

Keywords: BIM, BIM function, Software Capabilities, Quantity Surveying Practices.

INTRODUCTION

Building information modelling (BIM) is revolutionizing the construction industry and becoming the de facto standard to manage all the activities of the industry (Bilal *et al*., 2016). BIM is an integration of process and technology to enable the efficient life-cycle management of facilities from inception to demolition. It is a digital integration of previously disparate processes and technologies that allows organizations to support physical and functional requirements in the form of visualisation. BIM is a virtual representation of a building, potentially containing all the information required to construct the building, using computers and software (Succar, 2009). Hence, new technologies are offering the lure of simplifying processes and providing immediate benefit; thus, BIM technology is providing the means to deliver a better product for facility owners alongside wide-ranging impacts for the construction industry (Sattineni & Bradford, 2009). The key benefit of BIM is its accurate geometrical representation of the parts of a building in an integrated data environment (CRC Construction Innovation, 2007). Other related benefits are: Faster and more effective processes, better designs, controlled whole-life cycle costs and environmental data, better production quality, better customer service and lifecycle data (Ahzar *et al*., 2008). More so, Building Information Modelling (BIM) is a task-specific application that produces a specific outcome, such tools are those for model generation, drawing production, specification writing, cost estimation, clash and error detection, energy analysis, rendering, scheduling and visualization (Eastman *et al*., 2011).

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For Quantity Surveying (QS) profession, BIM presents huge challenges and opportunities, particularly in cost estimating and quantity take-off (Wu *et al*., 2014). Traditionally, the role of quantity surveyors has been mainly associated with the functions of estimating and cost planning, procurement advice, measurement, preparation of Bills of Quantities (BOQ) and tender documentation, construction cost control, and preparation of valuations, payments, contractual claims and final accounts (Ashworth and Hogg, 2007). By traditional, it means a manual process, which is very prone to errors and time consuming.

Consequently, Building Information Modelling is widely discussed in the construction industry, but there have been very few implementations for cost estimating. However, an evaluation of the capabilities BIM software in quantity surveying practice has not been undertaken.

Building Information Modelling

BIM has changed the way industry professionals worldwide think about how technology can be applied to building design, construction and management. BIM is defined as the use of ICT technologies to streamline the building lifecycle processes to provide a safer and more productive environment for its occupants, to assert the least possible environmental impact from its existence, and to be more operationally efficient for its owners throughout the building lifecycle (Arayici and Aouad, 2010; Sidawi, 2012).

In other words, Building Information Modelling (BIM) represents the process of development and use of a computer-generated model to simulate the planning, design, construction and operation of a facility. The resulting model, a Building Information Model, is a data-rich, object-oriented, intelligent and parametric digital representation of the facility, from which views and data appropriate to various users' needs can be extracted and analysed to generate information that can be used to make decisions and to improve the process of delivering the facility (Associated General Contractors, 2005; Ahzar *et al.*, 2008).

Similarly, BIM in most straightforward terms is the usage of a database infrastructure to encapsulate built facilities with specific viewpoints of stakeholders (Eastman *et al*., 2011).

BIM SOFTWARE

1. Solibri Model Checker (SMC)

SMC is not a BIM authoring tool or cost estimating tool, but a model checking application that helps to verify and determine the quality of BIM models produced by the architect/engineer using specific set of rules. SMC was initially introduced to the industry with functions mainly to perform quality checks to BIM models, including visualisation navigation and presentations compilation (Khemlani, 2011).

a) **Model information exchange**

SMC only supports BIM models in IFC and DWG formats, which in this case, the Revit model must be exported or converted into IFC or DWG format prior to being opened in the SMC application. However, IFC model format is found to be better option than DWG as it supports interoperability and allows conversion and merging of most information from BIM model into one single format rather than having it all split up into different DWG files.

b) Model visualisation

SMC supports visualisation of the BIM models effectively like the visualisation in BIM authoring tools. It provides the view of the 3D graphics of the model, the model tree – which shows all the object attributes within the model, and the information about the selected component. SMC also allow users to navigate and explore around the models using the elements breakdown in the model tree and the navigation map on the bottom right hand corner. It automatically zooms up to the selected objects in the model when any component is chosen in the model tree (Khemlani, 2009).

c) Quantification Process

SMC Information Take off depends upon the use of classifications and definitions to decide the type of information to be extracted from the model and to create structures and organisation to the data within the BIM model prior to quantity take-off process. SMC supports the flexibility of making changes to its standard built-in classifications to suit the users' requirements, so that the components can be restructured to the desired category, i.e. NRM category, and information extracted will be more accurate.

d) **Reliability of information production**

To make sure the BIM models produced by designers are up to the desired standards, SMC is an effective application to help Quantity Surveyors to perform checks before the quantification process. Users can either select from the range of parameters/rules/standards pre-defined in the application to perform checks to the model or customise the rules based on their preferences and purpose.

e) Change management/revision control

SMC generally does not support automatic updates of BIM models as there is no bidirectional links between Revit and the external application. However, if the revised BIM model is manually loaded into the application in IFC format, SMC has the features of enabling automatic identification and locating of any alterations made to the model while retaining unchanged information within the model (Corke, 2013).

f) **Report generation and export**

SMC enables export of taking off results into Excel files with the choice of standard templates available in the system, e.g. area calculations, building elemental quantities etc to match with the results. In Excel, users can then modify the layout of the report generated, e.g. add in rows to create the level structures for NRM format, add in columns to input rates and prices to generate cost estimates**.**

2. Autodesk quantity take-off (QTO)

a) Model information exchange

Autodesk QTO can create take-offs from a variety of file formats, regardless whether it is 2D drawing or 3D model format. However, the original Revit file is not directly supported. Alternatively, Revit BIM model can be brought in through 3D DWFx and DWF file to fully integrate with the application.

b) Model visualisation

The visualisation capability in Autodesk QTO mainly involves the basic model navigation features such as pan, select, zoom and rotate. These features enable users to easily explore and identify their required viewing position and location around the BIM model. Like other estimating tools, Autodesk QTO supports adjustments of objects visibility and transparency based on building elements to allow precise inspection of the BIM model and increase the accuracy of quantity take-off process.

c) Quantification Process

Autodesk QTO supports automatic measurement of the entire BIM model. However, it is not a fully automated process on the first time using take-off tool in this software, Autodesk QTO does not have the ability to automatically define the types of measurement or assign the objects to the required assembly to extract the correct quantity and create a valid take-off.

d) Reliability of information production

As part of the Autodesk product family, it is claimed by Alexander (2010) that it provides great level of integration with Revit model. However, Autodesk QTO which solely operates as cost estimating software does not contain any checking feature that helps to assess and examine the quality of information within the BIM model.

3. Exactal costX software

CostX, first produced by an Australian based software developer in 2004, claimed itself to be a powerful estimating tool that promotes BIM based cost management by enabling full integration of 2D and 3D digital design data with cost estimates (Day, 2008; Exactal, 2010). Day (2008) explained that CostX enables the capture and extraction of BIM information, e.g. object properties, dimensions, descriptions and etc; all in a single platform, including electronic measurements, spreadsheet calculations and estimates.

a) Model information exchange

CostX provides integration with Revit BIM model not only through 3D DWF and DWFx file; but also, IFC file format. Besides 3D file format, CostX can also read design information from 2D images, e.g. JPEG, BMP, JPG and standard industry 2D drawing formats, e.g. PDF,

DWG etc. Whichever file format is used, they all require users to go through model conversion process using Revit's internal export feature

b) Model visualisation

CostX provides an excellent visualisation of the BIM model like Revit. The drawing manipulation tool gives the ability to easily rotate, pan, zoom, spin and navigate around the model. The navigation button on the top right-hand corner helps to identify the position of the model views and secure the desired viewing perspective in any angle.

c) Quantification process

Quantification process in CostX is simple and does not require in-depth technical knowledge or CAD experience to operate (Day, 2008; Exactal, 2010). CostX is capable for both automatic and manual take-offs under the same working process; by means of capturing dimensional properties from BIM objects and classifying them into dimension groups and folders. CostX allows users to decide whether to quantify the model completely or partially, through manipulating the visibility of BIM objects within the dimension viewing tab.

d) Reliability of information production

Quality and content of a BIM model can be validated and assessed quickly and thoroughly using CostX. CostX can perform quick and effective tests to check and identify any unmeasured objects or possible duplications. Besides visual on-screen checking, CostX allows users to view all the items within the model which have been quantified through colour codes and labels.

4. BIM measure

BIMmeasure is the Building Information Modelling component in the Causeway's CATO Enterprise suite. It adds dynamic and automated measurement from BIM model to the pre-existing functionality of CADMeasure. BIMmeasure enables users to incorporate multiple modelling and drawing files in a single session and the integration of BIMmeasure with other modules in the CATO suite allows costs to be planned simply and effectively for BIM based project.

a) Model information exchange

BIMmeasure supports variety of the drawing format, such DWF, DWFX, IFC, PDF, and several image formats. BIM model from Autodesk Revit needs to be exported as DWF, DWFX or IFC file formats. In this review, DWFX file format was used. IFC file is also tested; opening IFC model took significant longer time than the DWFx model as the size of the IFC file is much larger. There are also several discrepancies on the model elements between the IFC model and DWFx model. It is mainly due to the exporting process in Revit. In our experiment, the DWFx format worked more smoothly.

b) Model visualisation

BIMmeasure provides good visualisation capability; it can easily rotate, pan, zoom, and navigate around the model. Model highlighting features (highlight, standout, isolate) are also very useful while investigating individual item or a group of items. The model content window on the left and property window on the right provides a good visual interface for users to interrogate the model during the quantification process.

c) Quantification process

The quantification process in the BIMmeasure is simple and user-friendly. The user can create the measurement element by element, or by using the dynamic measurement tool based on the element type or object property. The element quantity information is extracted from the BIM model element, so no manual measurement is required.

d) **Report generation and export capabilities**

All the measurements or quantities created in BIMmeasure can be exported in Excel and CATO format, the reporting facility is primarily provided through CATO suite.

CAPABILITIES OF BIM

BIM capability in this study is defined as the ability of BIM to perform tasks in quantity surveying practices to enhance their job performance through BIM adoption.

STAGE 1: Preparation stage

At this stage, QSs undertake feasibility studies by preparing cost appraisal to determine the initial building cost. Clients need professional cost advice from QSs to determine and assess the viability and feasibility of undertaking the project.

STAGE 2: Concept design

After establishing the cost range at the feasibility stage, the design team starts to develop the design in more detail at this stage. The task of QSs is to provide a more comprehensive cost estimate based on the developed design and scope of work. QSs begin to prepare the first structured cost plan; preliminary cost plan which aims to confirm the budget determined at the feasibility stage.

STAGE 3: Developed design

At this stage, design progressively develops as more detailed information becomes available. QSs conduct further cost studies and estimates to update the cost plan that is presented in an elemental cost format, stating the specific construction materials, finishes, specification, with elemental unit rates and quantities. It is noted that drawings, details and specifications from designers are important in this stage for QSs to perform detailed cost estimation.

STAGE 4: Technical designs

Bills of quantities (BOQ) preparation remains an important service provided by QSs at this stage. It is noteworthy that quantity take-off is tedious and time-consuming task during BQ preparation. It takes up a lot of the QSs' time, focus and attention to count as well as measure each item in the drawing. Automatic quantity take-off is one of the BIM capabilities that help to simplify and remove routine and drudgery that comes with this task.

BIM FEATURES

Object parametric modelling

Parametric modelling is the form of modelling done using parametric objects. A parametric object or component is an object or component that permits a (usually limited) choice of values for defined parameters.

A parameter is a variable value (as in mathematical equation) that when it changes, gives different but related characteristics to the original object.

Interoperability

Exchanging data seamlessly among these applications is key to successful project delivery. Interoperability is the ability of a software product to exchange data with heterogeneous software products to streamline and/or automate workflows. Since a higher level of coordination and collaboration is conceived as essential for successful project delivery, interoperability of the underlying software has a pivotal role in achieving this greater level of coordination and collaboration.

Bi-directional associativity

Geometric data is essential for graphical representation of building objects, a large number of supplementary data – including dimensions, quantities, relative locations, schedules, and specifications – are required for different analytical and evaluation purposes.

Visualization

Visualization combines interactive visual techniques for data analysis with human background knowledge, intuition, and creativity to discover latent trends in support of effective decision-making. In the context of construction, essential aspects of the building model are visualized and better understood in terms of potential issues, so that the right decisions are taken to resolve them prior to any fieldwork. Although visualization is relevant throughout the life-cycle of building, it is of immense importance. It could be helpful in the following ways:

Data

A single BIM database would contain all the relevant data required to predict and minimize construction waste and for large data storage. As such, access to a diverse range of data sources pertaining to design, procurement, and construction is essential. In addition to this, supporting the domain knowledge is integral to understanding the context of the data and allowing semantic reasoning for the precise analysis and estimation of construction.

Design

Clear 2D design and most of the construction and demolition waste is due to design changes, lack of dimensional coordination, and standardization of materials. The process of waste minimization requires trying out different design alternatives and choosing the ones with lower waste outputs. The design changes proposed in response at later stages of the project tend to result in reworking and ultimately lead to material and time wastage.

RESEARCH METHODS

The research approach adopted for the research work was quantitative method. This is because previous studies of similar nature adopted this method and because of the nature of the research question that the study seeks to answer, "what are the BIM features that support Quantity Surveying practice". The research adopted the use of a well-structured questionnaire, which was developed from literature. The choice of questionnaire is attributed to the fact that respondents would have time to thoroughly check the questions before responding to them. The target population was the entire practicing Quantity Surveying firms resident in Abuja and Kaduna state. Simple random sampling was adopted as the sampling technique. In the Simple random sampling method, each unit included in the sample has equal chance of inclusion in the sample. This technique provides the unbiased and better estimate of the parameters if the population is homogeneous (Singh & Masuku, 2014). The sample was selected from the total registered Quantity Surveying firms in Abuja and Kaduna state using the formula of (Kish, 1965). The practicing Quantity Surveyors were the target of the research. There are 145 numbers of registered Quantity Surveying firms in both Abuja and Kaduna (Vconnect, 2016).

The data collected was analysed with the aid of descriptive statistics.

RESULTS AND DISCUSSION

The following are BIM features as identified by Bilal *et al.,* (2016). Using a scale of 1 - 4, where **1 = "Low importance"**, **2 = "Moderate importance"**, **3 = High importance"**, **4 = "Highest importance"**.

Table 1: Cost Appraisal

BIM Features	Mean	Std. Deviation
Large Data Storage Capacity	3.17	0.60
Parametric Modelling	2.81	0.65
Clear 3D Visualisations Of All Views And Approaches	2.81	0.68
Ability To Create 2D Designs	2.64	0.71
Bi-Directional Associativity	2.51	0.62

Source: Field Survey (2016)

Table 1 shows the responses from the various respondents as to the BIM features that support quantity surveying practices in Nigeria for Cost Appraisal. Based on the mean obtained on cost appraisal, large data storage tops the group with a mean of 3.17 and a standard deviation of 0.60. The last which is bi-directional associativity has a mean of 2.51 and a standard deviation of 0.62.

Table 2: Cost planning

BIM features	Mean	Std. Deviation
Holistic	3.38	0.57
Life cycle design	3.32	0.72
Large data storage capacity	2.89	0.73
Parametric modelling	2.68	0.59
Clear 3D visualization of all views and approaches	2.62	0.85
Bi-Directional Associativity	2.45	0.58

Source: Field survey (2016)

Table 2 shows the responses from the various respondents as to the BIM features that support quantity surveying practices in Nigeria for Cost planning. Based on the mean obtained on cost planning, holistic tops the group with a mean of 3.38 and a standard deviation of 0.57. The last which is bi-directional associativity has a mean of 2.45 and a standard deviation of 0.58.

Table 3: Cost estimate

BIM features	Mean	Std. Deviation
Large data storage capacity	3.28	0.62
Ability to create 2D designs	2.96	0.78
Clear 3D visualisation of all views and approaches	2.91	0.69
Parametric Modelling	2.81	0.65
Bi-directional Associativity	2.68	0.73

Source: Field survey (2016)

Table 3 shows the responses from the various respondents as to the BIM features that support quantity surveying practices in Nigeria for cost estimate. Based on the mean obtained on cost estimate, large data storage tops the group with a mean of 3.28 and a standard deviation of 0.62. The last which is bi-directional associativity has a mean of 2.68 and standard deviation of 0.73.

Table 4: Data storage

BIM features	Mean	Std. Deviation
Interoperability	3.11	0.64
Parametric Modelling	3.04	0.66
Large data storage capacity	2.98	0.64
Bi-directional Associativity	2.83	0.70

Source: Field survey (2016).

Table 4 shows the responses from the various respondents as to the BIM features that support quantity surveying practices in Nigeria for data storage. Based on the mean obtained on data storage, interoperability tops the group with a mean of 3.11 and a standard deviation of 0.63. The last is bi-directional associativity which has a mean of 2.83 and a standard deviation of 0.70.

Table 5: Data updating

BIM FEATURES	Mean	Std. Deviation
Large data storage capacity	2.94	0.67
Interoperability	2.83	0.60
Parametric Modelling	2.74	0.61
Bi-Directional Associativity	2.57	0.65

Source: Field survey (2016).

Table 5 shows the responses from the various respondents as to the BIM features that support quantity surveying practices in Nigeria for data updating. Based on the mean obtained on data updating, large data storage capacity tops the group with a mean of 2.94 and a standard deviation of 0.67. The last is bi-directional associativity which has a mean of 2.57and a standard deviation of 0.65.

Table 6: Automatic take-off

BIM features	N	Mean	Std. Deviation
Clear 3D visualisation of all views and approaches	47	3.55	0.50
Large data storage capacity	47	3.40	0.57
Parametric modelling (quantities)	47	3.32	0.56
Ability to create 2D designs	47	3.26	0.71
Bi-Directional Associativity	47	3.21	0.66

Source: Field survey (2016)

Table 6 shows the responses from the various respondents as to the BIM features that support quantity surveying practices in Nigeria for automatic take-off. Based on the mean obtained on automatic take-off, clear 3D visualisation of all views and approaches tops the group with a mean of 3.55 and a standard deviation of 0.50. The last which is bi-directional associativity has a mean of 3.21 and standard deviation of 0.66.

Table 7: Cost checking

BIM FEATURES	Mean	Std. Deviation
Lifecycle	3.30	0.69
Holistic	3.15	0.75
Clear 3D visualisation of all views and approaches	2.96	0.66
Parametric Modelling	2.85	0.65
Ability to create 2D designs	2.74	0.64
Bi-Directional Associativity	2.70	0.62

Source: Field survey (2016)

Table 7 shows the responses from the various respondents as to the BIM features that support quantity surveying practices in Nigeria for Cost checking. Based on the mean obtained on

cost checking, lifecycle tops the group with a mean of 3.30 and a standard deviation of 0.69. The last which is bi-directional associativity has a mean of 2.70 and a standard deviation of 0.62.

Table 8: Reflecting design changes

BIM FEATURES	Mean	Std. Deviation
Clear 3D visualisation of all views and approaches	3.11	0.70
Large data storage capacity	3.04	0.69
Parametric Modelling	3.02	0.68
Bi-Directional Associativity	2.83	0.73
Ability to create 2D designs	2.83	0.70

Source: Field survey (2016)

Table 8 shows the responses from the various respondents as to the BIM features that support quantity surveying practices in Nigeria for reflecting design changes. Based on the mean obtained on reflecting design changes, clear 3D visualisation of all views and approaches tops the group with a mean of 3.11 and a standard deviation of 0.70. The last which is ability to create 2D designs has a mean of 2.83 and standard deviation of 0.70.

ASSESSMENT OF BIM FEATURES AND THEIR SOFTWARE THAT SUPPORT QUANTIITY SURVEYING PRACTICE

Table 9: Assessment of BIM features and their software

BIM features that support QS practice	Software	Percentages
Cost Appraisal	Solibri model checker	100%
	AQTO	100%
	COSTX	100%
	BIMmeasure	60%
Cost Planning	Solibri model checker	100%
	AQTO	100%
	COSTX	66.6%
	BIMmeasure	100%
Cost Estimates	Solibri model checker	100%
	AQTO	100%
	COSTX	71.4%
	BIMmeasure	100%
Cost Checking	Solibri model checker	83.3%
	AQTO	100%
	COSTX	100%
	BIMmeasure	100%
Data Storage	Solibri model checker	100%
	AQTO	100%
	COSTX	100%
	BIMmeasure	100%
Data Updating	Solibri model checker	100%
	AQTO	100%
	COSTX	100%
	BIMmeasure	100%
Auto Take-off	Solibri model checker	100%
	AQTO	100%
	COSTX	100%
	BIMmeasure	100%
Reflecting design changes	Solibri model checker	100%
	AQTO	60%
	COSTX	100%
	BIMmeasure	60%

The result of the assessment shows that data storage, data updating, and automatic take-off had 100% support of the various software. Also cost checking had 100% support, except that of solibri model checker with 83.3%, followed by cost estimate that had almost 100% except that of costX with 71.1%. Then cost planning also had 100% supports except for costX with 66.6%. And lastly, cost appraisal and reflecting design changes had nearly 100% except BIMmeasure for cost appraisal with 60%, and AQTO and BIMmeasure with 60% both.

This shows that all the four software namely; Solibri model checker, AQTO, COSTX, and BIMmeasure had 100% supports for data storage, data-updating, and automatic take-off. Therefore, the implication of the result shows that the above-named features are predominantly used for supporting Quantity surveying practice.

CONCLUSION

This research evaluated the capabilities of the BIM software that support quantity surveying practice in Nigeria with a view of evaluating the BIM features that support quantity surveying practice. The research identified and discussed 9 BIM features; object parametric modelling, design, visualization, data, holistic, lifecycle, interoperability, bi-directional associativity –from literature review. These features were categories into eight different layers. The research evaluated the existing BIM software products in terms of support for these features. Hence, it can be concluded that there are a number of BIM based Quantity Surveying tools available in the market and choosing the most appropriate tool is significant for the QS firms since different tools are designed by different software developers to best perform certain BIM Features. A list of 9 BIM features has been identified.

The study recommends that the Nigerian Quantity Surveying firms should adopt BIM-based software in project delivery because it helps the few firms that have adopted it in achieving some benefits that the traditional drafting tools could not help them to achieve.

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BUILDING INFORMATION MODELLING (BIM) AS IT RELATES TO THE CONSTRUCTION INDUSTRY: A REVIEW

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Due to the numerous steps, complication and extensive structure of construction industries; errors and reworks often happen during building construction. As such, Building Information Modelling (BIM) is regarded as a beneficial tool in minimizing the waste and improving the efficiency of building construction. BIM is a model-based design concept, in which buildings will be built virtually before they get built out in the field, where data models organized for complete integration of all relevant factors in the building lifecycle which also manages the information exchange between the Architects, Engineers & Contractors (AEC) professionals, to strengthen the interaction between the design team. It is a digital representation of physical and functional characteristics of a building. The paper reviews and summarizes a substantial amount of requisite information relating to BIM from past works, as it affect the construction industries.

Keywords: Building, BIM, Construction, Information, Modelling

1.0 Introduction

Building Information Modelling (BIM) is the documentation process consisting of information about different phases of any project like design, construction planning, construction, facility management and operation. It is one holistic documentation process beneficial for operational visualization, and construction application such as estimating, scheduling and design coordination. The main advantage of implementing BIM application is the visual coordination of the building systems such as MEP (Mechanical, Electrical, and Plumbing) systems and it also identifies the possible conflicts between the building systems. By detecting the conflicts, problems can be resolved before actual construction which in turn saves money and time invested, (Damian, Han Yan and Peter, 2008).

Building Information Modelling (BIM) is a new technology in the field of CAD, which contains not only geometric data, but can accommodate great amount of engineering data over the lifecycle of a building (Xudong and Jie, 2007). It simulates the construction of the building in a virtual environment. BIM assists planners in making crucial decisions by enabling visualization of the details of the prospective work at any specified time (Chau et al., 2004). When a project is planned and built virtually, most of its relevant aspects can be considered and communicated before the instructions for construction are finalized (Li et al., 2006).

According to Khemlani (2010), BIM is a revolutionary technology that goes well beyond the design phase to impact construction and lifecycle management of the project. BIM can be used in the preconstruction phase in cost and quantity estimates, and in integration and coordination among building components and their scheduling data. It can also be used as a life cycle information management process for safety planning (Sulankivi et al., 2010).

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The paper reviews and summarizes a substantial amount of requisite information relating to BIM from past works, as well as, gives the knowledge about BIM usage in Construction industry.

BIM Concept

A shift in process and expectation is happening in the construction market following the economic bloom and gloom, and architects are stepping up to the challenge. The focus is shifting from traditional 2D based to a practical reality with respect to functional, economic, energy. All disciplines involved with a project can share a single database. Architecture, structure, mechanical, electrical, infrastructure, and construction are tied together and challenge to coordinate them is unprecedentedly possible.

Energy analysis can be done at early stage of design, and construction costs are becoming more predictable. BIM allows use of a parametric 3D model to auto generate traditional building documents such as plans, sections, elevations, details, and schedules. Drawings produced using BIM supported software's are not of manually coordinated lines, but interactive representations of a model. The changes made in this Model are automatically coordinated throughout the project, which eliminate the coordination mistakes, improve overall quality of the work. There are many modelling software packages in the fields which have excellent application for conceptual level models, but these models do not have the ability to document a building design for construction.

BIM and CAD

The main differences between BIM and Computer Aided Design (CAD) is that, CAD system is usually 2D document, which are created separately and have no intelligent connection between separately created documents. In CAD, two lines represent a wall. While in BIM, wall is created in the form of an interactive tool, which has its own properties like width, height, bearing or non-load bearing virtue, demolished or new, interior or exterior, fire rating, and materials (such as boards or brick). The BIM platform assembles all information into one location and cross-links that data among associated objects. There is no linkage between the data created by CAD. Efficiency of BIM in comparison to CAD is being referred in Table 1.

Table 1: The Efficiency Difference between CAD and BIM Applications for a Particular Project in Different Phases

Task	CAD (Hours)	BIM (Hours)	Hours Saved	Time saving
Schematic	190	90	100	53%
Design development	436	220	216	50%
Construction documents	1 023	815	208	20%
Checking and coordination	175	16	159	91%
Totals	1 824	1 141	683	

Source: Rick Rundel (2007)

Benefits of using BIM

The many benefits of BIM during design, planning and construction (Ravetz, ND; O'Connor et al., 2004) have been studied both by practitioners and academics but for building operations and facilities managers, BIM is still a relatively new topic: its potential is still not fully understood and there is little interest regarding what happens once the building model is completed and handed over, and how BIM will be used to manage the facility beside the possible use for enhanced building maintenance (Eastman et al., 2011).

Many of the BIM advantages are observed as direct advantages; however the largest advantages really are the indirect advantages. The direct advantages include qualities, for instance the enriched imagination, conception and the concentration of building information in the project. In contrast, the indirect advantages are the essential for cooperation and giving the best result for project understanding, and reducing the project risk. Simulations authorize us that a design be planned checked virtually before the real project is constructed. A model can help us to have a visualization of the project. This visualization provides stimulation view in concerning the project needs that help to describe the project in an effective manner (Willem, 2008).

The three main BIM benefits, which have been organized, are the elimination, visualization, and collaboration. There is actually much overlap amongst these classifications, but they have been selected as the principal thought around which all the advantages can be better realized. Firstly, visualization mainly indicate the advantages for the improvement and an individual's personal realization as a consequence of utilizing the BIM. Secondly, collaboration can be the cooperative behavior of some members in the team as the BIM is encouraging and facilitating it. Finally, elimination refers generally project-related advantages, for example decreasing the waste, risk, and conflicts (Willem, 2008).

Richard and John (2009) stated in brief some advantages of BIM:

- Complex details can be surveyed and analyzed.
- The different trade components coordination can be reviewed for potential "hits."
- Sequence of placing a project with each other is expanded.
- The 4D, which added time, can be merged to demonstrate how quickly a project can be put together.
- The best routing could be reviewed for pipes, lights, ductwork wires, cables, and sprinklers.
- The site preparations with the hoists and cranes location can be analyzed.
- Lift schedules would be determined for the steel, concrete, and huge mechanical and electrical equipment placement.
- Developing the schedules and the associated argument will be expanded.
- Problems of potential safety would be evaluated.
- Alternatives can be assessed in more realistic terms.

BIM for Architects and Engineers

During the design stage, there is collaboration between design team, engineers and technical specialist's consultants which involves providing the proper project information relating to design, its use and context to the specialists to review and gaining advice for changes (Chuck et al, 2008). This aforementioned collaboration sometimes is considered as new service that can be grouped into two following areas:

- Concept design development.
- Integrating design with construction leading to improve coordination between the project members such as structural, mechanical and electrical engineers.

REVIEW ON BUILDING INFORMATION MODELLING (BIM)

The preliminary search terms were comprehensively evaluated to identify the most suitable search terms. Based on the stated objectives, the following terms were used to search the relevant papers in online databases: 'BIM', 'Construction', 'BIM in construction industries', 'BIM Application'. All articles were identified and retrieved from the online databases. The articles searched on the databases were published in the period 2012 to 2016. The screening and selection of the papers was done based on their titles, abstracts and conclusions. Table 2 shows the summary of the selected BIM papers as they relate to the various sections of the construction industries.

Various papers discussed the usage of Building Information Modelling (BIM) and its application in different places in the construction industry. These papers include: David et al. (2012), Ramesh and Helen (2013), Emad et al. (2014), Dooyong and Heesung (2014), Carbonari et al. (2015), Mojtaba et al. (2015), Abdulkadir and Godfaurd (2015), Maggie and Issam (2016), Pawel et al. (2016), Laila et al. (2016), Hande et al. (2016).

Table 2: Summary of Papers related to BIM in the Construction Industry

References	BIM Application	Benefit	Result
David et al. (2012)	Project benefit	Positive reviews received supersede the negative.	BIM reduces cost and controls project.
Ramesh and Helen (2013)	Constructability of Climbing formwork system	Details like cost, time, quality safety and other factors in conventional and climbing formwork are explored.	More complex formwork models can be generated, their constructability and build ability factors known.
Emad et al. (2014)	Cost Estimation/ Monitoring for Building Construction	BIM gives visual characteristics of a building and the facilities involved. The quantities are then extracted and exported from the model data base for project cost estimation to be made.	The actual cost and estimated cost difference can be calculated. The visualized cost estimate and control model helps to manage the project.
Dooyong and Heesung (2014)	Integration of Building Maintenance Data	BIM application in facility management for planning and management of project increases work efficiency.	BIM saves time and money in facility management.
Carbonari et al. (2015)	Building Information Model Implementation for Existing Buildings for Facilities Management	BIM usage for two existing building for better understanding of BIM system in UK.	BIM provide complete architectural details that helps facility manager manage buildings and improve their validity.
Mojtaba et al. (2015)	Reducing the Operational Energy Demand in Buildings using Building Information Modeling Tools and Sustainability Approaches	BIM usage for reducing environmental impacts and to know energy usage in real time in residential buildings.	BIM helps architects and building designers to develop energy efficient buildings in future and maintain their life cycle.
Abdulkadir and Godfaurd (2015)	Integrating Building Information Modeling and Health and Safety for Onsite Construction	BIM 4D CAD generate models for designers need showing tower crane movements and other construction vehicle movement.	BIM gives a visual environment of a site in order to make the construction site safe.
Maggie and Issam (2016)	Using BIM to Retrofit Existing Buildings	With proper data management and interoperability, BIM offers platform for reducing energy consumption in existing building.	Using standardise organisation framework for existing building, BIM can be utilised for projects renovation.
Pawel et al. (2016)	Decision Making with the Use of Building Information Modelling	BIM usage in decision making optimization in construction project.	Along with BIM some other project management decision making software are used.
Laila et al. (2016)	Integrating Heritage Building Information Modelling Tools in the Application of Sustainable Retrofitting of Heritage Buildings	Sustainable retrofitting was made in Egyptian heritage buildings for conservation to maintain the value embedded in them.	The need for investment for applying BIM and sustainable retrofit in Egypt to get a better return investment.
Hande et al. (2016)	Building Information Modelling (BIM) use in Turkish Construction Industry	Globalization changes, as a result of improvement in technologies brings about competition in the construction industry.	BIM gives more advantageous environment like efficient monitoring and reporting, efficient project management during project life cycle.

Source: Authors' work (2018)

David et al. (2012) paper on the Project Benefits of Building Information Modelling (BIM) studies BIM usage for benefits in projects. The authors collected secondary data from 35 construction projects done by BIM system. The authors received both positive and negative review about BIM. The positive review are BIM reduces cost and control project throughout the project life cycle. The negative reviews are more training and awareness are needed for

BIM usage. The paper concluded that BIM should be marketed widely and their initial costs should be reduced to enable smaller firms to use the software too.

Ramesh and Helen (2013) paper on Constructability Assessment of Climbing Formwork Systems Using Building Information Modelling, studies the usage of BIM in vertical development structures formwork system. The authors compared the conventional formwork system with climbing formwork system in a 20 storeys high-rise building using BIM. By developing the model using BIM, the authors explored the details like; cost, time, quality safety and other factors in conventional and climbing formwork. The paper concluded that more complex formwork models can also be generated using BIM and their constructability and build ability factors can be known. Other than formworks, scaffoldings and shoring can also be incorporated in BIM for better results.

Emad et al. (2014) focuses on BIM-Based Cost Estimation/ Monitoring for Building Construction. This studies BIM usage for cost estimation and monitoring of a building. The BIM gives visual characteristics of a building and the facilities involved in the building. The quantities are extracted and exported from BIM model database. Then using Microsoft Excel, project cost estimation can be made. The cost are then monitored after the estimation through MSP and they can be updated periodically. The actual cost and estimated cost difference can be calculated. By this visualized cost estimate and control model, the authors says it helps to manage the project in a well manner.

Dooyong and Heesung (2014) looks at Integration of Building Maintenance Data in Application of Building Information Modelling (BIM). The authors' studies BIM usage in a real time project to provide guidance for project managers in step by step approach in BIM, in order to maintain information in earlier stage of project. The authors carried out BIM with facility management for planning and management of project. So the work efficiency gets increased due to correct information provided in BIM model. In conclusion, the paper shows saving of time and money when using BIM with facility management.

Carbonari et al. (2015) paper on Building Information Model Implementation for Existing Buildings for Facilities Management: A Framework and Two Case Studies; studies BIM usage for two existing buildings, for better understanding of BIM system in UK. The model of two buildings are generated. They made retro-BIM framework model for facility management in two existing buildings. The model developed during design and construction phase are different from model generated in retrofitting stage in BIM. But it gives complete architectural details which helps facility manager in managing buildings and to improve the validity of the buildings through BIM.

Mojtaba et al. (2015) paper looks at Reducing the Operational Energy Demand in Buildings using Building Information Modelling Tools and Sustainability Approaches. They studies BIM usage for reducing environmental impacts and to know energy usage in residential building's real time. For constructing a sustainable building, they assigned different combination of material to design buildings using BIM to find out most successful combination of material for a good sustainable building and their energy consumption. By using BIM, it helps architects and building designers to develop energy efficient building in future and maintain the life cycle of the building.

Abdulkadir and Godfaurd (2015) paper on Integrating Building Information Modelling and Health and Safety for Onsite Construction studies BIM usage for health and safety in onsite construction. Through BIM 4D CAD, models can be generated by designers so that they show tower crane and other construction vehicle movements, which makes the construction more reliable. Through this provision, safety can be ensured during construction phase and they can be documented for future use. The paper concluded that BIM gives a visual environment of a site. So, health and safety can also be included as package property within BIM to provide a safe and comfortable construction site.

Maggie and Issam (2016) paper focuses on Using BIM to Retrofit Existing Buildings. This studies BIM usage in retrofitting existing buildings and their sustainability. The authors examines whether BIM offers platform for reducing energy consumption in existing building. By the proper data management and interoperability, serious informational challenges can be tackled. Adapting legal and organisational frameworks are necessary to standardise BIM for existing building and can be utilised for renovation projects.

Pawel et al. (2016) paper present Decision Making with the Use of Building Information Modelling, studies the usage of BIM in decision making optimization in construction project.

The authors chooses practical example for choice of best location of the office building. They gathered the facilities involved in building using BIM and different location were suggested by the planner. BIM perform the energy consumption of the building at different location and they are iterated through reference point method for decision making. The decision maker conducted six iteration and chooses the second iteration solution as the best one. The building is located in New Delhi, India. Thus the authors concluded that along with BIM some other project management decision making software are used and also suggested that they be included in BIM in the future.

Laila et al. (2016) paper on Integrating Heritage Building Information Modelling (HBIM) Tools in the Application of Sustainable Retrofitting of Heritage Buildings in Egypt, studies BIM usage for heritage building retrofitting work. The authors made sustainable retrofitting in Egyptian heritage building for conservation to maintain the value embedded in them. They analysed different heritage buildings by sustainable retrofit and HBIM. Although heritage buildings are analysed using BIM, there is lack of equipment, professional and finance in the country which make the heritage buildings as is it. Finally, the paper concluded that, there is need of investment for applying BIM and sustainable retrofit in Egypt to get a better investment returns.

Hande et al. (2016) paper on Building Information Modelling (BIM) use in Turkish Construction Industry studies that, due to globalization changes, there is a lot of improvement in technologies which rises a competition in the construction industry. By taking this into consideration, the authors analysed the usage of BIM in Turkish construction industry and found out about obstacles on using BIM for various reasons like; organisational structure and culture of companies, high initial investment over implementation of BIM software and hardware, technological deficiencies of stakeholder. The paper concluded that by overcoming these obstacles, BIM gives more advantageous environment like efficient monitoring and reporting, efficient project management during project life cycle, improved scheduling capabilities and reduces changes during construction.

CONCLUSION

From the review conducted on the selected papers, its shows that BIM is not only made for 3D modelling of buildings, they can also be used in various ways. BIM possess more positive approach to the construction industry for customer satisfaction, time reduction, cost reduction and good organisation work in future. BIM can also be used to achieve the following goals: To reduce errors in design & clash detection, to boost the integration of cost and time, to improve the integration of design and construction phase, to increase the collaboration between different construction sections. This shows that BIM application in the construction industry is diverse.

RECOMMENDATION

BIM usage in the construction industry will increase, therefore, professionals are advised to show more interest on implementing BIM system approach. It possess features like;

i. Project management.
ii. Decision making.
iii. Project documentation.
iv. Retrofitting of structure.
v. Health and safety management.
vi. Environmental impact analysis of the structure.

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ENERGY EFFICIENCY AND CONSERVATION

ENERGY CONSUMPTION PATTERN AMONG HOUSEHOLDS IN MINNA METROPOLIS, NIGER STATE, NIGERIA

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Residential buildings of all types rely heavily on the use of energy. This energy is needed in an ever-increasing amount to sustain economic growth, raise living standards, and reduce poverty. This study examines the influence of households' socio-economic characteristics on household demand for energy (electricity, petrol, diesel, kerosene, firewood, charcoal domestic gas). Primary data obtained in a cross-sectional survey of 550 households selected across three marked-out communities in Minna Metropolis, Niger State, Nigeria; was used in estimating energy demand and elasticity. The study reveals that an average household in the sample study areas had about five members, headed by a 52 year old male that had about nine years of formal education. The mean monthly household consumption expenditure was N15,458.63, of which about 25% was expended on the seven commodities. While the influence of education and household size on household energy use were insignificant; income (budget size), household ownership of electrical/electronic appliances and automobiles, as well as age of household heads exercised significant influence on the relative shares of some/all of the seven energy commodities in household budgets in the study area. The income effects were positive for all the energy commodities, except firewood. Demand for petrol, diesel and domestic gas were income elastic. Thus, the study concludes that improvement in income would cause increase in demand for electricity and petroleum products in the study area, but worsening real income would place greater demand on biomass fuel.

Key Words: Energy Consumption, Energy Demand, Household, Minna Metropolis, Pattern, Renewable Energy.

INTRODUCTION

Energy is essential to all human activities. It is required in its various forms to do useful work and, indeed critical to continual improvement in the living standard of any society. Energy is only one of the many important inputs for production, conversion, processing and commercialisation in all sectors (FOS, 1992). It has been universally recognized as one of the most important inputs for social and economic growth and human development. Economic development has progressed with increase energy used per capital. There is a strong two-way relationship between economic development and energy consumption. Also there is a strong correlation between the standard of living as measured by the per capital gross national product and the per capital energy consumption (Dorf, 1978). On one hand, growth of an economy, with its global competitiveness, hinges on the availability of cost-effective and environmentally friendly energy sources, and on the other hand, the level of economic development has been observed to be dependent on the energy demand (IEA, 2006). Energy intensity is an indicator to shows how efficiently energy is used in the economy. Energy demand is important as it affects the economy which in turn affects people's lives (i.e. their income, health, happiness), and their ability to meet basic needs such as the need for infrastructure, education and so on. Access to electricity is particularly crucial to human development as electricity, in practice, is indispensable for certain basic household activities, such as lighting, refrigeration and the running of household appliances, and cannot easily be replaced by other forms of energy (Treiber, 2002).

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Akanmu, et al., (2018). **ENERGY CONSUMPTION PATTERN AMONG HOUSEHOLDS IN MINNA METROPOLIS, NIGER STATE, NIGERIA.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

Energy demand unlike other consumption goods is a derived demand as it is not valued for itself but for what can be done with it, i.e. it is not wanted for its own sake but rather for the light and heat which it can provide. Energy consumption is also linked to urbanisation as any increase in urbanisation normally brings about changes to land use, causes increase in transportation, industry, infrastructure and the use of domestic appliances. It can be argued that an increase in urbanisation leads to an increase in energy consumption as the demand for goods and services may increase in due course.

According to Medlock (2009), the exceptional economic growth and major improvements in standards of living in general over the last few decades have mainly come about because of the replacement of the work force with mechanical power through technological progress. The demand for energy (i.e. electricity) in a developing country raises some important issues due to the existence of the black economy and the growing rate of urbanisation, which exists in such nations. Many developing countries are still faced with the challenge of providing adequate and modern energy services to their communities, and the lack of such services may deter the improvements to the standard of living through increased income and employment opportunities.

Due to the nature of most developing countries, and because of the lack of understanding of household dynamics and other factors influencing its dynamism, it is difficult to fully identify the impact of insufficient energy consumption on the development of the various regions in the country and on the standard of living of people. There is difficulty in designing or evaluating policies and programmes intended to address the impact of the use of energy within households. The aim of this study is to be able to provide an appropriate energy consumption pattern among households in Minna metropolis, Niger state, Nigeria. The objectives of the study

(i) Determine the types of household energy sources and their major uses in these households in Minna metropolis
(ii) Examine the determinants of energy expenditures among households in Minna metropolis

The rest of the paper will reveal steps taken to establish various factors that contribute specifically to the consumption of energy by households in Nigeria.

REVIEW OF LITERATURE

The relationship between use of energy and economic growth has been a subject of greater inquiry as energy is considered to be one of the important driving forces of economic growth in all economies (Pokharel, 2006). The increasing world demand for oil, leads to frequent escalation in the world oil prices. Like shortage of oil, there is also shortage of electricity and other forms of energies viz. natural gas. The shortage can significantly affect the consumption and production in the economy. One or the other forms of energy becomes vital to all the sectors of the economy viz. agriculture, industry and services. This energy dependence being common to every sector of the economy justifies the association between energy utilization and the overall economic growth rate in an economy. Hence any deficiency in supply of oil, natural gas and electricity generations may directly constrain the economic activities, thereby the growth rate. The declining supply of these sources of energy not only raises the input prices but also influences the prices of other commodities leading to a rise in overall inflation rate and thereby dampening the aggregate demand and growth rate.

The major determinant of the amount and type of energy used by households in urban area is a function of population and urbanization. Research indicated that household consumption of domestic energy corroborated with “energy ladder” that implies that households consumes less costly energy and less conventional (biomass) energy, of immediate price and quality (kerosene) to more expensive highly convenient types of energy (LPG, electricity) as their income increases and or habits changes over time (Sathaye and Meyer 1990; UNCHRS, 1991; Smith, 1994) but the inflation rate has changed the whole situation as households depend on biomass to beat the effect of inflation. There has been increase in the use of kerosene among the middle and low income group in recent past (Sathaye and Meyer 1990) but the trend has changed for high consumption of charcoal due to recent increase in pump price of petroleum product in early 2012. The key factors that affect the consumption of any kind of energy in urban area by households include: the price of the energy, the

availability of the energy, income and cultural preference. All these contributed to pattern of energy consumption by households. It has become an established fact that there are disparities in the energy consumed by urban households and rural households, between high and low income group; within a region, country and among countries (Takama *et al*, 2011). Level of urbanization, economic development and lifestyle has also been a contributing factor in the use and differences (Dzioubinski and Chipman, 1999). Urbanization influences demand for cheaper energy in Nigeria because of high level of poverty (NBS, 2011).

It needs to be noted that India domestically meets up 30 percentage of its crude oil requirement and the rest is being imported from the oil producing nations. Indian transport sector is the principal consumer of petrol and diesel followed by big and small industrial units. Similarly, electricity consumption share too is the largest by this sector (GOI, 2005).

India in the past had experienced a huge import bill on account of an increase in the price of crude oils. The inelastic oil demand and rising oil import bill had put pressure on the scarce foreign exchange resources and had also been largely responsible for shortages in energy supply. In the first oil embargo, India's import bill rose beyond 50 per cent, while the adverse impact of 1990-1991 Gulf War caused a huge balance of payment deficit and pushed up the inflation rate to an all-time high of 13 per cent. These economic uncertainties had deterred the pace of growth of India (Ghosh, 2006). Even though the relationship between energy consumption and output growth has been a well-studied topic over the past three decades, the evidence is still controversial. The literature has extensively evaluated the nature of temporal causality between energy consumption and economic growth or employment. However, empirical evidence of these studies is mixed, ranging from bi-directional or unidirectional causality to no causality.

These studies in the literature generally have no consensus judgment due to different countries or different time within the same country. The pioneering study of Kraft and Kraft

(1978) provides evidence in support of unidirectional causality running from gross national product (GNP) to energy consumption for the case of the U.S. over the period 1947-1974.

The results imply that energy conservation policies might be enforced without affecting GNP growth. Nevertheless, Akarca and Long (1980) failed to obtain causality between energy consumption and GDP when the period is shortened. They argued that Kraft and Kraft's study could suffer from temporal time period instability.

Masih and Masih (1996, 1997) in a multivariate framework examined the relationship between total energy consumption and real income of Asian economies such as India; Pakistan; Malaysia; Singapore; Indonesia; Philippines; Korea; and Taiwan. Energy consumption was found to be neutral with respect to income for Malaysia, Singapore and

Philippines, unidirectional causality existed from energy consumption to GNP for India; exactly the reverse for Indonesia and mutual causality was present for Pakistan. Paul and

Bhattacharya (2004) applied alternative econometric time series models via Engle-Granger co-integration, Granger causality test and Johnsen's multivariate co integration technique on the Indian data for the period 1950-96, found that Engle-Granger and Johnsen's result show that in the long run economic growth leads to energy consumption but the standard Granger causality shows that energy consumption leads to economic growth. The finding from

Granger causality is also consistent with Johnsen's error correction result. From their survey, they found that while Cheng (1999) had established a unidirectional influence from economic growth to energy consumption but Adjaya (2000) found causality in the reverse direction.

Ghosh (2005) using co integration and error correction modelling approach found the existence of a long-run equilibrium relationship between total petroleum products consumption and economic growth in India for the period of 1970-71 to 2001-02. Several researchers have since joined the debate, with some who have either confirmed or contradicted Kraft-Kraft's results. There are cases where unidirectional Granger causality was found to be running from energy use to economic growth. These studies include the Philippines (Yu and Choi, 1985), India (Masih and Masih, 1996), Singapore (Glasure and Lee, 1997), Indonesia (Adjaye, 2000), and in the cases of France, West Germany, Japan, and Turkey by Soyta and Sari (2003). In some other works, an opposite unidirectional Granger causality running from economic growth to energy use was found by Yu and Choi (1985) and Soytas and Sari (2003) for South Korea, and in Cheng and Lai (1997) for Taiwan.

Finally, the remaining cases uncover causality running in both directions with respect to the neutrality hypothesis. These are the United States (Stern, 1993, 2000) and Cheng (1995), Thailand and the Philippines (Adjaye, 2000), and Taiwan (Yang, 2000). To sum up the reviewed research papers gives different direction and casual relationship between energy consumption and GDP.

Study Area

Minna, the capital city of Niger state is located in the North Central Zone of Nigeria. It is about 185Km from Abuja, the Federal Capital City of Nigeria. It has an estimated land area of about 1,000 square kilometres (Maxlock, 1980). Minna is fast assuming a cosmopolitan city with a population of about 300, 000 by 2006 (NPC, 2010). The population of Minna is said to be growing of an average rate of 3.5% per annul. Minna is linked to other parts of Nigeria by road, railway and air. Residential land use in Minna indicates three characteristics; which are low, medium and high densities with a good mixture of these densities except for the low density areas that are clearly marked out. The vegetation in Minna is guinea savannah vegetation and the area is well noted for the cultivation of yam and maize which also incidentally formed the stable foods of the residents of the town. Minna is most noted for the relative peace it has enjoyed over many decades compare to many other part of Northern Nigeria. This peace and the relative low cost of living in the area have attracted an increasing number of migrants from rural areas of the state as well as refugees from the Boko Haram insurgency in the upper North of Nigeria. Further development plans for the city and the area are based primarily on continued upgrading of Minna's infrastructure, like the dualization of the road linking the state capital to the Federal Capital Territory, Abuja; an expansion of industrial and manufacturing activities, including an increase in commerce. This influx is threatening to overwhelm and straining already inadequate infrastructure and social services in many parts of the city. Urbanization is worsening the crowded conditions found in the high density wards of Minna. Basic services in these areas, including water, sewage, waste disposal and power, are solely, lacking, and their absence is attributed to contribute to relatively high rates of infant mortality and morbidity in these communities (Abdulrazak *et al.,* 2012).

MATERIAL AND METHODS

The materials used in the study included questionnaires, Microsoft Excel, Statistical models and statistical percentile. Guided interviews were conducted on the respondents using research assistants who understood, Hausa, English and one local language of either Nupe or Gwari languages. The residential land use in Minna shows three characteristics: that is high, medium and low densities with mixture of these densities (Abdulrazak *et al.,* 2012). This research was conducted in all the three residential areas of the identified neigbourhoods. Four neigbourhoods were sampled in high density area: Ungwan Daji, Kateren Gwari, Kpankungu and Maitumbi. For medium density area, four neigbourhoods were sampled: Bosso low cost housing area, F-layout area, M.I. Wushishi housing estate and Talba Estate. Three were used in the low density area: GRA, Professorial quarters of FUT Minna and Legislative quarters.

Fifty (50) questionnaires were administered in each neigbourhood totalling five hundred and fifty (550). Primary data were used for the study. A well structured random sampling were employed in the administration of the questionnaire to choose the respondents. Quantitative data that were collected were analyzed using descriptive statistics; this was done through the use of Statistical Package for Social Science (SPSS v17). The results were presented using frequency distribution; percentages were used to analyze the level of availability of energy source/s, challenges associated with energy usage by the households and availability of the energy source with respect to socio-economic placement of each of the household. Energy used at each household was computed using Microsoft Excel. The quantities of energy resources consumed per household in relation to these same socio-economic factors as they influence energy consumption patterns were also highlighted.

RESULTS AND DISCUSSION

Table 1: Monthly incomes of the High Density, Medium Density and Low Density household in Minna, Niger state

HOUSEHOLD	Amount (Naira, ₦)	Population of households	Percentage (%)
High density	0 – 19, 999	385	70
	20, 000 – 49, 999		
Medium density	50, 000 – 99, 999	137	25
	100, 000 – 200, 000		
Low density	> 200, 000	27	5
Total		**550**	**100**

Table 1 shows the density of households' income, number of household covered and their percentage respectively. The high density households have to categories of income earners as thus; income earners from ₦0 to ₦9, 999 and ₦20, 000 to ₦49, 999. The medium density households also have to categories of salary earners as thus; income earners from ₦50, 000 to ₦99, 999 and ₦100, 000 to₦200, 000. The low density households have above ₦200, 000.

Further, over 80 percent of those who are classified as low income earners (₦0 to 19, 999) and ₦ ₦100, 000 to ₦200, 000, it is interesting to note that they are living in flats/bungalows while majority of those who earn over ₦200, 000 live in duplex houses.

Analysis of the data collected from the survey indicates that most households did not use just one form of energy but rather a combination of different types of energy for different purposes. For instance, a household may use electricity for lighting and cooling but use kerosene or gas mainly for cooking. The survey also revealed that the issue of availability was the most important factor to be considered when it comes to deciding whether to change from one energy type to another.

Energy Use Pattern In A Typical (High Density, Medium Density and Low Density) Household in Minna, Niger State

Domestic Energy Types and Usage Patterns of fuel for high density households

The analysis in the table 2 indicated that the pattern of energy use by the high density households. Majority of the respondents from the high density area (36.36 percent) were using wood for water heating, 27.09 percent were using charcoal for water heating. Kerosene was used by 0.36 percent of the households for cooking. Wood was used by 4.36 percent for cooking. Electricity was the least used of the energy types in the study area. This could be attributed to the fact that respondents could not afford the high cost of electricity bill and also because of its erratic supply. Kerosene was used by 0.36 percent of the household for lighting. While Candle and battery was used by 0.73 and 0.55 percent of the household for lighting. Due to the fact that high density area are low income earners natural cooling and ventilation was observed to use by the household due to erratic power supply by PHCN. 0.18 percent of the households used electricity for Others Refrigerator, TV, Handset charging etc. The analysis shows that the consumers of kerosene have shifted to the use of wood due to the fact that they are low income earners and the increase in the price of kerosene have not allowed them to use the product often. Furthermore, it was revealed that the price of the product is not what the government place on it due to scarcity and non-availability of the product in the filling station.

Table 2: Usage pattern of fuel types among households in high density area

HIGH DENSITY HOUSEHOLD			
Usage of Fuel types		Frequency	Percentage
Water heating	Wood	104	36.36
	Charcoal	77	27.09
Cooking	Kerosene	1.0	0.36
	Wood	12.5	4.36
Lighting	Electricity	0	0.00
	Kerosene	2	0.36
	Candle	4	0.73
	Battery	3	0.55
Cooling Ventilation	Electricity	0 0	0.00 0.00
Others Refrigerator, TV, Handset charging	Electricity	1	0.18
Total		**385**	**70**

Table 3: Usage pattern of fuel types among households in medium density area

MEDIUM DENSITY HOUSEHOLD			
Usage of Fuel types		Percentage	Frequency
Water heating	Electricity	10	1.82
	Kerosene	21	3.82
	charcoal	15	2.73
Cooking	Wood	73	13.27
	Kerosene	6	1.09
	Electricity	2	0.36
Lighting	Electricity	3	0.55
	Kerosene	2	0.36
Cooling Ventilation	Electricity	2 0	0.36 0.00
Others Refrigerator, TV, Handset charging	Electricity	3	0.55
Total		**137**	**25**

Households' choices of energy types and their usage patterns are presented in Table 3. The analysis in the table indicated that the pattern of energy use by the medium density households change during this period as more households' resolved to the use of wood (13.27 percent) for their domestic energy use, due to the effect of the economy recession we are in. The use of other sources such as electricity is on the decline with 1.82 percent of the households used it for water heating. Residents in the medium density are have declined from using this source of energy because of erratic power supply by PHCN after payment of electricity bills and also the use of electricity cooker/hot plate for cooking by large number of household is not visible because of the amount of energy it consumes and also there has been increase in the tariff of electricity over time in Minna, Niger state and nationwide. There has been increase demand of kerosene and charcoal (3.82 and 2.73 percent) by residents for cooking. This is because they are available and cost efficient. Electricity and Kerosene was used by 0.55 and 0.36 percent of the household for lighting. 0.36 percent of households used electricity for cooling while 0.00 percent of households used electricity for ventilation. 0.55 percent of households used electricity for others appliances such as Refrigerator, TV, Handset charging etc.

Table 4: Usage pattern of fuel types among households in low density area

LOW DENSITY HOUSEHOLD			
Usage of Fuel types		Percentage	Frequency
Water heating	Electricity	5	0.91
	Gas, Solar	3	0.55
Cooking	Electricity	2	0.36
	Gas	4	0.73
Lighting	Electricity	5	0.91
	Solar photovoltaic	0	0.00
Cooling Ventilation	Electricity	4 0	0.73 0.00
Others Refrigerator, TV, Handset charging	Electricity	4	0.73
Total		**27**	**5**

Households' choices of energy types and their usage patterns are presented in Table 4. There is no debate to the choice of energy type and their usage pattern to this density, because they are the low density households which simply mean they earn more income compare to the other two densities. Majority of the respondents from the low density area (0.91 percent) were using electricity for water heating, 0.55percent were using gas and solar for water heating. Electricity and gas were used by 0.36 and 0.73 percent of households for cooking. Electricity and solar photovoltaic were used by 0.91 and 0.00 percent of household for lighting. 0.73 and 0.00 percent of households uses electricity for cooling and ventilation, while 0.73 percent of households used electricity for other appliances, Refrigerator, TV, Handset charging.

CONCLUSION AND RECOMMENDATION

The quality and quantity of the type of energy available and obtainable to majority of a population inhabiting a particular geographical location reflects the extent of their economic development and indeed the level of civilization they have already attained.

The low grade energy source like firewood, charcoal etc. are most predominantly among high density households and the reverse is the case in the low density households that uses mostly high grade energy source like electricity LPG for most of their household energy needs. While the medium density household uses a mixture of both extremes. They more than the other two densities are susceptible to energy use change at the slightest change in availability, supply or price.

The changes in type of energy consumption are related to the income level of the households, poverty, easy of availability, convenience of usage and affordability of the different energy source types. The survey reveals that the use of biomass will continue except urgent and proactive measures are put in place to change the consumption pattern. There is also the need for government's intervention with subsidies on energy efficient store, solar photovoltaic systems and solar water heating system. This will move the people to the use of clean and sustainable energy usage. This effort will reduce pressure on the depletion of forest and also reduce time being used for fetching fuel woods.

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DETERMINANTS OF HOUSEHOLDS DOMESTIC COOKING ENERGY CHOICE AND TECHNOLOGY IN MINNA, NIGER STATE NIGERIA

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Domestic energy poverty occasioned by acute shortages and frequent price fluctuation have compelled urban households to various cooking energy options. Reliance on modern energy for cooking especially electricity is questionable because of its epileptic nature, cost and inadequate infrastructure. Inaccessibility of modern domestic energy supply is among the research problems in the study area. The study is justified as a result of the irregularities in terms of availability and affordability of modern domestic cooking energy in Minna metropolis, the capital of Niger State. The main objective is to analyse households' energy characteristics in order to discern the factors influencing households cooking fuel choices in Minna. The study hinges on energy access and poverty concepts from literature. Multistage sampling method involving delineation of the study area into 28 neighbourhoods was adopted. Descriptive statistics was employed in the analysis using SPSS. With kerosene being the prevalent domestic cooking energy type among electricity, gas, charcoal and fuel wood used with variety of cooking technologies, the study revealed that the major determinants of households' fuel choice are affordability (29.5%) and availability (26.3%). The study concludes that the choice of cooking energy among the households is pattern less as all options at their disposal based on affordability and availability are explored. Besides promoting access to electric power being a very important dimension to consider in enhancing households' access to energy, the study recommends improving modern energy supply, households' income and education.

Keywords: Poverty, Cooking energy, Choice, Availability, Affordability

INTRODUCTION

The choice of households' energy in urban areas is majorly determined by pressure and its consequences as one of the effects of population and urbanization. Urbanization, a common characteristic of developing countries usually alters both production and consumption structures which affects energy access and usage among urban households (Karekezi, Kimani and Onguru, 2008). It mounts pressure on the modern urban services, facilities and energy, including electricity, refined petroleum products and this leads to acute shortages and price fluctuations because many poor urban households particularly will be lacking access to modern energy carriers (energy poverty). National Bureau of Statistics (NBS, 2011) observed that because of the poverty level that is high, urbanization influences the quest for cheaper energy in Nigeria.

Energy poverty sets in because of inadequate energy infrastructure for modern energy delivery resulting from population pressure on the few infrastructure and inability of households to pay for the desired energy resulting from price fluctuations of the few available energy types. Domestic energy poverty is the in-affordability and inaccessibility of households to modern energy forms. Bouravoski and Herrero (2016) are of the view that domestic energy poverty is a situation that varies from area to area where a household cannot afford or lack access to their daily basic energy needs and services.

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The commonest domestic energy needs in Minna includes energy for lighting, cooking, preservation and communication. Morenikeji *et al.* (2006) concludes that most urban dwellers resort to dependence on biomass (wood fuel) for cooking because of the inconsistencies in accessing modern energy carriers.

Minna with population density of 56 persons per square kilometre is one of the growing cities in Nigeria which is as a result of increasing developmental projects when it became the capital of Niger state (Abd'razack *et al.,* 2012). In Minna, fuel wood is one of the cheap energy forms utilized domestically and this is as a result of its availability and affordability. Immigrants from rural areas that are already used to biomass energy use aggravate the wood fuel utilization situation.

Falling out of subsidy removal in 2012 and recently 2016 in Nigeria, the increased the prices of modern energy, compelled households in Minna to cheap energy utilisation (especially traditional wood fuel) in the face of the energy price hike. The National Population Commission (NPC 2006) observed that out of 729,964 households in Niger state, 571,254 households representing 78.3% depend on firewood as their main domestic cooking energy. Morenikeji *et al.* (2006) also observed the high dependence on fuel wood by Minna residents (74.45%) for cooking especially the poor who constituted higher percentage.

Domestic energy poverty occasioned by acute shortages and frequent price fluctuation have compelled households especially those in low and medium income categories, to resort to energy stacking. This multiple domestic cooking fuel use is determined by choice factors which are as a result of energy poverty and the eventual energy types relied on are wood fuels (biomass). The studies on environmental and economic implications of fuel wood trade and use conducted by Morenikeji *et al.* (2006) revealed that wood fuel business in Minna, Niger State is lucrative though it impacts negatively on the environment. The economic aspect of urban biomass trade and consumption differ from the rural situation because of the magnitude of dependence, even by poor households, on fuels bought and responsiveness to market mechanisms. The study therefore seeks to determine the factors influencing the prevalent wood fuel utilisation in the study area

Energy poverty which is an expression of lack of energy especially electricity to a great extent determines the livelihood of electricity dependent households. Access to modern energy facilitates households' energy services such as cooking, preservation, lighting, communication, etc. Households' energy poverty status is worsened by the inaccessibility to modern energy which play major roles in urban households' domestic and economic activities. In terms of cooking, urban households resort to various domestic cooking energy sources to meet up with their cooking needs. Some rely on pollutant emitting energy types with or without knowledge of the implications hence justifying the need for the study. Therefore the study aims to analyse household energy characteristics in order to discern the rationale for households cooking energy choice in Minna.

METHODOLOGY

Study area

The Study area is Minna metropolis; the capital of Niger State and is the headquarters of Chanchaga Local Government Area (Niger State Statistical Year Book, 2011). It lies between Latitude 9º 33' and 9º 40' North of the Equator and Longitudes 6º 29' and 6º 35' East of the Greenwich Meridian on a geological base of an undifferentiated basement complex of mainly gneiss and magnetite (Max Lock, 1979).

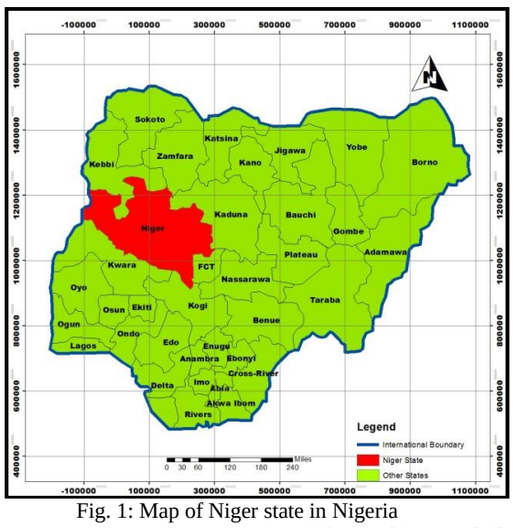

Fig. 1: Map of Niger state in Nigeria

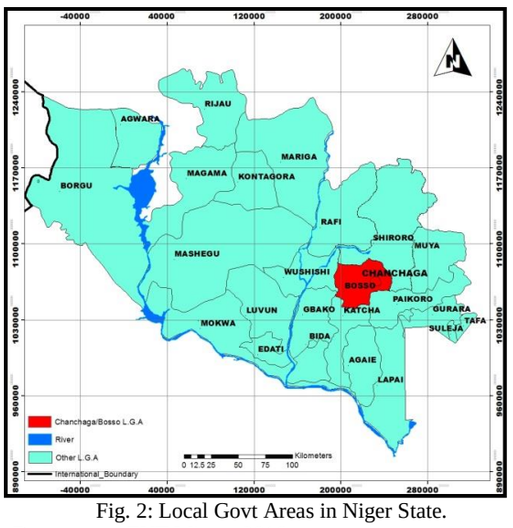

Fig. 2: Local Govt Areas in Niger State.

Source: Urban and Regional Planning Department, FUT Minna, 2016.

With the creation of the Federal Capital Territory, Minna has become enhanced in all her developments as more people are attracted to the town.

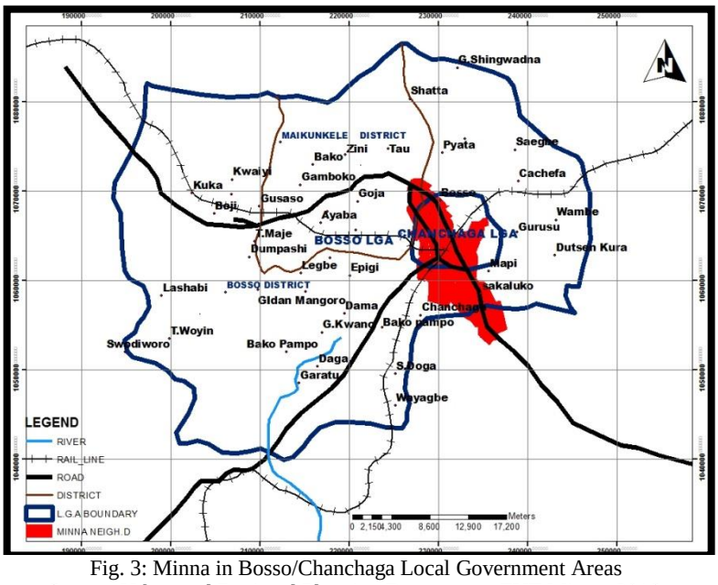

Fig. 3: Minna in Bosso/Chanchaga Local Government Areas

Source: Urban and Regional Planning Department, FUT Minna, 2016.

Being the state with the largest land mass of about 76, 469.903 Square Kilometres (about 10% of the total land area of Nigeria) out of which about 85% is arable (Niger State Statistical Year Book, 2011), the majority of the populace in the State (85%) are farmers while others constituting (15%) are involved in vocations such as white collar jobs, business, craft and arts. This suggests availability of wood fuels (charcoal, fuel wood, etc) which influences its dependence as cooking energy alternative.

Conceptual Framework and Literature Review

The choice of domestic cooking energy can be linked to households' economic status. Some varieties of choices in energy carrier are at the disposal of the wealthier people where many go for more efficient, cleaner and modern energy sources. Both relatively and often absolutely, the energy expenditure of the poor generally outweighs that of the rich as they hardly offset the upfront cash for devices that increases fuel use efficiency or facilitate changing from local to modern energy (Clancy *et al.*, (2002). The poor people now have very limited options, an energy poverty situation. Biomass fuels will for some time most likely remain the major heat processing and cooking fuels since electricity is more expensive for such applications in almost all situations.

Energy poverty which implies the lack of access (in terms of availability and affordability) to modern energy sources breeds reliance and dependence on inefficient and cheap energy sources used for energy dependent domestic activities. Part of the United Nation's Sustainable Energy for All (SE4All) Initiative objectives is achieving access to modern energy universally with greater efficiency in energy and increased renewable energy use. Energy access jointly is defined by Masud *et al.* (2007) as the provision of quality and

reliable modern energy supplies optimally sufficient when and as needed, as well as the individual's power to pay for such supplies quantitatively and qualitatively necessary for their day to day use. Access to energy entails the availability of adequate and timely energy as well as that being reliable, qualitative, affordable, legal, convenient and safe, for all the household, community and productive services requiring energy (ESMAP, 2014). It implies ensuring the ability of the end users to procure (Al-amin, 2014) and efficiently use these services at a reasonable price for their various needs with consideration to their respective budgetary constraints (Masud *et al.,* 2007).

In order to meet various purposes especially at the household levels, energy is very imperative at all times. Life tends not to be easy and possible with inadequate and irregular energy supply for domestic needs. Momodu (2013) suggested that availability and affordability are two major factors that determine the energy for domestic purposes. It implies that handy and affordable energy must be at the people's door steps especially the poor. Household activities are supported by energy through fundamental and basic needs provision such as a temperature for comfortable living, cooked food, illumination and appliances use, sewerage, preservation, education and information/communication aids and transport (Nnaji *et al.,* 2010; Oyedepo, 2012). In the developing countries, the commonly and widely used domestic energy resources includes electricity, LPG, kerosene, charcoal and fuel wood. In the rural areas of Africa and Nigeria in particular, endemic poverty among households and inaccessibility to basic social services has led to reckless exploitation of natural resources (Akwa *et al*., 2008). Among all the energy sources, however, fuel wood is mostly available and is utilized virtually everywhere in Nigeria for meeting households' energy needs.

However, as a measure of economic development level of a particular society, energy must be available to all in that specific society. Momodu (2013) gave an example of advanced economies of France, United Kingdom and USA where the greatest percentage of their population accesses cost effective and affordable energy supply as a result of their technology advancement. Unlike in a developing country like Nigeria, large proportion of its populace has low purchasing power and necessary energy infrastructures are not in place suggesting inaccessibility to choice energy sources by majority of the people (Momodu, 2013).

In Nigeria, commercial energy accounts for a negligible fraction of total energy consumption different from what is obtainable from most industrialised countries. A large percentage of energy consumption is supplied by the "traditional" and "non-commercial" sources such as charcoal, fuel wood, vegetable wastes and dung. Momodu (2013) observed that generally, cheap, reliable and environmentally benign energy sources are not accessed by most of the undeveloped nations.

In Nigeria, a developing country with about 180 million people, the rural dwellers, with their often basic needs, depend largely on the local energy sources for their domestic energy needs unlike the bulk of the urban dwellers that are dependent on both traditional sources of energy and fossil fuels. In terms of energy existence, Nigeria has ample energy sources at her disposal such as wind, solar, hydro, coal, oil and gas, used especially for domestic consumption. In addition, the household use requiring large amount of domestic energy however relies mostly on fuel wood and partly on electricity and kerosene in many countries in the world.

The inadequacy in generating electric power likewise poor distribution network in the country has subjected a large chunk of the citizenry to fuel wood use for their domestic needs. Sambo (2005) asserted that for cooking especially, household sector depends maximally on fuel wood and minimally on electricity and kerosene in many countries. Like any form of energy, Sanusi (2008) stated that the presence of electricity is important for productive services, for development of most community services and preservation of the environment, particularly forest resources that could be used for cooking in the absence of accessible and dependable electricity supply. Most discouraging is the supply and distribution of petroleum products in Nigeria. Kerosene is inaccessible to many for their domestic needs in terms of purchasing power. Where it is available, it is sold at exorbitant prices. Inadequate and poor condition especially, of energy infrastructure truncates regular supply of electric energy to the people.

Energy poverty is defined as households' inability to satisfy basic costs of energy for warming and illuminating their homes and cooking food adequately. It also can be defined

as the availability of insufficient options for reliable, affordable, qualitative, safe (Bekele, Workneh, Negatu & Getachew, 2015) and favourable environmental energy services to support both human and economic development (Reddy, 2004). Affordability refers to prices of choice energy in relation to household income and also incorporates flexibility which implies the ability to pay for needed energy against being compelled to pay what is available for sale (Al-amin, 2014).

In the light of inaccessibility to electricity, energy poverty situation is worsened when energy expenditure (economy, health) is high. Energy expenditure increases with income although the rate is less proportional, (World Energy Outlook - W.E.O., 2002). As poor households continue spending larger part of their income on energy, it gets to a point where they begin to be conservative on their energy consumption. Accordingly, W.E.O, (2004) stated that economic energy poverty is at a level when households' energy expenditure is more than 10% of the disposable income, excluding transportation costs. Khandker, Barnes & Samad, (2010) stated that frequently mentioned in the literature is threshold point of 10% of total income as poor households common expenditures level. The idea is that for energy, households who are cowed to spend up to 10% of their cash earnings are short of other basic needs for life sustenance.

In developing countries like Nigeria, Bamiro and Ogunjobi (2015) observed the share of energy expenditure to be 23% indicating high level of domestic energy poverty. Electricity (36%) and kerosene (30%) are the two most important fuels in proportioning total energy expenditure. While it may be true to say that the poor always access low services, it is also clear that the middle income or even the high income people can also suffer service deficiency (Sanusi, 2008). By this position, he concluded that deficiency in service provision may be explained by inadequacy of governance system rather than the income of the people.

Inadequacy in modern energy supply likewise shielding from deregulation, facilitates the prices of energy sources to often rise above the poor's ability. The Federal Government of Nigeria (FGN) upward deregulation of the petroleum products prices, consequently compelled people to adopt cheaper energy source. Equally falling out of government's insensitivity to the predicaments of the masses, infrastructures were and are still vandalized in Nigeria to date thus leading to artificial scarcity of energy with its consequences (Momodu, 2013). According to Abd'razack *et al.* (2012), economic dead end and global economic meltdown have also affected households greatly and this has altered both their ability to provide shelter and energy use and services adequately. In the same vein, Bruce *et al.* (2011) suggest the importance of not relying on economic growth and other poverty alleviation measures as the basic means of improving poor households energy choices.

This state of the economy has jeopardised households in their daily energy use in trying to attend to needs. Rural populace and households' with low income cannot afford the supposed major sources of cooking energy which are Kerosene and LPG. As a consequence, the domestic energy consumption pattern by households in Nigeria changed and has great adverse impact on the socio-economic characteristics of the poor. The relationship of poverty and energy can be described with reference to the quality and quantity of energy used. In general, most poor households use biomass fuels because of affordability and they do not have sophisticated energy appliances such as gas and electric cookers (Ogwumike, *et al.*, 2014). It also has environmental effect as biomass consumption has been on the increase for households cooking energy used day in day out.

Households domestic energy choice and consumption as indicated by researches substantiate the energy ladder suggesting the consumption of cheap and less conventional energy such as biomass, of quick price and quality (kerosene) than costlier and highly convenient energy types such as LPG and electricity while moving up the income ladder and or habits change overtime (Sathaye & Meyer 1990; Smith, 1994; UNCHS, 1991). However, as inflation rate has altered the situation, households rely on biomass to beat its effect. In the past, petroleum products pump price increase in the early 2012 has decreased kerosene patronage among the middle and low income groups (Sathaye and Meyer, 1990) for increased and high charcoal consumption. The major factors influencing the use of any kind of energy by urban households include availability and affordability of the energy, cultural preference and income. Despite being established that there are differences in the urban and rural households energy consumption, between high and low income group; within a region, country and among countries (Takama *et al*., 2011), households energy consumption pattern are as a result of the aforementioned factors. Also

the level of urbanization, lifestyle and economic development influences the use and differences (Dzioubinski and Chipman, 1999).

As the modern energy supply is unstable and unreliable likewise the demand of fuel wood which is soaring in both urban and rural setting as poor man's basic energy source, households are at risk of daily energy use for their need. The supposed alternative cooking energy source of electricity and LPG becomes unreachable to many households. This influences the variation in the choice and pattern of households' domestic energy consumption which could be for various reasons in Minna.

Data Collection and Method of Analysis

Multi-stage sampling technique involving delineation of the study area into 28 urban neighbourhoods was adopted. Within each neighbourhood, stratification using roads system was done and within each stratum, random sampling was conducted. Four hundred (400) copies of the research instrument were distributed to household heads in the sampled buildings as shown in Figure 4 based on the proportion of the individual neighbourhood's population that make up the total neighbourhoods population using Adams *et al.* (2007) sample size formula, $n_o = Z^2_{a/2} \frac{p(1-p)}{d^2}$.

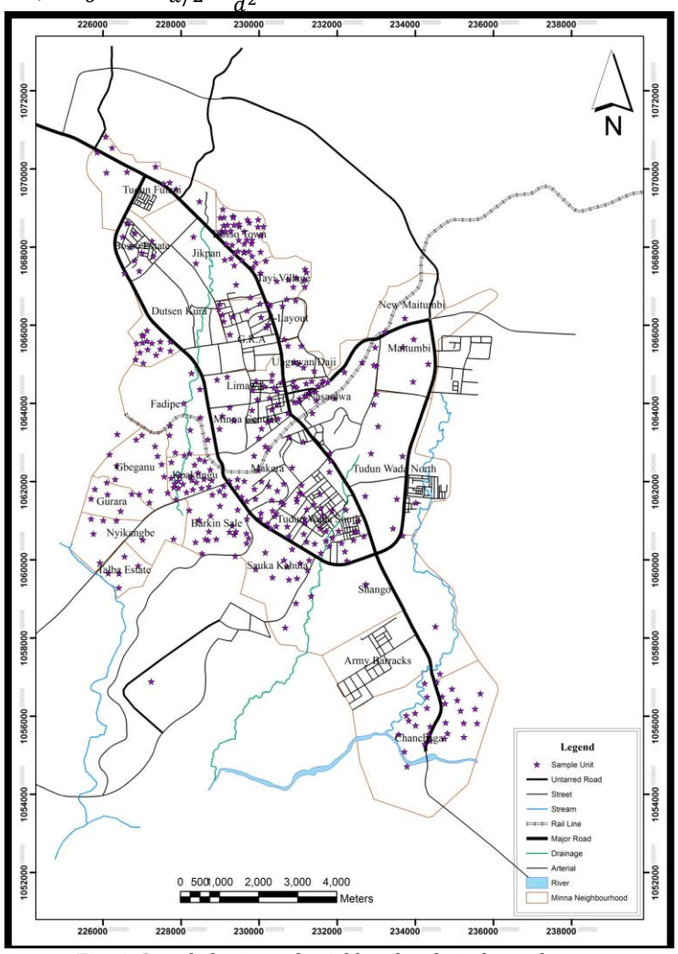

Fig. 4: Sampled units and neighbourhoods in the study area
Source: Author's field work, 2016.

Questionnaire, digital camera and hand-held GPS instrument were used as primary data collection instruments for Minna households' energy characteristics. Descriptive statistics using tables was employed in determining households' domestic primary cooking energy choices.

RESULTS

The elements of household energy characteristics examined are the various types of primary cooking energy forms and the technology used. The factors influencing the choice of energy type used and the proportion of households' monthly income spent on the primary cooking energy types are also examined.

Primary energy types

Contextually, primary domestic energy used for cooking refers to the preferred cooking energy options at the households' disposal. The primary domestic cooking energy options observed in the study area are electricity, gas, kerosene, charcoal and fuel wood. These are used with variety of cooking technologies.

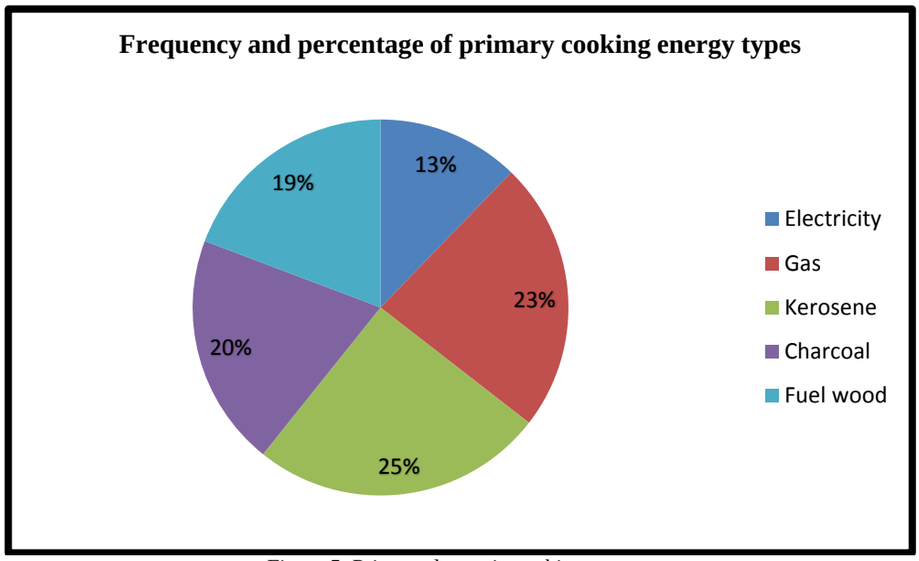

Figure 5: Primary domestic cooking energy
Source: Author's field work, 2016.

The households' primary cooking energy types in the study area are illustrated in Figure 5. It portrays that kerosene is the energy type mostly used for cooking representing 25% of the households in the study area. This is closely followed by gas which represents 23%, charcoal and fuel wood users each represent 20% and 19% respectively while electricity is 13%.

Primary cooking energy technology

This study revealed the primary cooking technologies that households in the study area use to include gas and electric appliances, kerosene pressure stove (Plate I), local charcoal efficient stove (Plate II) and fuel wood efficient (Plate III).

Plate I: Kerosene pressure stove

Plate II: Charcoal efficient stove

Plate III: wood efficient stove

Source: Author's field work, 2016.

The study also discovered the inefficient versions in the technology of the adopted cooking coping fuels in the wake of energy poverty. These include the Nigerian conventionally fabricated iron charcoal stove called *'Abacha stove'* in local parlance (Plate IV) and iron or stone wood stoves (Plates V and VI).

Plate IV: Iron charcoal stove (*Abacha stove*)

Plate V: Iron wood stove

Plate VI: Stone wood stove

Source: Author's field work, 2016.

Equally used by the households are local versions of efficient charcoal and wood stoves as depicted in Plates VII and VIII.

Plate VII: Local charcoal efficient stove

Plate VIII: Local wood efficient stove

Source: Author's field work, 2016.

Factors for the choice of primary cooking energy

Accounting for the choice of primary cooking energy, Table 1 shows the reasons households adduced to the choice of a particular primary cooking energy.

Table 1: Factors for the choice of primary cooking energy type

Energy type	Cheap	Available	Easy to use	Durable	Safe	Cultural Preference	Clean energy	Low uptake cost	Fast	Household size	Others
Electricity	12	17	13	0	0	0	7	0	1	0	0
Gas	7	22	8	9	2	0	24	0	21	0	0
Kerosene	20	28	37	2	6	0	0	1	5	0	1
Charcoal	41	16	12	3	0	1	0	3	4	0	0
Fuel wood	38	22	8	1	0	5	0	0	1	1	1
Total	**118**	**105**	**78**	**15**	**8**	**6**	**31**	**4**	**32**	**1**	**2**
Percentage	**29.5**	**26.25**	**19.5**	**3.75**	**2**	**1.5**	**7.75**	**1**	**8**	**0.25**	**0.5**

Source: Author's field work, 2016.

DISCUSSION

In spite of electricity being a clean energy type, the research discovered that 14.3% of the households using it as their primary cooking energy adopt it because it is a clean energy type. The remaining households who use it for its availability, cheapness and being easy to use are represented by 32.7%, 24.5% and 26.5% respectively. This implies that 85.7% of the households using electricity for cooking are least aware of it being a clean energy type which influenced their choice of other cooking energy types.

Similarly, LPG as a clean energy is adopted as primary cooking energy by 25.8% of the households. Some other LPG using households represented by 23.7% and 22.6% use it because it is available and fast respectively while 18.3% adduced their reason to the choice of LPG because it is easy to use. The survey indicates that 7.5% of the households use it because it is affordable. The findings suggest that as much as 74.2% of the LPG using households do not use it because it is a clean energy form.

Apart from kerosene being the most used cooking energy fuel in general, it is '*unclean*' and the most sought among the low level energy sources which include charcoal and fuel wood. Its choice by the 25% of the households as their primary cooking energy type is because it is easy to use against charcoal and fuel wood users who adopt them because of affordability and availability respectively.

From Table 1, it can be deduced that the major determinants of cooking fuel choice by households are affordability (29.5%) and availability (26.3%) as a fallout of domestic cooking energy poverty. The least factor as observed is household size which accounts for 0.25% determinant of cooking energy choice.

The implication of the choice of kerosene, charcoal and fuel wood is the occurrence of carbon monoxide emissions.

The mean monthly income and expenditure of the primary cooking energy types of the households are summarised in Table 2. It shows that the average income and energy expenditure across the energy types are ₦125331.7 and ₦2460.08 respectively.

Table 2: Summary of Households' Mean Monthly Income and Energy Expenditure

Energy type	No. of Households	Household Income	Energy expenditure
Electricity	49	153040.8	2382
Gas	93	174112.7	3152.3
Kerosene	101	101543	2593.9
Charcoal	80	81252.6	1647.5
Fuel wood	77	116709.5	2524.7
Average		**125331.7**	**2460.08**

Source: Author's field work, 2016.

In the light of the above, Table 3 represents the percentages of households' income spent on cooking energy in the study area. It shows that the greatest percentage (36.5%) of households in the study area spends 2% of the monthly income on their respective primary cooking energy. The households spending about 1% of their monthly income on cooking energy is represented by 22.3%. The households that spend no proportion of their monthly income represented by 2.5% are those using fuel wood that they source elsewhere other than purchasing.

Table 3: Percentage of Households' Income spent on Cooking Energy

Cooking energy type	No. of Hshds	Percentage of income spent on cooking energy														
		0 %	1 %	2%	3 %	4 %	5 %	6%	7 %	8 %	10 %	11 %	12 %	16 %	21 %	23 %
Gas	93		23	49	9	5	3	3	1							
Charcoal	80		24	27	12	7	7		1			2				
Fuel wood	77	10	4	12	8	14	13	12						1		3
Kerosene	101		18	49		9	4	14	3	1	1	1			1	
Electricity	49		20	9	9	7	2		1				1			
Total	**400**	**10**	**89**	**146**	**38**	**42**	**29**	**29**	**6**	**1**	**1**	**3**	**1**	**1**	**1**	**3**

Source: Author's field work, 2016.

CONCLUSIONS AND RECOMMENDATIONS

The major determinants of cooking fuel choice by households in the study area are affordability and availability. Equally, the choice of cooking energy do not have a definite pattern among the households as all options at their disposal based on affordability and availability are explored. Besides promoting access to electricity being a very important dimension to consider in enhancing households' access to energy, the findings suggest the importance of enhancing households' income, education, gas and kerosene supply. Eventually and in trying to meet up with domestic cooking energy demand, the choice of traditional energy sources as coping strategies in the absence of modern energy is relied on. The study concludes that poor access to regular and efficient modern energy supply is the main rationale for diverse energy choices in Minna metropolis.

Improvement in modern energy access especially electricity in terms of availability and affordability and enlightening energy consumers to be more proactive in improving and adopting sustainable energy use are basic recommendations emanating from the study. Accessing modern cooking energy types by making them available and very affordable in the study area will positively alter the choice and use of various cooking energy types. Also, encouraging efficient cooking energy choice is recommended to meet up with reduction of the negative effects of using inefficient domestic cooking energy needs in the face of unreliable and inconsistent modern energy supply.

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PASSIVE TECHNIQUES FOR ENERGY CONSERVATION IN HOTEL BUILDINGS IN MINNA, NIGERIA

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Globally, hospitality ranks as being high in energy demand and high energy consumption. Energy is used to provide comfort and services in hotel buildings, accounting for 20-50% of the energy use. In Nigeria, the price of energy and its expenses has rapidly increased which underscores the need for energy conservation for sustainable buildings, the input of the built environment professionals. The aim of this research was to find from the opinion of the Built environment professionals on passive techniques as it relates to energy conservation on the design of hotel buildings in Minna. The methodology used in carrying out this research was by administration of questionnaire to the built environment professionals in Minna. The questionnaires were analysed with the aid of the SPSS software package and measured using, Pearson product moment correlation and the Likert scale and presented with the use of tables and charts with the aid of Micro-soft Excel. Findings indicate the need for more awareness on energy conscious integration of passive designs in hotel design to reduce dependence on energy use which could be electrical or mechanical for lighting and thermal comfort. The paper concludes that passive techniques in building designs could lead to hotel buildings that are energy efficient, sustainable and environmentally friendly.

Keywords: energy conservation, energy use, hotel buildings, integration, passive designs.

INTRODUCTION

The increase in energy costs and environmental disasters has caused a global resolve for a more sustainable and long-term preservation and better quality of life in the-twenty first century and beyond (Mohamed, 2017). The hotels being a part of the hospitality industry play are important as guests, visitors, and tourists are offered accommodation and its allied facilities in exchange of payment (Chan & Mackenzie, 2013). Therefore, it is imperative for owners and managers of hotels to be aware of the impact of energy conservation, their running costs and carbon emissions on the environment (Chong & Ricaurte, 2014; Hotel Energy Solutions, 2011). Low energy efficiency practice has consequently made hotels to take up a bulk of the energy and resources in the hospitality industry (Bohdanowicz *et al.*, 2001).

Researches carried out on buildings in Greece, China, UK, Malta and UAE suggest that energy efficiency is attainable when approached with appropriate measures (Gonzalez & Yousif, 2015; Wang *et al.*, 2015; Krestiniti, 2017; Jonesa *et al.*, 2017; Ibrahim, 2017). In recent times, several efforts are being directed to achieving sustainability across all sectors in the society. As a result of these efforts, different groups have generated their own rating systems equivalent to their societal and natural environments requirements. In addition, to achieving sustainability, other groups have set up authorization points that require every construction to adhere to, in elevating the effectiveness of public part in design process (Ibrahim, 2017).

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It is therefore necessary that the opinion of the built environment professionals in every society on the pressing issues of using passive techniques and energy use in building is known so that researches can be made in such a way that they are tailored to be related to and applicable by the profesionals. The factors that can influence the use of passive techniques for energy conservation and energy efficiency in Hotel buildings in Minna as studied in this paper includes;

- Acceptance of passive design techniques for lighting and cooling (which includes ventilation)
- Suggested possible minimum time of use of active qualities for lighting and cooling
- Importance of passive techniques in some selected parts of a hotel for lighting and cooling
- Most suitable passive techniques for hotel buildings in Minna metropolis
- Challenges of integrating passive techniques in hotel buildings in Minna

Hotel Buildings and Energy Consumption

Hilton Team (2015) noted that energy is logically the second or third major cost for a regular hotel, as it is imperative for the use of power appliances, heating, cooling, lighting and air conditioning. The International Energy Agency (IEA) (2013) also noted that buildings have a share of about 80% of Total Final Consumption (TFC) globally as an energy source. The revenue of a full-service hotel has between 4% and 6% going to its operating costs. There is a possibility of saving 20%-50% by reducing energy use from the lighting system, heating, ventilating and air conditioning systems (E Source Customer Direct Brochure, 2004; International Cablemakers Federation (ICF-International), 2008). It was found that heating, catering, domestic hot water and lighting are the main energy consumers in a hotel building (CADDET, 1997). Hence, the key elements to be engaged in order to be able to lower the energy usage in a hotel building are the HVAC (Heating, Ventilation and Air Conditioning), lighting system and laundry. (San Diego Gas & Electric Company (SDGE), 2010).

The comfort of the guests and staff in a hotel can be ensured along with the reduction of operating costs when energy conservation measures are properly applied (E Source Customer Direct Brochure, 2004). According to Wang *et al*.(2015) the feasibility and possibility of reducing energy consumption is sure because there exists a variety of factors that have been recommended. The reason for it is that they lead to high level of energy use in a hotel building and they include the climate of the location of the hotel, the hotel features, the technical equipment and the building materials used (Upadhyay *et al.,2017*). The actions of the occupants inhabiting in low energy buildings contribute largely to their actual energy consumption (Jonesa *et al.*, 2017).

Low energy design of urban environment and buildings in heavily populated regions need contemplation of a broad array of factors including urban setting, transport planning, energy system design, and architectural and engineering details (Omer, 2003). Kapiki (2010) pointed out that in Thessaloniki in Greece, certifications and energy-saving practices for; electricity and water consumption reduction are important in addition to the fact that deliberate energy saving measures on hotels can show the way to the reduction of their operating costs.

Passive Techniques in Design And Low Energy Use

The challenge for architects and other building professionals today is to design and promote low energy buildings in a cost effective and environmentally responsive way. The study and improvement of the quantity of the built environment and living conditions should be encouraged by the built environment professionals (Omer, 2003). Integrating passive techniques in building design requires a good understanding and analysis of thermal comfort, energy performance and the local climate of the building (Mikler, Bicol, & Breines, 2009).

Selecting the appropriate technology and equipment and reducing air-conditioning and lighting energy use is the key to energy savings in the hotel (Gu, Zhao, & Ma, 2012).In Greece it was found in a research by Krestiniti (2017), through simulation that building envelope measures can cause noteworthy reductions that involves both heating and cooling needs, therefore implying that integrating passive techniques is good for energy conservation and useful economically. The hotel proprietors and hotel designers have important options to think about, the carrying out of strategic measures on energy use is an investment that is both interesting and not too cost demanding and has very low impacts on the environment

(Parpairi, 2017). Integrating passive techniques in the design of buildings have been discovered to be schemes that could be efficient in causing a decrease in energy consumption with diverse factors like climatic zone, building typology and determining the design technique that could satisfactorily fit it. (Bodach, Lang, & Auer, 2016)

According to the KS Architects (2009) architectural group, there are three primary factors that are to be critically considered in determination of energy conservation or efficiency of a space:

1. *Air- ventilation*
2. *Light – artificial lighting control*
3. *Heat- Cooling and heating*

The Integrated Energy Design process centres on using passive qualities in realizing maximum comfort and as minimum active qualities as possible in terms of installations, adjustments and other technical systems involving ventilation, cooling and lighting (KS Architects, Denmark, 2009).

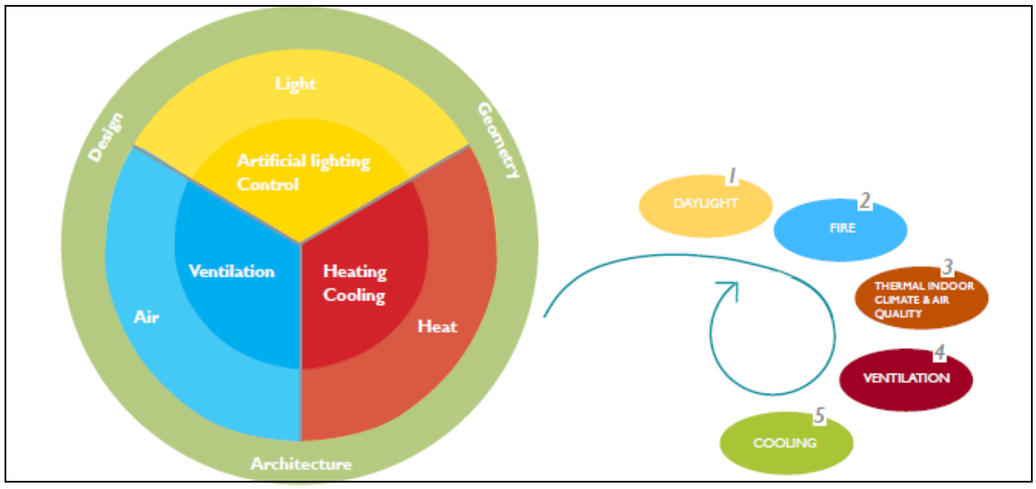

Figure 1.0: Integrated Energy Design Process Source**:** KS Architects, 2009

These factors also play a role on the general wellbeing of the occupants of the hotel building and this is often evident through the equipment, fixtures and fittings like the lighting bulbs, revolving fans and air conditioners that are installed in the hotels all towards maximum comfort. Akande *et al.*,(2015) noted that the design and construction stages are basic and important in the provision of energy efficient buildings that are comfortable and effective at their designated purpose. To that effect, in making a better indoor environment quality, the following are involved; daylight, ventilation, and cooling (https://www.whittlesea.vic.gov.au).

Laustsen (2008) suggests that achieving energy efficient built environment with less expense starts as early as the design phase from the costs of some efficiency improvements like; construction costs, energy improvements, works on the building envelope and HVAC systems. Some constructions that might need efficiency improvements include concrete floors and hidden pipes or foundations. The increase in the energy efficiency of an entire building can be started by considering both the architectural and energy designs together. As the mechanical systems, electrical systems, and structural systems would be affected in the incorporation of passive solar technologies and the implementation with the guidance of information from building simulation software (Littlefield *et al.*, 2009)**.**

Therefore, the process of achieving energy conservation in a building would best work as integrating passive techniques with the variables in the building design stage(Lewis, 2004).The essence of seeking the view of the Built Environment Professionals (BEPs) in terms of passive techniques for energy efficiency and conservation was deduced from the conclusion of the works of Omer (2003), Gu *et al.*(2012) and Parpairi (2017) which suggested that it is possible for the building professionals to achieve low energy buildings even from the design stage. As they contribute in the conception, design, planning and registration of the building before its construction. From the literatures that were reviewed, it was deduced that the use of passive techniques for energy conservation and energy efficiency in Hotel buildings are viable. These can also be applied in a wide range of ways along with the minimum use of active qualities for lighting and cooling

RESEARCH METHOD

The aim of this research was to pin point from the opinion of the built environment professionals their perception of passive techniques on energy conservation and efficiency on the design of hotel buildings in Minna. The findings were weighed to observe the flow and trend of the opinions of the BEPs. The BEPs considered include architects, builders, quantity surveyors and civil/structural engineers, others considered includes planners, estate valuers, mechanical and electrical engineers. The data for this work was collected through the use of questionnaires which were administered to one hundred (100) BEPs in Minna.

Table 1.0: Number of Professionals per response

	Profession	Sample size	Response Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Architects	30	27	32.5	32.5	32.5
	Quantity surveyors	15	14	16.9	16.9	49.4
	Civil engineers	10	5	6.0	6.0	55.4
	Builders	20	16	19.3	19.3	74.7
	Others	25	21	25.3	25.3	100.0
	Total	100	83	100.0	100.0	

Source**:** Author's fieldwork, 2017

The sampling technique used for this survey was stratified random sampling method, with the Architects as the designers of the building taking the most of the strata with 30% as is on Table 2.0 and from The Architects Registration Council of Nigeria (ARCON) (2013), the number of accredited architects located in Minna was about 23. Hence 30 questionnaires were allocated for the strata of architects as the prime consultant (The Nigerian Institute of Architects, 2000) with room for an increase as at the time survey was taken while the questionnaires for the other professionals were allocated by quota with 20 going to builders, 15 to quantity surveyors and 10 to civil/structural engineers, while 25 were administered to planners, estate valuers, mechanical and electrical engineers (Table 1.0). The questionnaire is made up of two sections as, the first section is made up of closed ended questions about energy conservation and its relevance in the design of hotel buildings and the second section is comprised of open ended questions inquiring of their opinion on the passive techniques that can help in energy conservation and the possible challenges that could affect their application in hotel buildings in Minna.

Eighty three (83) questionnaires were answered as at the moment they were picked up, with 89.16% of the closed ended part of the questionnaire answered and 83.13% of all the retrieved questionnaires had the open ended questions responded to. Out of the 83 questionnaires collected were 32.5% from architects, 16.9% from quantity surveyors, 19.3% from builders and building technologists, 6% from civil engineers and 25.3% from the other professionals (which includes planners, estate valuers and mechanical and electrical engineers). The data retrieved were analysed with the aid of the SPSS package. The results from the questionnaires were measured using, Pearson product moment correlation and the Likert scale and presented on tables and charts.

RESULTS AND DISCUSSION

The outcome proves opinions on passive techniques from the view of the Built Environment Professionals on the usefulness and application in hotel building designs in conserving energy. There is a wide range of opinions on the perceptions and use of passive techniques that were suggested for the energy conservation in the hotel buildings in Minna. The results from the questionnaires that were administered is discussed with the use of doughnut charts, stacked column in 3D, Pearson product moment correlation, Likert scale and bubble diagram.

Views on Effectiveness of Passive Techniques on Energy Conservation

It can be seen from Figure 2.0 that a high percentage of the BEPs view that passive techniques can be used for energy conservation in the hotel buildings in Minna. It is in agreement with KS architects (2009) as it is on Figure 1.0, that even in the maximum utilization of passive techniques for day-lighting and passive cooling, there would be times in which active alternatives may be used to supplement, and to this effect these active means might be required for a specific period of time per day.

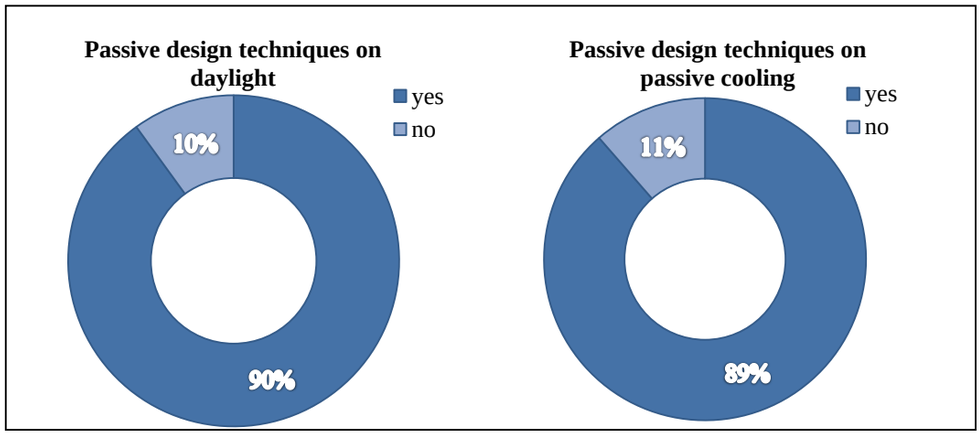

Figure 2.0: Effectiveness of energy conservation to the design of hotels
Source**:** Author's fieldwork, 2017

Maximum Time of Use of Active Qualities for Lighting and Cooling for Energy Conservation

It was observed from Figure 3.0 that a majority of the professionals in the built environment agree that the minimum time that these active techniques like the artificial lighting and HVAC systems can be used to supplement day-lighting and passive cooling respectively is from 7 to 12 hours per day.

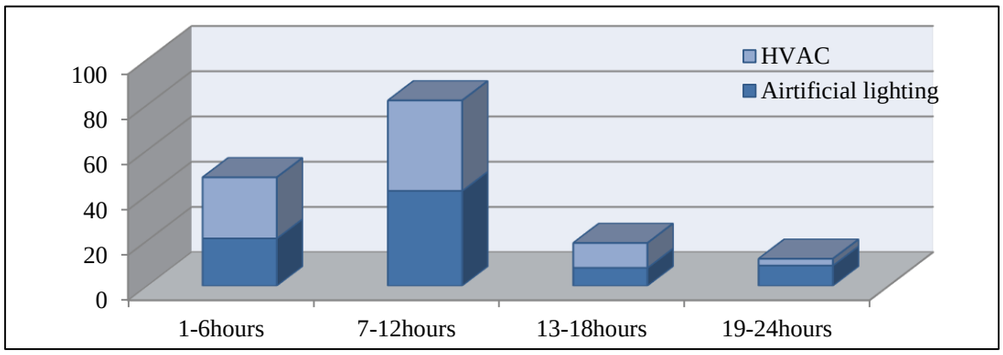

Figure 3.0: Maximum allowable time of use of active systems for energy conservation in hotel buildings
Source**:** Author's fieldwork, 2017

Product Moment Correlation of Maximum Time for Artificial Lighting and the HVAC Systems

Values of 1-4 were assigned to the options for the questions on the importance of some passive techniques. The significant relationship of their response for both energy use systems were analyzed with two (2)-tailed test and a level of significance at 0.05for this correlation analysis. The results from the test of the statistics that was carried out with the Pearson product moment correlation for the significant relationship between the suggested maximum time of use for the artificial lighting and the HVAC systems in hotel buildings. From the data used for Figure 3.0, the test showed that there is a significant relationship between the preferred times of maximum use of the artificial lighting and HVAC systems in ensuring energy conservation as calculated in **T**able 2.0.

Table 2.0: Correlations of Suggested time of use for both artificial lights and HVAC Systems

		Artificial lights	HVAC
Artificial lights	Pearson Correlation	1	.282
	Sig. (2-tailed)		.012
	Sum of Squares and Cross-products	48.765	15.380
	Covariance	.610	.197
	N	81	79
HVAC	Pearson Correlation	.282*	1*
	Sig. (2-tailed)	.012	
	Sum of Squares and Cross-products	15.380	64.688
	Covariance	.197	.819
	N	79	80

*. Correlation is significant at the 0.05 level (2-tailed).
Source**:** Author's fieldwork, 2017

Likert Scale Measurement of Perception of the Relevance of Passive Techniques for Energy Conservation in Hotel Building Spaces

A one-sided scoring of 1-4 was allocated to the diverse alternatives for the respondents due to their insight of the variable being considered. The scoring of the alternatives is noted below;

Very Unimportant 1

Unimportant 2

Important 3

Very Important 4

Tables 3.0 and 4.0 explain that majority of the respondents are extending within the very important section of the scale of measurement. The number of respondents in each section is multiplied by the weighted score allocated to it; the calculation for this is shown in Tables 3.1 and 4.1, the total score across the rows are added up and offered as the total at the end of the Table.

Table 3.0: Number of respondents per opinion on importance of day-lighting for energy conservation in parts of a hotel building

Measured variable	Very unimportant X1	Unimportant X2	Important X3	Very important X4	Total
Corridors	5	8	26	35	74
Bedrooms	5	4	33	32	74
Conference halls	4	2	25	43	74
Reception area	7	2	26	37	72
Stairs area	4	7	26	37	74
Restaurant	3	6	37	27	73

Source**:** Author's fieldwork, 2017

Table 3.1: Sum of the responses on importance of day-lighting for energy conservation in parts of a hotel building

Measured variable	Very unimportant X1	Unimportant X2	Important X3	Very important X4	Total
Corridors	5	16	78	140	239
Bedrooms	5	8	99	128	240
Conference halls	4	4	75	172	255
Reception area	7	4	78	148	237
Stairs area	4	14	78	148	244
Restaurant	3	8	111	108	230

Source**:** Author's fieldwork, 2017

Table 4.0: Number of respondents per opinion on importance of passive cooling (natural ventilation inclusive) for energy conservation in parts of a hotel building

Measured variable	Very unimportant X1	Unimportant X2	Important X3	Very important X4	Total
Corridors	4	9	39	20	72
Bedrooms	4	2	32	36	74
Conference halls	2	3	32	38	75
Reception area	3	4	35	32	74
Stairs area	5	18	33	17	73
Restaurant	4	4	31	34	73

Source**:** Author's fieldwork, 2017

Table 4.1: Sum of the responses on importance of passive cooling (natural ventilation inclusive) for energy conservation in parts of a hotel building

Measured variable	Very unimportant X1	Unimportant X2	Important X3	Very important X4	Total
Corridors	4	18	117	80	219
Bedrooms	4	4	96	144	248
Conference halls	2	6	96	152	256
Reception area	3	8	105	128	244
Stairs area	5	36	99	68	208
Restaurant	4	8	93	136	241

Source**:** Author's fieldwork, 2017

It can be observed from tables 5.0 ad 6.0 that majority of the respondents are of the opinion that both day-lighting and passive cooling are important for the spaces in the hotel, this is imperative of the fact that all the spaces in a hotel design should be considered for proper

day-lighting and passive cooling in order to achieve energy conservation and energy efficiency.

Table 5.0: importance of day-lighting for energy conservation in parts of a hotel building

Measured Variable		Sum	Mean	Interpretation
Rating of Corridors	74	239	3.23	Important
Rating of Bedrooms	74	240	3.24	Important
Rating of Conference halls	74	255	3.45	Important
Rating of Reception area	72	237	3.29	Important
Rating of Stairs area	74	244	3.30	Important
Rating of Restaurant	73	230	3.15	Important

Source**:** Author's fieldwork, 2017

Table 6.0: importance of passive cooling (natural ventilation inclusive) for energy conservation in parts of a hotel building

Measured Variable		Sum	Mean	Interpretation
Rating of Corridors	72	219	3.04	Important
Rating of Bedrooms	74	248	3.35	Important
Rating of Conference halls	75	256	3.41	Important
Rating of Reception area	74	244	3.30	Important
Rating of Stairs area	73	208	2.85	Important
Rating of Restaurant	73	241	3.30	Important

Source**:** Author's fieldwork, 2017

Most of the professionals believed that both passive cooling and day-lighting are important (about 46% and 42% respectively) and very important (about 40% and 51% respectively) in the selected areas (corridors, stair areas, bedrooms, conference halls, reception area and restaurants) for energy conservation to be achieved in the hotels in Minna city.

Passive Techniques and Their Challenges

The results obtained from the open ended questions in the questionnaire showed the popularity of the respective passive techniques known to the BEPs through the sizes of the bubbles and the respective purpose of their application with their location of the different axes on the chart on Figure. 6.0. On Figure 6.0; A- Use of openings, B- Use of courtyards and atriums, C- Building orientation, D- Proper landscaping, E- Use of shading devices, F- Evaporative cooling, G- wind catchers and wind towers, H-Use of air tunnel, open corridors, green roofing, solar shading and use of traditional building materials, I- Use of skylights, J- composite construction, K- Use of light tubes, L- Use of curtain walls.

The most popular passive technique was found to be the "A"- use of the openings (this includes the consideration of their sizes, location, quality, types and quantity) to aid in enhancing day-lighting in the hotel buildings while for passive cooling, it was "D"- proper landscaping. Techniques like "I", "J", "K" and "L" were only suggested for day-lighting and similarly "D", "E", "F", "G" and "H" were only suggested for passive cooling.

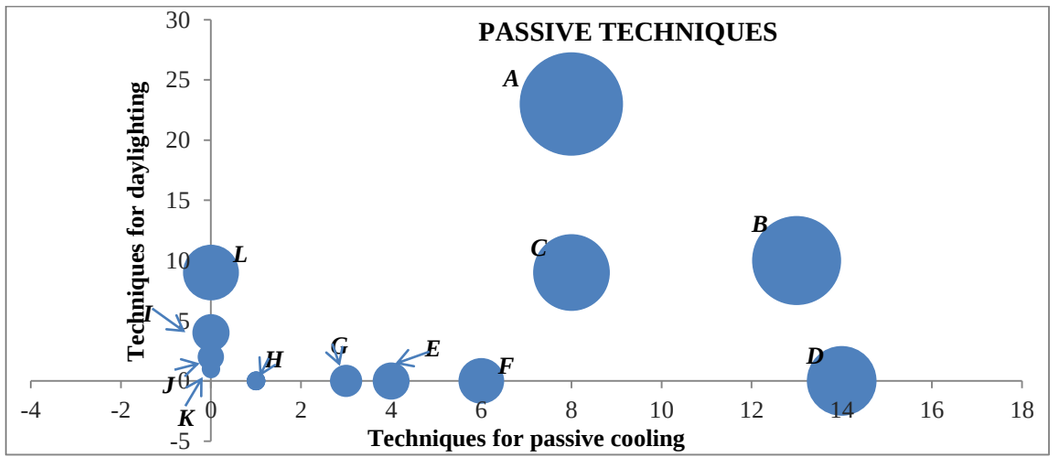

Figure 6.0: Suggestions of passive techniques for hotel buildings in Minna to cause energy conservation
Source: Author's fieldwork, 2017

The challenges that the Built Environment Professionals face that could also affect the use of passive techniques for energy conservation in Minna as shared by the BEPs are outlined on Table 7.0. They are outlined in descending order based on popularity; the most common challenges shared by the professionals (BEPs) are the feared cost of maintenance in the application of passive techniques on buildings, the presence of little or no awareness of

passive techniques on buildings and the uncertainty about the possibility of energy conservation in a building.

Table 7.0: Challenges for passive techniques for hotel buildings in Minna

S/N	**Challenges according to the BEPs**
1	Feared cost of maintenance and application
2	Little or no awareness
3	Unavailability of materials
4	Client requirements
5	Government development control agencies
6	Insufficient skilled force for building construction
7	Indiscriminate construction of buildings
8	Little or no proper site analysis
9	Ignorance on the part of the professionals

Source: Author's fieldwork, 2017

CONCLUSIONS

The opinion of a majority of the Built Environment Professionals (BEPs) was that the application of passive techniques for more daylight and passive cooling could be effective in achieving energy conservation in hotel buildings. To that effect, the minimum time that a majority of them opined that the need for active qualities like artificial lighting and Heating Ventilation and Air conditioning (HVAC) systems could be required. According to 52% and 48% of the BEPs, it would be for about 7-12hours in a day, for energy efficiency in the use of the HVAC and artificial lighting systems respectively. There was also an agreement from a majority of them that proper day-lighting and well introduced passive cooling techniques in the areas in a hotel building is important for energy conservation.

It was found that there was a significant relationship between the opinions of BEPs for the minimum time of use for both the HVAC and artificial lighting systems for cooling and ventilation and lighting respectively. The test for the level of importance of Energy conservation in some selected areas of the hotel building (they include; the corridors, stair area, conference halls, restaurant, bedrooms and the reception area) showed that energy conservation is important to all those areas in the hotel building. As such, both day-lighting and passive cooling if passive techniques should be applied in every space n the hotel building. Some suggested passive design techniques that could be used for energy conservation in Minna includes; strategic use of openings, courtyards and atriums, optimum use of Building orientation, Proper landscaping and the use of shading devices.

In conclusion, the BEPs in Minna have an idea of the need for energy conservation in the built environment as well as their needed contributions towards it. But, the challenges that could come with the incorporation of passive design techniques are what could be affecting their interest in them. Further research on the design of buildings would help also in achieving better hotel buildings that are not only energy efficient but also, sustainable and environmentally friendly.

RECOMMENDATION

The research towards energy conservation and efficiency in the building industry in Minna and in Nigeria should be encouraged through the provision of equipment and agencies provided with relevant data for proper and adequate measurement and assessment of buildings and their performance in the climate of the location of construction. Professionals involved in the built environment, private individuals and the government should offer special support toward researches on energy conservation in buildings in Nigeria, because it does not only influence the short term issue of providing better living standard of people in buildings, reduced energy demand and energy use, but also the issue of the use fossil fuels and other non-renewable energy sources with long-term effects, such as climate change.

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ANALYSIS OF ENERGY POVERTY IN RAFI LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA

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Energy access is an essential tool for social and economic development of any nation. The energy that most people in developed countries enjoy is usually out of the reach of most people in the developing countries, especially Nigeria. Energy access in Nigeria has urban and rural dimension; the situation is even worse in rural areas than the urban centres. This study, therefore, examines energy access (EA) and its determinant in Rafi LGA of Niger State. The objective of the study is as follows; to assess resident access to electricity and clean cooking energy, measure energy poverty and assess the determinant of energy poverty. Energy access was measured using a multi-tier approach to energy access measurement developed by Nicolina Angelou for Energy Sector Management Assistant Programme (ESMAP, 2014). Energy access in Rafi LGA was examined in ten (10) selected communities, one from each of the ten (10) wards of the LGA. Households, enterprise, and community institution forms the three (3) tiers of the community energy access levels, using graduated measurement rather than binary measurement. A total of 447 copies of questionnaires was administered. The data collected are analysed by using descriptive and inferential statistics. Regression analysis was employed as an analytical tool to identify the determinants of energy poverty in the study area. The study shows that electricity access from the three (3) tiers of the communities varies; households energy access index is (0.53), Enterprise (0.31), community institution (0.23), while the energy poverty for Rafi LGA stands at (0.29). The poor performance of energy access is occasioned by poor access to clean cooking fuel (0.05) at household level. The regression analysis shows that 65.4% of energy access in Rafi LGA can be explained by years spent in school, age of marriage, age of household head, household size and the income of the household head. The study concludes that access to clean cooking fuel is by far the most pressing challenge to energy access in rural communities of Rafi LGA. Therefore, the study recommends that clean and affordable cooking fuel should be made available across the study area with proper awareness creation on the benefits of using clean cooking fuel. If energy access at the rural areas must be tackled, education and livelihood of the people must also be improved.

Keyword: *Energy, Energy Access, Energy Access Index, Energy Poverty*

INTRODUCTION

Poverty is undoubtedly one of the world's most pressing issues, which requires immediate attention. Over the years, the term "poverty" has been conceptualized in various ways by many authors (Foster *et al*., 2003; International Energy Agency (IEA) 2010a; United Nation Development Programme (UNDP, 2012); Practical Action (PA, 2010). Poverty is conceptualized in economic terms through the use of income, or in social terms, which involves lack of access to basic human needs (food, water, clothing, shelter, sanitation, healthcare and education). There is also the energy dimension of poverty; popularly termed energy poverty. There is no doubt that quite a number of concepts and definitions of energy poverty abound in both policy and academic literatures. The extant literature review has shown that there is no consensus as to how best to define and measure energy poverty (Reddy et al., 2000; IEA, *et al.*, 2010b; Asian Development Bank (ADB, 2013).

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However, even with the multiplicity of energy poverty definitions, it is evident that most scholars are in agreement over two indicators; access to electricity and access to clean cooking fuel (United Nations, 2005; IEA, 2010b, ADB, 2013). Therefore the Asian Development Bank (ADB, 2013) definition of energy poverty was adopted for the study. The definition is stated thus "*absence of sufficient choice in accessing adequate, affordable, reliable, high quality, safe and environmentally benign energy services to support economic and human development*."

Despite Africa's endowment in energy resources, it remains the least in terms of energy access amongst all other regions of the world (IEA, 2016). There is a sharp contrast in energy access between the northern Sahara and the Sub-Saharan countries (Moulot, 2005). Electricity access in the northern Sahara is estimated to be 95% as against 23% in the sub-Saharan Africa, which drops considerably to as low as 1% in some countries (UN, 2005). UN (2005) asserted that in Sub-Saharan African countries with the exception of South Africa, 80% of the inhabitants depend on traditional biomass for their energy use; hence it is fair to posit that access to modern energy services (electricity and clean cooking fuel) is by far the most pressing challenge facing the continent. Globally, it is estimated that about 3 billion people are currently living in the rural areas, many of who do not have access to clean energy services (Sumiya, 2016). It is also estimated that about one-third of humanity cannot access modern energy forms and services (IEA 2009).

The situation of energy poverty in Nigeria is not different from that of the region. Ogwumike and Ozughalu (2015) estimated that energy poverty in Nigeria stands at 75%. Further study carried out by Apere *et al*., (2014) shows an increase in energy poverty in Nigeria to as high as 95%. Energy poverty across the states in the south-south zone is as high as 96.7% in Cross River State and 60.1% in Edo. Edoumiekumo *et al.,* (2013) also suggested that energy poverty has a rural dimension; energy poverty in the rural area was estimated to be 98%, and is more severe in the rural areas than the urban areas. Sanusi and Owoyele (2016) estimated that access to clean cooking energy in Nigeria is as low as 0.38% in Zamfara State; while the highest is recorded in Abuja the Federal Capital with just 12.76% of the inhabitants having access to clean cooking fuel. Despite the abundance of energy resources in Nigeria, an estimated 113 million people, representing about 70% of the population, lack access to electricity, while the remaining 30% have only intermittent and unreliable access (Adedeji, 2016). IEA (2016) estimated that electricity access in Nigeria stands at 45%, 55% in the urban areas and 36% in the rural areas, while it is estimated that 134 million people rely on traditional biomass for energy use accounting for 76% of the population.

Several studies have been directed toward addressing the issue of energy poverty in Nigeria; (Sunday, 2011; Stephen et al., 2011; Edoumiekumo *et al*., 2013; Apere, 2014; Sanusi and Owoyele, 2016). Most of the studies on energy poverty dwell more on estimating energy poverty at national, zonal or state level. Studies on energy poverty in Nigeria concentrate on national level estimations, ignoring disaggregated information on energy access at the local level. Furthermore, there is little or no studies on energy poverty and access that shows the spatial disparities of energy access in the rural areas of the country; Sanusi and Owoyele (2016) mapped out the spatial disparity in energy poverty at state level, thereby neglecting the rural areas where poverty levels are higher and dependency on traditional fuels is noticeably great (Sanusi and Owoyele, 2016). In Nigeria, studies on energy poverty have dwelled more on the composite indicator approach using Multidimensional Energy Poverty Index (MEPI), Total Energy Access (TEA), or Energy Development Index (EDI) (Edoumiekumo *et al*., 2013; Apere *et al*., 2014; Ogwumike and Ozughalu, 2015; Sanusi and Owoyele, 2016) which considers indicators on binary metric (Access or No Access) rather than measuring access base on graduated level of its capacity, duration, reliability, quality, affordability, legality and convenience as proposed by the Multi-Tier energy poverty measurement approach.

By these studies, there are two major research gaps. First is the dearth of local level study, especially at the level of rural settlements and secondly, there is a methodological gap in the current approach to measuring energy poverty. This study intends to fill this gap by focusing on rural communities and by employing Multi-Tier energy poverty measurement approach. This was achieved through the following objectives; assess energy access, measure energy poverty using multi-tier approach and identify the determinant of energy poverty in Rafi LGA.

Energy and Human Wellbeing

Energy is a central aspect of human life as it affects agricultural productivity, environmental sustainability, health care, and job creation. More than a need, energy per se is absolutely essential to deliver adequate living conditions, food, water, health care, education, shelter and employment (Najam *et al*., 2003). Poverty comes in different dimensions; and hence energy is a dimension of poverty. When there is energy poverty; it simply implies that one of the bundles of product needed to maintain a good life is missing (Sanusi *and Owoyele*, 2016). Energy is one of the basic human needs that play a crucial role in improving human well being (Global Network on Energy for Sustainable Development (GNESD), 2013). Human wellbeing, poverty reduction, social inclusion, and economic improvement cannot be advanced without access to electricity and clean cooking fuel (Karkezi *et al*., 2012).

Renewable Energy Policy Network for the 21st century (REN21, 2005) noted that the only available and affordable energy for the world's poor is "traditional biomass" which includes animal waste, fuel wood, and crop residue. Practical Action (2010) cited in Sanusi and Owoyele (2016), highlighted three (3) mechanism that relates energy access to wellbeing, they are; creating new earning opportunity, improving existing earning activities and reducing cost, drudgery and releasing time to enable new earning opportunity. Presently energy is one of the most essential ingredients for poverty alleviation as it is a vital input for people's livelihood. At the most basic level, energy is needed for cooking, heating and cooling (Clancy *et al.*, 2003). UNDP (2004) suggested that the deprivations arising from energy poverty on human development are far more significant than energy poverty itself; because it does not only reflect energy poverty but human poverty. There are various deprivations that arise from energy poverty (Ramani, 2004; Modi *et al*., 2006).

Although basic educational services and literacy can be achieved without the use of cleaner energy input, yet, there is a link between access to energy and education services. Access to cleaner energy option can improve the quality and availability of educational services and increases the likelihood that children will attend and complete school (IEA, 2010a; UNDP, 2005; UN, 2005). Mapako (2010) posited that access to cleaner, affordable and modern energy can help to induce a more child friendly environment that encourage school attendance and reduce the significant dropout rate experienced in many low income countries. It can enhance access to clean water, sanitation, lighting, space heating/cooling, and energy for cooking in the case of boarding schools. Access to clean energy can provide quality lighting for both the boys and girls for comfortable night studying (Mapako, 2010); as it also helps to reduce the risk to child's eyesight (Eva and World Health Organization, 2006).

There is an equity dimension to energy poverty, richer household can afford cleaner and qualitative energy services and fuel than the poorer households (Clancy *et al.*, 2003; Cecelski, 2004). Women from poorer households tends to suffer from large health problems, spend more time collecting firewood and hence pay a higher price per unit of energy (Reddy 2000). The health dimension to energy poverty also exists; as poor households do not boil water and eat less cooked food, thereby inducing health problems which hinder effective women participation in economic and social activities, hence affecting their general wellbeing (Clancy *et al.*, 2003).

Most of the poor people in the world get their daily caloric intake from grains, such as rice, corn, millet, and wheat. Aside from the fact that these grains require energy for cooking before consumption, it also requires energy for their production, harvest and processing as well as for it cultivation, irrigation, transportation and preservation for some food crops especially the perishable crops. Food and Agricultural Organization (FAO, 2011) asserted that through the facilitation of irrigation, food security can be enhanced through access to cleaner energy options. Energy can play a vital role in enhancing food security among the poor by adopting technologies that can be used for irrigation and water pumping.

All production activities from the simplest to the most complex requires energy, be it electricity or fuel. It is an essential input of production and hence has a major effect on the cost of the final product (Modi e*t al.*, 2006; UN Energy, 2005). In its simplest form it can be animal or human energy for doing manual work or transporting goods, while with the introduction of high degree of technology in the production process comes the application of different forms of energy. Formal and informal sector employment is positively correlated to access to cleaner energy options such and electricity and Liquified Petroleum Gas (LPG) (Modi et al., 2006). Transformation of economies is also linked to access to clean

energy; it is an important factor in transforming from an agrarian economy to an industrial based economy. Conversely, economies with record of low clean energy use tend to show high contribution of agriculture to Gross Domestic Product (GDP) which is as a result of poor development of the industrial sector (Modi et al., 2006; UNDP, 2005; UN, 2005).

Although energy itself is not a basic human need, it is critical for the fulfilment of all needs. Lack of access to diverse and affordable energy services means that the basic needs of many people are not being met (Adria and Bethge, 2013). Figure 2.1 shows the graphical presentation of the conceptual framework for this study, indicating how access to modern, clean, and affordable energy can impact positively on the general wellbeing of individual and the community at large.

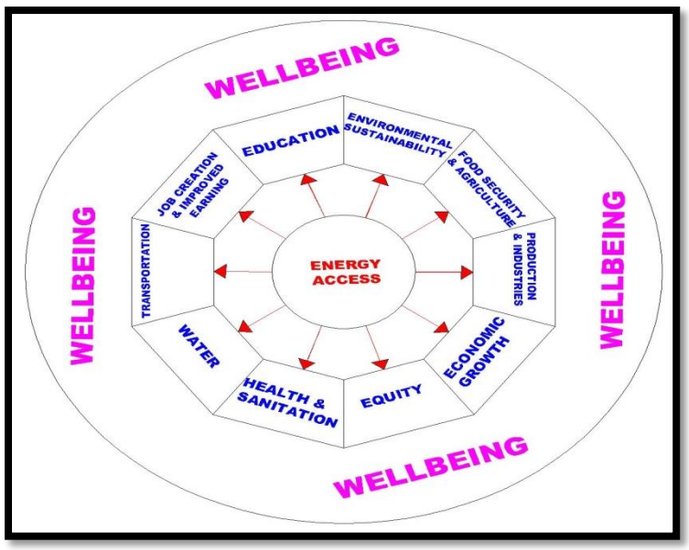

Figure 2.1: Conceptual Framework.
Source: Akande (2017)

Concept of Energy Poverty

Numerous concepts of energy poverty abound in development literatures, yet there is no universally accepted or adopted concept of energy poverty. Although, popular conceptualizations of energy poverty are usually based on minimum physical levels of basic energy needs, the minimum energy expenditure required and maximum proportion of energy expenditure in relation to total disposable income or expenditure. In the case of poverty itself, researchers have to rely on various indicators to capture the depth of poverty from diverse measurements. However, the realities of energy poverty differ across the globe. Phenomena of energy poverty diverge considerably between developed and developing, between rich and poor countries, as well as between different climatic zones.

Energy poverty and fuel poverty are sometimes used interchangeably by some authors; some sccholars consider energy poverty as a concept highlighting problems in developing countries, while fuel poverty is seen to be prevalent in the Organization for Economic Cooperation and Development (OECD) countries. British definition of fuel poverty from 2000/2001 is expressed as "adequate standard warmth" or not being able "to keep a home warm at reasonable cost" (Schuessler, 2014). Boardman (2009) offered a broader definition according to which a household is energy poor if it cannot attain adequate energy services for less than 10 percent of its net income. In simple term energy poverty refers to poverty in terms of access and consumption of energy. Traditionally poverty is measured in terms of monetary income or expenditure. With the time, the ways of measuring poverty have been changed. In Modern days poverty is directly linked to deprivation. Therefore we can simply identify energy poverty as constraints in energy services for households (Tennakoon, 2008).World Economic Forum (WEF, 2013) conceptualizes energy poverty as: "The lack of access to sustainable modern energy services and products". Energy poverty is defined as a situation where the absence of sufficient choice of accessing adequate, reliable, affordable, safe and environmentally suitable energy services is found (ADB, 2013). In simple words, energy poverty is the lack of access to sustainable and modern energy services and products (kerosene, liquefied petroleum, gas etc).

Energy poverty definitions are based on different indicators, some of which was highlighted by ADB (2013) as follows: Minimum amount of physical energy that meets cooking, lighting, heating, and other basic needs (Barnes *et al*., 2010); Type and amount of energy used by households at or below the poverty line (Barnes *et al*., 2010); Household energy spending beyond a certain percentage of the household budget (Barnes *et al*., 2010); Income level sufficient only to sustain the bare minimum energy needs (below that, energy use or energy expenditure remains the same) (Barnes *et al*., 2010);

Poverty and lack of access to modern forms of energy (Modi *et al*. 2006); or Lack of access to energy services (Pachauri *et al.*, 2004). However, even with the multiplicity of energy poverty definitions, it is evident that most scholars are in agreement over two indicators; access to electricity and access to clean cooking fuel (UN, 2005; IEA, *et al.* 2010, ADB, 2013).

Concept of Energy Access

The concept of energy access does not lend itself to an easy definition. In the past, access to energy usually was considered synonymous with household access to electricity. It has been defined variously as, household electricity connection, an electric pole in the village, and an electric bulb in the house. However, these definitions do not take into account the quantity and quality of electricity provided. The global agenda on energy poverty has arose various debate and argument on what constitute energy access by scholars, international organizations and research groups across the globe (IEA, 2009, Energy Sector Management Assistant Programme (ESMAP), 2014). It is important to have a working definition of energy access prior to the development of metrics or indicators for measuring energy access. IEA (2011) conceptualizes energy access in three (3) incremental steps, they are as follows; (i) basic human needs (electricity for lighting, health, education and communication) approximately 50 – 100 Kw per person per year and approximately 50-100 goe of modern cooking fuel or improved biomass cooking stove (ii) Productive uses; electricity and modern cooking fuel for agriculture (pumping of water for irrigation, mechanized tilling), electricity for commercial agricultural processing, cottage industry and other light industries and electricity and modern fuel for transportation e.g. electric train (iii) Modern Society Needs; Modern energy services for many more domestic appliances, increase requirement for cooling and heating (Space and Water) private transportation. Electricity usage is approximately around 2000Kwh per person per year

In 2010, in a report published by the UN Secretary-General's Advisory Group on Climate Change (AGECC, 2010), energy access was conceptualized as "a basic minimum threshold of modern energy services for both consumption and productive uses, that is reliable and affordable, sustainable and where feasible, from low Green House Gas (GHG)]-emitting energy sources."The international development charity Practical Action (2012), in its Poor People's Energy Outlook, uses the term "energy access" to mean the "use of modern energy services by un-served and underserved people." IEA (2012) defines energy access as being without access to electricity and without access to clean cooking facilities. Access to energy is the ability to avail energy that is adequate, available when needed, reliable, of good quality, affordable, legal, convenient, healthy & safe, for all required energy services across household, productive and community uses (ESMAP, 2014). International Institute for Applied System Analysis (IIASA, 2012) define energy access to include access to three forms of energy, each of which provides distinct but essential benefits for economic and social development: less polluting household energy for cooking and heating; electricity for powering appliances and lights in households and public; and mechanical power from either electricity or other energy sources that improve the productivity of labour.

Going by the various definitions of energy access highlighted by international organizations and scholars, it is obvious that there is no single internationally-accepted and internationally-adopted definition of modern energy access. Yet significant commonality exists across definitions, including; Minimum level of electricity access by household; Access to sustainable and safe cooking and heating fuels and stoves; Access to modern energy that enables productive economic activity, (mechanical power for agriculture, textile and other industries); Access to modern energy for public services, e.g. electricity for health facilities, schools and street lighting.

All of these elements are crucial to economic and social development, as are a number of related issues that are sometimes referred to collectively as "quality of supply", such as technical availability, adequacy, reliability, convenience, safety and affordability.

Measurement of Energy Poverty

If the gap between policy and action on energy poverty must be bridged, there is a need for the development for an all in one metrics for measuring the state of energy access. Although, quite a number of metrics exist for measuring energy poverty; this study will provide an insight into four common measurement approach of energy poverty as highlighted below:

Energy Poverty Line & Minimum Energy Require to Satisfy Basic Needs (Energy Threshold)

This measurement approach is deduced from the conventional income or expenditure poverty measure. Energy poverty is determined by estimating energy use as a function of income or expenditure and by estimating the average level of energy use that correspond to the amount of expenditure or income specified by the official income or expenditure poverty line (Pachauri, and Spreng, 2003). Although this approach to energy poverty measurement is easy to compute and useful in determining headcount of energy poverty, it is often criticized on the grounds that it only provides a single energy or fuel poverty line and does not provide an insight by way of suggesting the factors responsible for the low spend or low consumption by households (Jain, *et al*., 2015).

This approach to energy poverty measurement uses estimate to determine the amount of energy required to satisfy basic need (Pachauri & Spreng, 2003; Practical Action, 2010). Modi, *et al.,* (2005) has recently proposed an alternative and less data intensive way to estimate the energy required for basic needs. Unlike the poverty line approach, two poverty line must be exceeded; the first is the minimum amount of final energy used in the form of modern fuel and the second is the minimum amount of electricity for all other services excluding heating and mobility (Jain, *et al*., 2015)

The income poverty line and minimum energy required estimate approach are uni-dimensional and normative in nature. Ascertaining the minimum level of energy required for basic needs is the problem with setting the normative threshold, which is usually due to the significant inter-country and regional differences in cooking practices and heating requirement (Jain, *et al*., 2015). Khandker, *et al*., (2010) argued that energy requirement and consumption is location specific which is due to difference in climatic condition and cultural practices. The minimum needs for physical quantities of energy (for specific tasks) are chosen somewhat arbitrarily. In the opinion of Nussbaumer *et.al* (2011), modern energy services have a higher service quality, hence it reduces household expenditure and increase resource efficiency simultaneously. It therefore implies that as technology improves in energy wise, these metrics (and thresholds) require to be updated constantly and often lose their utility over time.

In the bid to overcome the drawback of these two approaches, Khandker, *et al*., (2010) empirically determine an energy poverty threshold based on estimation of final and end-use energy consumption. The threshold is defined as the income decile where energy consumption is significantly different from the consumption in the first decile. In this approach, the threshold represents the point at which energy demand becomes insensitive to income changes as threshold below the point can only consume a bare minimum of energy (Jain, *et al*., 2015). This metric provides the basic understanding of the difference that exist between income and energy poverty. Nonetheless, it is often criticized for not providing insight into the factors that keep households from meeting the threshold energy consumption. Furthermore, the approach fails to highlight that energy consumption is elastic even among the poor (Bensch, 2013).

Multidimensional Energy Poverty Index

The availability of datasets that provide necessary data for both the developed and developing countries coincided with the notion of poverty as a multidimensional phenomenon (Deaton, 2010). Multidimensional Energy Poverty Index (MEPI) is a child of the Multidimensional Poverty Index (MPI) and it was presented by Nussbaumer, (2012). This approach proposes dual cutoff instead of a single poverty cutoff to define threshold in two steps; weight is attached to each sub-dimensions so that the final head count of energy poverty that is defined incorporates the importance that is attached to all the dimensions. The authors were of the opinion that attainment in all the six sub-dimensions are important and are expressed as dummy equalling one (Jain, *et al*., 2015).

MEPI has been criticized on the basis that the proxies used in defining energy access quality in this approach are not robust enough. Jain, *et al*., (2015) argued that possession or mere consumption of a quantum of these assets does not translate to energy access for households. Just like It was noted by KandehYumkella, the then Director-General of the UN Industrial Development Organization, and UN Secretary-General Ban Ki-moon's that "*the provision of one light to poor people does nothing more than shine a light on poverty*". Therefore, it can be said that energy access transcends mere possession of modern energy assets and

consumption of small quantum of energy. Fuel stacking, which is a common phenomenon especially in developing countries is not fully accounted for or penalized.

Total Energy Access Standard (TEA)

In the light of the criticism of MEPI, an alternative multi-dimensional approach was proposed by the Practical Action (PA, 2012) in United Kingdom (UK). This approach was developed in cooperation with the International Energy Agency (IEA), World Bank, The Global Alliance for clean cooking stoves and the National Development Cooperation Agencies. This approach is called the Total Energy Access Standard (TEA). The TEA corresponds to the headcount ratio of energy poverty, the major point of departure from MEPI is in intensity as it considers the intensity of deprivation as irrelevant. Even with the numerous dimensions captured in the TEA, some areas exist with intractable field data and some areas exist where the definition is just to define the absolute bare minimum threshold of energy consumption. Jain, et al., 2015 argued that even though TEA is dimensionally extensive, it has a binary view of energy access.

It is clear that existing metrics fail on several grounds to provide a nuanced view of energy access. More importantly, they do not dwell on the factors that preclude access. The key point is that energy access is not only multi – dimensional, but also multi-tiered. In other words, households are distributed on an energy consumption spectrum, rather than a binary classification of having and not having access to energy and the services thereof. In the submission of Bensch (2014), he argued that MEPI and TEA are two composite indices which deliver quite distinct results mainly depending on normative judgment inherent in the two indices. MEPI allows for a certain degree of deprivation (e.g. a household maybe energy non-poor). The TEA is far more restrictive in that everybody is considered energy poor, when a household is deprived in any of the six sub-dimensions of the TEA

Multi-Tier Energy Poverty Index

The recent attempt at understanding the subtle difference in energy poverty is that of the Global Tracking Framework (GTF). They combined multi-dimensionality of energy poverty with multi-tiers. This implies that all the facet of the community is captured in terms of the households or community energy access, productive energy access for agricultural processing and enterprises for economic activities. The multi-tier energy poverty measurement approach was developed by Nicolina Angelou who is an Energy economist for Energy Sector Management Assistance Programme (ESMAP) in 2014. This method of energy poverty measures energy poverty based on energy access as a continuum of improvement, based on the performance of the energy supply which includes; Capacity, Duration/Availability, Reliability, Quality, Affordability, Legality, Convenience, and Health & Safety. It is a composite energy poverty approach and it is expressed mathematically as $\Sigma(Pi \times K)$. The multi-tier energy captures all the dimensions of energy poverty from different tiers of the community. Multi-tier framework does not only measure the consumption of energy services, but also measures the quality, reliability, affordability, safety and adequacy of energy access. The method has since been applied and completed by ESMAP in five countries, namely, DRC, Uganda, India, Ethiopia, and Malawi. The multi-dimensionality and the composite measurement approach of the multi-tier energy poverty measurement approach is a good improvement to the existing multidimensional energy poverty measurement approach.

Related Studies

Edoumiekumo *et al.,* (2013) carried out a study on multidimensional energy poverty in the south-south geo-political zone of Nigeria, using the Multidimensional energy poverty index developed by Nussbaumer *et al*., (2011). The study revealed that 83% of the inhabitants in the south-south are energy poor and are deprived of 90.3% of the weighted indicators, while at the state level, Akwa-Ibom, Bayelsa, Cross-Rivers, Delta, Edo, and Rivers were energy poor at 92.1%, 96.7%, 76.8%, 60.1%, and 83.1% respectively. Energy poverty in the south-south geo-political zone was found to have a rural-urban, educational attainment and occupational dimensions.

Apere *et al.* (2014) carried out a similar study on multidimensional energy poverty in Nigeria, with focus on national and zonal levels. Using similar data set and MEPI by Nussbaumer *et al.,* (2011), the study established that 95% of Nigerians are energy poor, while deprivations stands at 74% of the weighted indicators and a MEPI score of 70%. Furthermore, MEPI methodology and NLSS data 2009-2010 was also employed by

Edoumiekumo and Karimo, (2014) to determine energy poverty at state level in Bayelsa State and its implication for sustainable development. The study shows that energy poverty and deprivations stands at 96% and 82% respectively in Bayelsa State. The study also reveals that energy poverty cut across all sectors in Bayelsa State. The studies (Edoumiekumo and Karimo, 2014; Edoumiekumo *et al*., 2013; Apere *et al*., 2014) on multi-dimensional energy poverty at state, zonal and national level in the country focus more on estimating the level of energy poverty without examining the determinant of energy poverty.

Sanusi and Owoyele (2016) examined energy poverty and its spatial differences in Nigeria. Energy development index approach to measuring energy poverty was adopted along with regression analysis to establish the relationship between energy poverty and factors of energy access. The study shows that most of the state performed fairly well with the highest access rate recorded in Lagos State with 99.3% and the lowest recorded in Taraba State with a 10.9%. However, in respect to cooking fuel, the performance is quite poor with the highest rate recorded in Lagos State with a 10% of her household using clean energy for cooking. Generally 55.6% have access to electricity while only 2.7% cooks with clean cooking fuel. Lagos State recorded the highest EDI of 0.613, of all the 36 state only Lagos and the FCT are having fair energy wellbeing, while others are poor. The study also shows that there is disparity in energy access between the northern and the southern states; the former are poorer in terms of energy access.

Adedeji (2016) in his study on the "spatial exploration and analysis of electricity poverty in Nigeria" posited that access is not a problem in Nigeria's urban areas, but rather inadequacies and unreliability of electric supply in substantial quantity and reliable quality. The study establishes that huge infrastructural deficit and metering gap are the major challenges bedevilling the electricity access in the country urban area. The study recommends a total overhauling, maintenance, upgrading and expansion of grid network infrastructure and adequate supply of natural gas to power generation plants to ensure adequate provision of reliable electricity to households.

Metaksa (2016) carried out a study on multidimensional household measure of energy poverty and its determinants in Ethiopia; using MEPI and data from Ethiopian socio-economic survey of 2011 and 2014. Four dimensions and five variables of energy poverty was captured for rural and small towns in Ethiopia, while the static random effect and logit model was used to examine the determinant of energy poverty. Energy poverty in rural and small towns of Ethiopia was found to be severe with about 74% and 73% of the inhabitant found to be multi-dimensionally energy poor in 2011 and 2014 respectively. Furthermore, family size, rural-urban, and household head where found to be the determinant of energy poverty in Ethiopia, while age of household head, number of rooms, and total expenditure were the determinant of poverty. The study recommends that reduction in energy poverty should be handled simultaneously with poverty reduction policies, promotion of rural energy and energy efficient technologies and appropriate energy source pricing mixes.

Madobi (2016) carried out a study on energy poverty in at Marondera urban area of Zimbabwe; 120 respondents were sampled from three residential areas using a multi-stage sampling technique of purposive and random sampling technique. Survey design, interview and documentary analysis were used to collect data; the study was able to establish that resident of Marondera are energy poor with limited energy options, because in the absence of electricity they are forced to rely on traditional energy sources (biomass). The study, therefore, recommends that energy and other related policies be pro-poor and that research in the line of energy sources be done to increase energy options for both rural and urban dwellers.

RESEARCH METHOD

The study adopted a non-experimental research design approach. This implies that it is empirical as it involves a field survey. The study relies on quantitative data. Primary and secondary data were collected and analysed. A total of 500 copies of questionnaires were administered using simple random sampling technique, and 447 copies were returned completed. The data collected were analysed using descriptive and inferential statistics. Regression analysis was employed as an analytical tool to identify the determinants of energy poverty in the study area. The unit of measurement for the sample is household; the sample population for the study was estimated at 3885 households. The sample size for the

study was determined using Sallant and Dilmann (1997) sample size formular to arrive at 500. Table 1 shows the sample population and sample size for the study.

Table 1: Sample Size for the Study

S/N	Name (Rafi LGA)	Households	Sample Size (500)
1	Sihonna	283	34
2	Inga Gari	321	39
3	Kukogi	392	47
4	Guwa	297	36
5	Pangungari	369	44
6	Yakila	709	85
7	Maikujeri	465	56
8	Garun Gabbas	582	70
9	Gidi Gori	294	35
10	Kundu	456	55
	Total	**3885**	**500**

Source: Authors Computation (2017)

Multi-tier energy poverty measurement approach was adapted to estimate energy poverty in the selected rural areas of Rafi LGA of Niger State. This method of energy poverty measures energy poverty based on energy access as a continuum of improvement, based on the performance of the energy supply which includes; Capacity, Duration/Availability, Reliability, Quality, Affordability, Legality, Convenience, and Health & Safety. It is a composite energy poverty approach and it is expressed mathematically as $\Sigma(Pi \times K)$, where Pi = Proportion of households at the k^{th} tier; K = Tier number {0,1,2,3,4,5}

RESULTS AND DISCUSSION

Electricity Connection and Duration of Access

Connection to the public electricity grid was assessed, and the rate of electricity connection in the study area is presented in Table 1. The result shows that electricity connection at household level is 80%, 75% at institutional level, and 49% at the enterprise level. The overall connection rate in the communities is estimated at 68%. The result shows that the entire community tier performed above average, except for institutional tier that records a low connection rate. The result also shows that all the communities are connected to the public electricity grid, except for Sihonna village.

The average daily duration of electricity access in the study area is depicted in Table 2. The analysis shows that the average electricity duration at household level in Rafi LGA is 5.3 hours, 1.9 hours at institutional level, 4.3 hours at the enterprises level.. On the average the communities enjoy 3.8 hours of electricity per day. This shows that although electricity connection rate is high, duration of electricity access is low.

Table 1 Electricity Connection Rate

Communities	Household	Institution	Enterprises	Overall
Garun Gabbas	100	67	89	85
Gidi Gori	87	50	100	79
Guwa	77	0	100	59
Inga Gari	86	50	100	79
Kukogi	93	50	100	81
Kundu	100	50	88	79
Maikujeri	88	50	83	74
Pangungari	70	100	0	57
Sihonna	0	0	0	0
Yakila	100	75	86	87
Rafi LGA	**80**	**49**	**75**	**68**

Source: Author's Fieldwork (2017)

Table 2: Average Daily Duration of Electricity Access

Communities	Household	Institution	Enterprise	Overall
Garun Gabbas	16.8	5.7	9.5	10.7
Gidi Gori	2.3	0	3.4	1.9
Guwa	3.3	0	3	2.1
Inga Gari	6.3	2.5	3.7	4.2
Kukogi	7.3	2.5	4	4.6
Kundu	3.1	0.5	1.5	1.7
Maikujeri	3.6	3	3.7	3.4
Pangungari	2.3	1	-	1.6
Sihonna	0.0	0	-	0.0
Yakila	8.5	3.8	5.4	5.9
RAFI LGA	**5.3**	**1.9**	**4.3**	**3.8**

Source: Author's Fieldwork (2017)

Reliability of Electricity Access

The reliability of electricity access was assessed based on number and duration of electricity outages. The result on average number of daily electricity outages is presented in Table 3. At household level, an average of 2.6 daily outages is recorded, 2.4 outages for enterprise, and 1.5 daily outages for institutions. The low number of outages recorded at institutional level may be as a result of hours spent at such institutional areas compared to enterprise and household.

The duration of daily outages was also assessed, and the result is depicted in Table 4. The result shows that daily power outage in Rafi LGA last for an average of 4.7 hours. The highest average duration of outages was recorded at household level (5.9 hours), enterprise 3.6 hours, and institutions 3.3 hours.

Table 3: Average Number of Daily Outages

Communities	H	E	I	Overall
Garun Gabbas	0.9	1.7	1	**1.2**
Gidi Gori	2.5	3.4	2	**2.6**
Guwa	3.2	2	0	**1.7**
Inga Gari	3.4	4	1.5	**3.0**
Kukogi	4.8	3	2	**3.3**
Kundu	3.6	3.4	1	**2.7**
Maikujeri	2.7	3.3	3	**3.0**
Pangungari	2.1	0	3	**1.7**
Sihonna	0.0	0	0	**0.0**
Yakila	3.3	2.9	1.75	**2.7**
LGA Level	**2.6**	**2.4**	**1.5**	**2.2**

Source: Author's Fieldwork (2017)

Table 4: Average Duration of Daily Outages

Communities	H	E	I	Overall
Garun Gabbas	0.5	0.8	0.83	0.7
Gidi Gori	3.7	4.4	4	4.0
Guwa	4.7	4	0	4.4
Inga Gari	6.1	4	2.5	4.2
Kukogi	6.3	4.7	3.5	4.8
Kundu	16.2	9.3	11	12.2
Maikujeri	3.9	4.2	3.5	3.9
Pangungari	14.3	0	5	9.7
Sihonna	0	0	0	0
Yakila	3.5	4.1	3	3.5
RAFI LGA	**5.9**	**3.6**	**3.3**	**4.7**

Source: Author's Fieldwork (2017)

Quality of Electricity Access

The quality of electricity accessed was analysed based on the proportion of respondents from various tiers that experience electricity fluctuation and the duration of fluctuation. The result as presented in Table 5 shows that only 19.6% of the respondents experience power fluctuation. Enterprise recorded the highest proportion of respondents that experience power fluctuation. This may be due to the nature of machines and tools used by enterprises, especially the grinders and welders. Furthermore, the communities experience an average of 8.8 minutes of power fluctuation, while at household level, the average duration of fluctuation is 9.1 minutes, enterprise 8.6 minutes, and institution 10 minutes (Table 6).

Table 5: Electricity Fluctuation by Communities

Communities	H (%)	E (%)	I (%)	Overall
	Yes	**Yes**	**Yes**	**Yes**
Garun Gabbas	3.3	44.4	0	**16**
Gidi Gori	6.3	60	50	**39**
Guwa	0.0	0	-	**0**
Inga Gari	2.9	66.7	0	**23**
Kukogi	9.8	66.7	50	**42**
Kundu	7.8	37.5	0	**15**
Maikujeri	10.2	50	0	**20**
Pangungari	8.1	--	0	**4**

Sihonna	-	-	-	
Yakila	6.8	42.9	0	**17**
LGA Level	**6.3**	**45.4**	**11**	**19.6**

Source: Author's Fieldwork (2017)

Table 6 Average Duration of Fluctuation

Communities	H	E	I	Overall
Garun Gabbas	10	10	0	10
Gidi Gori	7.5	8.3	10	8.6
Guwa	0	0	0	0
Inga Gari	10	7.5	0	8.8
Kukogi	6.7	7.5	10	8.1
Kundu	8.3	10	0	9.2
Maikujeri	10	8.3	0	9.2
Pangungari	5	0	0	5
Sihonna	-	-	-	-
Yakila	15	8.3	0	11.7
Rafi LGA	**9.1**	**8.6**	**10**	**8.8**

Source: Author's Fieldwork (2017)

Household Access to Clean Cooking Energy Distance Covered and Rate of Distance Change in Search of Cooking Energy

The study reveals that all the households rely on firewood as the primary source of cooking energy. Therefore, the study assessed the distance covered by households in search of firewood in the last five years and in recent time. The result is presented in Figure 1. The result shows that the average distance covered by household in search of firewood is 2.5km in the last five years, while presently households cover an average of 4.5km in search of firewood. In recent time, the highest average distance covered in search of firewood is recorded in Yakila (5.9km), while the lowest is recorded in Guwa 3.6km.

The rate of distance change within five years is computed and presented in Table 7. The result shows the distance covered in search of firewood increases at 9.2% per annum in Rafi LGA. The lowest rate of distance change per annum is recorded in Garun Gabbas 6.7%, while the highest is recorded in Maikujeri 13.1%. This is an indication that there is high rate of distance change per annum, which may result to energy stress.

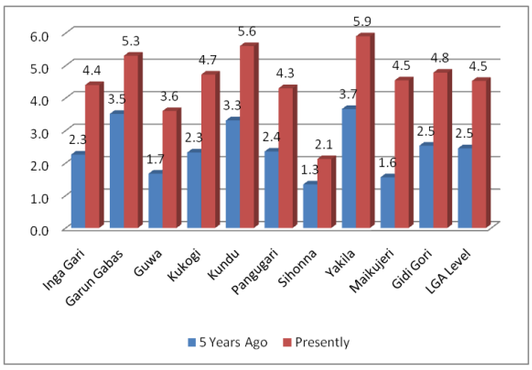

Figure 1: Distance Covered in Search of Firewood
Source: Authors Fieldwork (2017)

Table 7: Change in Distance Covered in Search of Firewood

Community	Change in Dist (Km)	Rate of Change/Annum
Garun Gabbas	1.8	6.7
Gidi Gori	2.3	9.4
Guwa	1.9	10.7
Inga Gari	2.1	9.7
Kukogi	2.4	10.2
Kundu	2.3	8.2
Maikujeri	2.9	13.1
Pangungari	1.9	9.1
Sihonna	0.8	7.4
Yakila	2.2	7.6
LGA Level	**2.0**	9.2

Source: Authors Fieldwork (2017)

Similarly, Figure 2 shows the time spent by households in search of firewood. The analysis shows that, on the average, households spend about 3.22 hours in search of firewood in Rafi LGA. Yakila recorded the most hours spent in search of cooking fuel, while the least is recorded in Sihonna. This shows that households spend more than 30 minutes in search of firewood as stated by

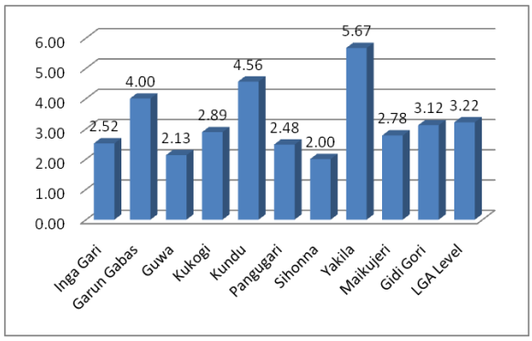

Figure 2: Time Spent in Search of Firewood
Source: Authors Fieldwork (2017)

Energy Poverty in Rafi LGA

Energy poverty in Rafi LGA was computed using the Multi-tier energy poverty measurement index. Electricity poverty index across the three levels of the community (Household, Enterprise, and Institutions) and household access to clean cooking energy forms the basis of the energy poverty assessment. Access to electricity and clean cooking energy was also computed across dimensions at various community levels.

Electricity access index in Rafi LGA is depicted in Table 8. The result shows that all the communities are electricity poor, except Garun Gabbas that is medial electricity poor. The communities recorded a poverty index of less than 0.50. Households recorded electricity access index of 0.55 (medial poor), while enterprises and institution are electricity poor with electricity access index of 0.31 and 0.25 respectively. Households perform better than enterprise and community institution in terms of electricity access.

Table 8: Electricity Access Index by Tier

Community	**H**	**E**	**I**	**EAI**	Remark
G/Gabbas	0.85	0.44	0.41	0.57	**Medial Energy Poor**
G/Gori	0.53	0.33	0	0.29	**Energy Poor**
Guwa	0.61	0.50	0	0.39	**Energy Poor**
Inga Gari	0.60	0.35	0.40	0.45	**Energy Poor**
Kukogi	0.59	0.35	0.28	0.41	**Energy Poor**
Kundu	0.48	0.38	0.38	0.41	**Energy Poor**
Maikujeri	0.58	0.35	0.40	0.44	**Energy Poor**
Pangungari	0.48	0	0	0.16	**Energy Poor**
Sihonna	0	0	0	0	**Energy Poor**
Yakila	0.59	0.36	0.46	0.47	**Energy Poor**
Rafi LGA	0.53	0.31	0.23	0.36	**Energy Poor**
Remark	**MEP**	**EP**	**EP**		

Source: Authors Fieldwork (2017)
Note: H=Household; E=Enterprise; I=Institutions;

Table 9: Electricity Access Index by Dimensions

Communities	**C.I**	**D.I**	**R.I**	**Q.I**	**A.I**
Garun Gabbas	0.83	0.24	0	0.58	0.49
Gidi Gori	0.6	0.2	0.04	0.48	0.53
Guwa	0.67	0.05	0	0.67	0.9
Inga Gari	0.83	0.15	0.02	0.77	0.69
Kukogi	0.83	0.24	0	0.58	0.49
Kundu	0.79	0.01	0.03	0.85	0.35
Maikujeri	0.78	0.16	0.04	0.8	0.61
Pangungari	0.33	0	0.05	0.31	0.11
Sihonna	0	0	0	0	0
Yakila	0.82	0.25	0	0.83	0.45
Rafi	**0.65**	**0.13**	**0.02**	**0.59**	**0.46**
Remark	**MEP**	**EP**	**EP**	**MEP**	**EP**

Source: Authors Fieldwork (2017)

Electricity access index across sub-dimensions of access is presented in Table 9. The result shows that Rafi LGA is medial electricity poor by the dimension of electricity connection (0.65) and quality (0.59). Electricity poverty is experienced from the dimension of duration of access (0.13), reliability of access (0.02) and affordability of access (0.46) in Rafi LGA. This shows that electricity reliability, duration and affordability remains a major challenge

to electricity access in the rural communities. The spatial distribution pattern of electricity access is depicted in Figure 3.

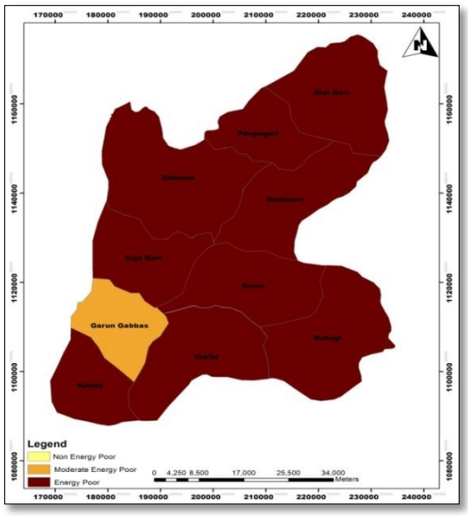

Figure 3: Spatial Distribution Pattern of Electricity Access
Source: Authors Fieldwork (2017)

Household Access to Clean Cooking Energy

Household access to clean cooking energy was examined from three dimensions; cleanliness, quality and convenience of access. The household clean energy access index is presented in Table 10. The result shows that all the communities are energy poor. The poor performance of the households in access to clean cooking fuel is occasioned by the type of primary cooking fuel, distance and time spent in search of cooking energy. The spatial distribution pattern of access to clean cooking energy is depicted in Figure 4.

Table 10: Access to Clean Cooking Energy

Communities	C.I	Q.I	CVI	CEAI	Rank
G/Gabbas	0	0	0.38	0.13	**EP**
Gidi Gori	0	0	0.34	0.11	**EP**
Guwa	0	0	0.5	0.17	**EP**
Inga Gari	0	0	0.36	0.12	**EP**
Kukogi	0	0	0.37	0.12	**EP**
Kundu	0	0	0.3	0.10	**EP**
Maikujeri	0	0	0.43	0.14	**EP**
Pangungari	0	0	0.41	0.14	**EP**
Sihonna	0	0	0.45	0.15	**EP**
Yakila	0	0	0.38	0.13	**EP**
Rafi	**0**	**0**	**0.39**	0.13	**EP**
Remark	**EP**	**EP**	**EP**		

Source: Authors Fieldwork (2017)

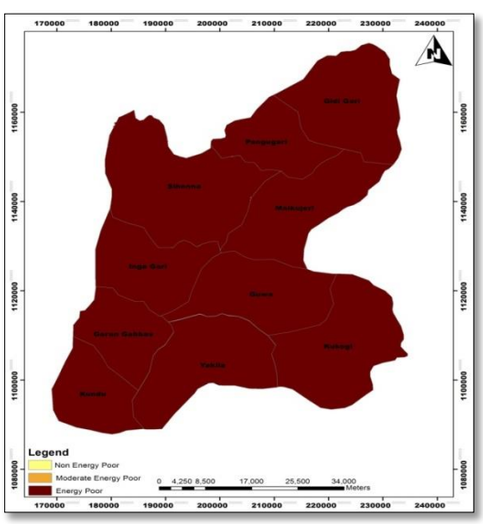

Figure 4: Spatial Distribution Pattern of Access to Cooking Energy
Source: Authors Fieldwork (2017)

Energy Poverty in Rafi LGA

The energy poverty index for the communities was computed based on access to electricity and access to clean modern cooking energy. The result shows that all the communities are energy poor. That is, they record an index of less than 0.5. The best energy poverty index is recorded in Garun Gabbas (0.45), followed by Inga Gari and Maikujeri (0.37) respectively (Table 11). The least is recorded in Sihonna (0.03), which is occasioned by the total absence of electricity connectivity in the community. The spatial distribution pattern of energy poverty in Rafi LGA is presented in Figure 5.

Table 11: Energy Poverty Index

Communities	**EPI**	Remark	**Rank**
Garun Gabbas	0.45	EP	1
Gidi Gori	0.22	EP	8
Guwa	0.30	EP	7
Inga Gari	0.37	EP	3
Kukogi	0.33	EP	6
Kundu	0.35	EP	5
Maikujeri	0.37	EP	3
Pangungari	0.10	EP	9
Sihonna	0.03	EP	10
Yakila	0.39	EP	2
LGA Level	0.29	EP	

Source: Authors Fieldwork (2017)

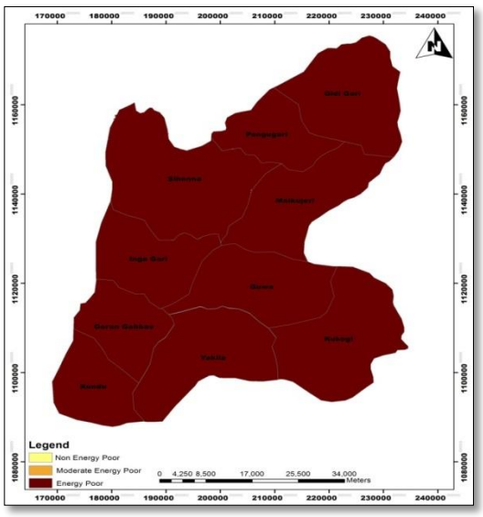

Figure 5: Spatial Distribution Pattern of Energy Poverty
Source: Authors Fieldwork (2017)

Energy Poverty and the Determinant

In other to identify the determinant of energy poverty; regression analysis was carried out between energy poverty and socio-economic variables in Rafi LGA. The operational variables for the regression analysis are: energy poverty, age of household head, Age of marriage, household size, years spent in school and monthly income. The dependent variable of the regression analysis is "energy poverty", while the socio-economic variables are the independent variables. The result of the regression analysis is presented in Table 12(a-c). Table 12a shows the regression model summary; the regression analysis recorded an R^2 value of 65.4%. The F-statistics of the regression model is 41.990 and a p-value of (0.00), significant at 95% confidence level. It therefore implies that socio-economic variables account for 65.4% of the energy poverty, while the balance (37.3%) is determined by other variables not considered for the study. The coefficient of the regression model is presented in Table 12c.

Table 12a: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.809[a]	.654	.639	.09656

a. Predictors: (Constant), Monthly Income, Years in School

Table 12b: ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1.957	5	.391	41.990	.000[b]
Residual	1.035	111	.009		
Total	2.992	116			

Dependent Variable: Energy Poverty
Predictors: (Constant), Monthly Income, Years in School, Age of Marriage, Household Size, Age of Household Head

Table 12c: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-.137	.082		-1.667	.098
Age of Household Head	.004	.002	.240	1.736	.085
Age of Marriage	-.004	.002	-.212	-1.532	.128
Household Size	.005	.005	.063	.969	.335
Years Spent in School	.026	.002	.753	12.587	.000
Average Monthly Income	3.079E-6	.000	.208	3.564	.001

a. Dependent Variable: Energy Poverty
Source: Authors Analysis (2017)

The model for the study as derived from the regression model is stated as follows:

$Y=a +b_iX_i +b_{ii}x_{ii}$……..……..bnxn….Equation (1)

Where Y= energy poverty a= Intercept b= slope X= explanatory variables ($x_{i=age\ of}$ household head, X_{ii}=age of marriage, X_{iii}=Household Size, X_{iv}=years spent in school, X_{v}=average monthly income)

$Y= -0.137 + 0.004(x_i)-0.004(x_{ii}) +0.005(x_{iii}) + 0.026\ (x_{iv}) + 0.000003079(x_v)$....Equation (2)

The model for the determinant of energy poverty as presented in equation (2) shows that all the variables except age of marriage contributes positively to energy poverty, while age of marriage has an inverse relationship with energy poverty. This implies that an increase in the age of household head, household size, years spent in school and average monthly income leads to a corresponding increase in the value of energy poverty value, while a decrease in age of marriage by a factor of the -0.04 implies an increase in energy poverty.

CONCLUSION AND RECOMMENDATION

Electrification (connection to national grid) in the rural communities of Rafi LGA is quite impressive; which is as a result of government effort towards connecting rural community to public electricity through rural electrification programme across the LGA and the state at large. The quality of electricity enjoyed by the rural communities is also commendable; this may be due to the relatively low population of the communities and absence of heavy machines and equipment which may cause overloading and other electrical problem. However, complete access to electricity is still far from the reach of the rural populace, which stem from the low duration of daily electricity supply especially at nights, and the reliability of the access which is usually subject to unannounced interruption that could last for hours, all these are some of the challenges to electricity access in the rural communities of Rafi LGA..

Access to clean cooking energy in the rural areas is a major challenge and a major contributing factor to energy poverty. It is likely that easy access to trees within and around the environment makes the use of firewood handy and convenient. The availability of fire wood in abundant quantity, and at relatively no cost coupled with the ease of use is among the factor responsible for household choice of cooking energy.

The study therefore, recommends that, access to electricity in the rural areas in terms of connection and quality of access must be matched with reasonable hours of electricity access. Outages and duration of outages must also be reduced. Until this is achieved, Rafi LGA is still far from achieving electricity access. Concerted effort must be directed towards providing clean cooking energy in Rafi LGA. The use of fuel wood as cooking fuel must be discouraged systematically, through the provision of alternative cooking energy at

affordable prices across the LGA. Residence must also be sensitized on the health and environmental implication of fuel wood as primary cooking energy. Electrification in the rural areas must not be restricted to households alone. Other facet of the rural community (enterprise and institution) should also be connected to the electric grid for optimum access. Until the entire community facet is connected to electricity, energy access in the rural areas will remain a mirage.

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USER'S SATISFACTION LEVEL WITH PASSIVE COOLING DESIGN TECHNIQUES IN PUBLIC SECONDARY SCHOOLS MINNA, NIGERIA

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Passive cooling is a building design approach that focuses on heat gain control and heat dissipation in a building in order to improve the indoor thermal comfort with low or no energy consumption. Thermal conditions in classrooms have to be considered carefully mainly because of the high occupant density classrooms and because of the negative influences that an unsatisfactory thermal environment has on learning and performance. This study aims at assessing the user's thermal satisfaction level of passive cooling design techniques in public secondary schools of Minna, for the purpose of creating a sustainable learning environment. Qualitative research method was used in carrying out the research by administering 40 structured questionnaires each to eleven selected government secondary schools in Minna to make a total of 440 questionnaires of which 404 were received. Data collected was analyzed on SPSS using descriptive and inferential statistics and the results are presented in tables and charts. The result indicates that most of the users are dissatisfied with the learning environment as a result of the inadequacy of passive cooling techniques incorporated in the school. The study recommends that architects and builders should put into proper considerations passive cooling features in institutional buildings as an inherent part of the design.

Keywords: Learning, Passive Cooling, Schools, Thermal Comfort, Users.

INTRODUCTION

Modern societies are living on the Earth's resources at an increasingly rapid pace to satisfy certain needs and desires. In face of the present global climate change and related anthropogenic carbon emissions, the use of energy from fossil fuels becomes a main concern. At least three pathways to reduce energy consumption are at hand: first is to simply lower the demand and use less energy; second is to be more energy-efficient in our energy-based technology and systems; and third is to substitute fossil fuels with renewable energy sources to meet the demand (Toe, 2013). The same approaches apply to buildings. This study takes the first pathway as a fundamental approach towards energy-saving in buildings. Its focus is on passive cooling to fulfil indoor comfort needs

Passive cooling in buildings includes the utilization of normal procedures – that is natural environment involving the micro biotic features, to accomplish balanced indoor conditions (LHSBC & Guido, 2009). The atmosphere in urban areas is described by surrounding temperatures, decreased wind rate, lessened relative stickiness and diminished direct sun radiation. The use of fitting arranging components, for example, vegetation and water elements can adjust the microclimatic state of a range (Brown & DeKay, 2001). Caldas, 2008 in his research concluded that building orientation and an optimized distribution of interior spaces can prevent overheating. Santamouris & Asimakoupolos, 1996 therefore described passive cooling as the cooling without any form of energy intake, other than sustainable energy source. Passive cooling techniques are also closely connected to the thermal comfort of the occupants.

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Isijola et al., (2018). **USER'S SATISFACTION LEVEL WITH PASSIVE COOLING DESIGN TECHNIQUES IN PUBLIC SECONDARY SCHOOLS MINNA, NIGERIA.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

Thermal comfort is a significant factor of the indoor environment, not only because of the comfort sensation that the occupants feel, but also because it is related to the energy consumption of a building, which influences its sustainability (Nicol & Humphreys, 2010). Proper design of school buildings requires the balance of the thermal performance and an acceptable quality of the indoor climate conditions (Allard & Santamouris, 1998). The construction of schools is a major priority in most societies; it is also a complex task since the running costs of heating, cooling, and ventilation seem far less important than the achieved indoor environmental comfort due to the vulnerability of the occupants' health, well-being and ability for attendance. The design of a building determines the environmental comfort conditions and its energy efficiency.

To attain ideal comfort conditions, the users' behaviour in relation to the environment and spontaneous adjustments to the environment are imperative factors (Theodosiou & Ordoumpozanis, 2008). Liang *et al*. (2012) and also Sfakianaki *et al*. (2011) proved that building envelope design has a high impact on indoor thermal conditions in naturally ventilated spaces. Moreover through Santamouris *et al*. (2008) studies, it is established that there is a statistically significant relation between window openings and the indoor to outdoor temperature difference in the hot humid climate.

LITERATURE REVIEW

The indoor air quality and comfort is a major problem in the developed and industrialized countries. Dascalaki and Sermpetzoglou (2011) studied that in industrialized countries people spend an average of 80–90% of their time in indoor environments. Therefore the quality control of the indoor environment depends on thermal, visual and air quality parameters. It is vital for the building envelope to reduce heat gain to keep the indoor air temperature lower than outdoor temperature (Muna and Zalena, 2015). Bathish (2007), stated that in order to exploit full potential from daylight but reduce radiant heat some design features must be tackled by designers by the right selection of window type and daylight harvesting devices.

Recently, research adopted scientific methods to analyze the effectiveness of traditional techniques. In this regard, qualitative studies were devoted to assess the aspects of passive cooling strategies, while the quantitative approach involved in-depth studies to evaluate the real performance of thermal environment under climate factors through field measurement. Taylor et al. (2009) applied qualitative studies to vernacular architecture in hot-dry climate of Oman. The study outcome illustrated that vernacular architecture of the region both culturally and climatically provides appropriate solutions for creating comfortable environments utilizing only natural and renewable forms of energy.

Regarding the benefit of using the application of qualitative and quantitative studies, Foruzanmehr and Nicol, (2008) study naturally ventilated building in the city of Yazd, Iran where the climate is hot and dry. The studies pointed out the acceptability and applicability of traditional Iranian architectural technologies in a modern context as well as their effectiveness in reducing energy consumption and CO2 emission. However in quantitative study, Meir and Roaf (2006) investigated different building technologies and materials, morphologies under different arid conditions typical of the Middle Eastern and Mediterranean climatic regions to provide resilient buildings for the 21st Century.

The investigations carried out a number of methods and techniques, including monitoring, modelling, numerical analysis, simulation and infra-red thermograph. Interestingly, vernacular prototypes were built with high thermal mass, with very limited fenestration area, usually unglazed. These properties make them very inert in relation to ambient daily fluctuations. Therefore, the results presented that an extreme inertia is counter-productive due to the inability of such structures to take advantage of solar gains in winter and of night cooling by cross ventilation in summer, primarily, but only, due to their limited fenestration size.

Maintaining a comfortable surrounding within a space relies on decreasing the amount of heat gains into the space and the removal of excess heat from the space. Shading devices are essentially a link within day lighting and the thermal performance of structure spaces the relationship between the sun and the surface of the building (Kamal M. , 2012). In a passively cooled building, this problem is overcome by using solar control devices. (Energy in Architecture, 1992), typically states that shading devices are used in two directions:

horizontal or vertical. Fixed shading devices are most commonly used on the external facades where they can prevent direct radiation from reaching glazing or other openings. If placed internally, heat will build up between the shading system and the glazing thus reducing the efficiency of the system by nearly 30%.

RESEARCH METHOD

The post occupancy survey method is incorporated in carrying out this research, to inquire into the users' perception of the subject matter. The study area (Minna) is selected because it lies near the tropical dry forest where the season of high temperatures experienced are more than the cold seasons, hence the need to incorporate passive cooling in our learning spaces. A structured questionnaire was developed and administered amongst eleven public secondary schools in Minna selected using an area random sampling method; as each school was selected from different district areas in Minna. A total of 440 questionnaires were administered, the questionnaires were administered to the students in the classroom giving room for the researcher to further explain the research variables to the students for proper understanding, as such, all questionnaires administered in the classrooms were returned giving a 100% return rate while the teachers filled the questionnaires at their leisure with 30 valid questionnaires received giving a 45% return rate. A total of 404 valid questionnaires were returned, giving a return rate of 91.8%. The selection of respondents within each school using a purposive sampling method was spread among the senior students of SS2 & SS3 and teachers. The data collected was analysed on SPSS using descriptive and inferential statistics, results are presented in tables and charts. The eleven public secondary schools selected in the study area are shown in table 1.0

Table 1.0: Name of public secondary schools selected in the study area and percentage of respondents.

S/N	Names of public secondary schools	No of questionnaires returned	Percentage
1	Bosso Secondary School	45	11.1
2	Day Secondary School Chanchaga	32	7.9
3	Government Day Secondary School Maitunbi	31	7.7
4	Zarumai Model School	35	8.7
5	Day Secondary School Tunga	35	8.7
6	Junior Secondary School, Barikin sale	33	8.2
7	Day Secondary School Gbada	34	8.4
8	Ahmadu Bahago Secondary School	41	10.1
9	Government Day Secondary School Bosso Road	34	8.4
10	Sir Ahmadu Bello Memorial Academy	34	8.4
11	Model Day Secondary School, Tudun Fulani	50	12.4
	Total	**404**	**100%**

Source**:** Author's fieldwork, 2014

RESULTS AND DISCUSSIONS

A questionnaire survey was conducted with the objective of knowing the users comfort level resulting from the availability and adequacy of the passive ventilative features and solar control features incorporated in the planning and design process of the schools.

Socio-Economic Characteristics of Respondents

Out of the four hundred and four (404) respondents, 60.9% were males while 39.1% were females, of which 7.4% are teachers while 92.6% were student (the frequent users of the classrooms). The students' respondents were basically from the higher class due to the researchers' assumption that the senior student had a longer experience in the school. 8.2% of the respondents were in JSS3, 38.1% were in SS2 and 46.3% were in SS2.

Solar control features

One of the effective means of achieving passive cooling within a space is by reducing the amount of heat from solar energy, allowed into and within the building. The result obtained from the study shows that the users have different satisfaction rating of the solar control features available at the study area of which the users that are dissatisfied with the cumulative solar control features are of the highest frequency as presented in Table 2.0. furthermore, the result was computed to generate a chart in figure 1.0 which indicate that 27% of the users are dissatisfied with the solar control features in the schools, 16% are very satisfied, 20% are partially satisfied, and 17% are very dissatisfied, while the remaining 20% are satisfied:

which indicate that majority of the respondents were not satisfied with the overall solar control features in the schools.

Table 2.0: users' satisfaction rating of solar control features in the schools

Variables measured	Very satisfied	Satisfied	Partially satisfied	Dissatisfied	Very dissatisfied	Total
Type of window	23	57	64	183	97	404
Type of wall material	19	35	109	177	62	402
Type of floor finish	56	97	92	134	25	404
Shading device	22	71	50	158	89	390
Size of windows	23	52	94	146	89	404
Location of windows in classrooms	180	116	69	27	12	404
Window sill height	143	132	87	11	21	394
Size of classroom	15	62	80	118	129	404
Population of students	19	51	74	101	159	404
Class headroom	156	110	90	15	11	382
Total	**656**	**783**	**809**	**1070**	**694**	

Source**:** Author's fieldwork, 2014

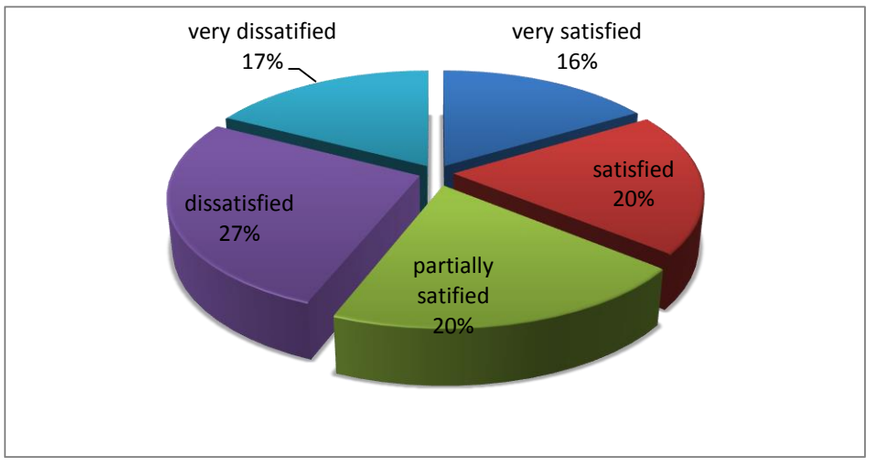

Figure 1.0: users' satisfaction rating of solar control features in the schools
Source: authors' field work, 2017

The scoring for the options of the respondents based on their perception of the measured variables are stated as follows:

Very satisfied 5

Satisfied 4

Partially satisfied 3

Dissatisfied 2

Very dissatisfied 1

Table 3.0: sum of respondents' perception of solar control features available in the public secondary schools

Variables measured	Very satisfied (X5)	Satisfied (X4)	Partially satisfied (X3)	Dissatisfied (X2)	Very dissatisfied (X1)	Total
Type of window	115	228	192	366	97	998
Type of wall material	95	140	327	354	62	978
Type of floor finish	280	388	276	268	25	1237
Shading device	110	284	150	316	59	946
Size of windows	115	208	282	292	89	986
Location of windows in classrooms	900	464	207	54	12	1637
Window sill height	715	528	261	22	21	1547
Size of classroom	75	248	240	236	129	928
Population of students	95	204	222	202	159	882
Class headroom	780	440	270	30	11	1531

Source**:** Author's fieldwork, 2014

The likert scale of calculation is used to interpret the obtained result and this is based on the following range of scale:

1.0 - 1.49 very dissatisfied

1.5 - 2.49 dissatisfied

2.5	-	3.49	partially satisfied
3.5	-	4.49	satisfied
		>4.5	very satisfied

Table 4.0: interpretation of respondents' opinion of passive cooling design techniques in the schools

Variables measured	Total	Mean	Interpretation
Type of window	998	2.47	Dissatisfied
Type of wall material	978	3.33	Dissatisfied
Type of floor finish	1237	3.06	Partially satisfied
Shading device	946	2.43	Dissatisfied
Size of windows	986	3.44	Dissatisfied
Location of windows in classrooms	1637	4.05	Satisfied
Window sill height	1547	3.93	Satisfied
Size of classroom	928	2.30	Dissatisfied
Population of students	882	2.18	Dissatisfied
Class headroom	1531	4.01	Satisfied

Source**:** Author's fieldwork, 2014

It was observed from the interpretation in table 4.0 that majority of the respondents are dissatisfied with the passive cooling design features in their schools due to the fact that it does not enhance a conducive learning environment and thermal comfort. The respondents are satisfied with some of the features, which include; the orientation of the windows as the windows are oriented towards the north and south which allows for proper cooling of the classrooms, the class headroom due to the fact that higher apertures allows for the proper circulation of air within the classrooms, and the windows sill height which to allow for maximum use of ventilation

Micro climatic features

The result presented in table 5.0 and figure 2.0 indicates that the majority of the micro climatic features available in the schools were inadequate, of which 32% of the respondents indicate that the micro climatic features in the school are very inadequate, 28% are inadequate, 12% are partially adequate, and 14% each are adequate and very adequate.

Table 5.0: users' satisfaction rating of the micro climatic features in the schools

Variables measured	Very adequate	Adequate	Partially adequate	Inadequate	Very inadequate	Total
Number of windows	172	129	64	25	14	404
Availability of trees	124	109	58	63	50	404
Availability of shrubs	15	32	63	138	128	376
Availability of grasses	7	52	24	177	144	404
Availability of courtyards	154	101	76	36	32	399
Availability of gardens	20	43	87	122	122	394
Availability of parks	23	50	26	152	150	401
Availability of fountains	18	30	32	138	186	404
Availability of ponds	12	10	38	170	174	404
Availability of pools	11	8	17	113	255	404
Total	**556**	**564**	**485**	**1134**	**1255**	

Source**:** Author's fieldwork, 2014

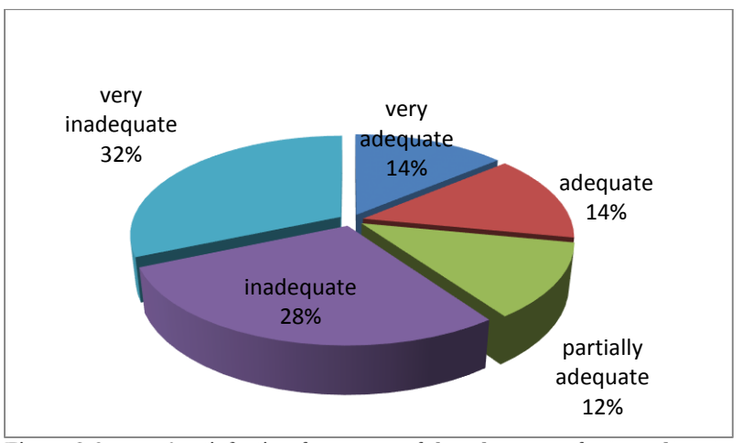

Figure 2.0: users' satisfaction frequency of the adequacy of micro climatic features in the schools
Source: authors' field work, 2017

Table 6.0: sum of respondents' perception on the adequacy of passive cooling design features in the public secondary schools

Variables measured	Very adequate (X5)	Adequate (X4)	Partially adequate (X3)	Inadequate (X2)	Very inadequate (X1)	Total
Number of windows	860	780	192	50	14	1896
Availability of trees	620	436	174	126	50	1406
Availability of shrubs	75	128	189	276	128	796
Availability of grasses	35	208	72	354	144	813
Availability of courtyards	770	404	228	72	32	1506
Availability of gardens	100	172	261	244	122	899
Availability of parks	115	200	78	304	150	847
Availability of fountains	90	120	96	276	186	768
Availability of ponds	60	40	114	340	174	728
Availability of pools	55	32	51	226	255	619

Source**:** Author's fieldwork, 2014

Table 6.0 present the rating and calculation according to likert scale of the respondents' perception of the passive cooling design features. Table 7.0 indicates the interpretation of the respondents' satisfaction level of the adequacy of passive cooling design features available in the school. The result shows that the respondents are dissatisfied with the adequacy of most of the micro climatic features available in the school as presented in figure 7.0. The respondents are satisfied with the adequacy of courtyard and trees in the school as these can be easily incorporated in the design of the school with little maintenance cost and risk required.

Table 7.0: interpretation of respondents' opinion of the adequacy of passive cooling design techniques in the schools

Variables measured	Total	Mean	Interpretation
Number of windows	1896	4.69	Satisfied
Availability of trees	1406	3.48	Partially satisfied
Availability of shrubs	796	2.12	Dissatisfied
Availability of grasses	813	2.01	Dissatisfied
Availability of courtyards	1506	3.77	Satisfied
Availability of gardens	899	2.28	Dissatisfied
Availability of parks	847	2.11	Dissatisfied
Availability of fountains	768	1.90	Dissatisfied
Availability of ponds	728	1.80	Dissatisfied
Availability of pools	619	1.53	Dissatisfied

Source**:** Author's fieldwork, 2014

CONCLUSION

Poor school conditions make it more difficult for effective teaching and learning. Solar control features and micro climatic features were the variables used in assessing passive cooling design techniques in Minna government secondary schools of which the result indicates that the users were dissatisfied with the passive cooling status of the school building as evaluated in figure 4.0 and 7.0. Some of these features were not available; some were below standard while others were well considered.

Since the users were dissatisfied with most of the passive cooling design techniques existing in the schools, the study recommend that these buildings are revisited to make necessary amendments as well as put into absolute consideration, these passive cooling features in subsequent design proposals.

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INTEGRATING NATURAL LIGHTING DESIGN APPROACH TO LIBRARY OF PUBLIC UNIVERSITIES IN NORTH CENTRAL NIGERIA

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Library is perceived as the power house of any higher educational establishment. Achieving increase in quality of services provided by the library becomes difficult due to inadequacy in power supply in Nigeria in recent times. The use of natural day lighting by designers to reduce power consumption is investigated in this study as a sustainable approach for energy optimisation. Therefore, the aim of the study is to examine the integration of natural lighting in the design of public universities library with a view to contribute to factors for an energy efficient building. For this purpose, using descriptive-analytic method and library research tool, the effectiveness of natural lighting in a library spaces within north central are investigated, analysis of data through a well-structured observation schedule was used and analysed using tables, percentages and charts. And in the end, a set of strategies for architectural design of natural lighting integration in a library will be presented, by taking the advantage of fundamental concept of passive design approach .It will also reveal that roof light which is one of the most effective means of lighting integration has least application. The paper will conclude that to achieve an optimised day lighting design in library there is need to consider the well-being of building occupant by detail understanding of importance of day lighting.

Keywords: energy, library, natural lighting, optimisation, sustainable.

INTRODUCTION

Lighting is very necessary in our lives. Before the 1940s, daylight was the main light source in buildings; artificial lights become additional to the natural light. In a short span of 20 years, electric lighting had transformed the workplace by meeting most or all of the occupants' lighting requirements. Edwards & Torcellini,(2002). Recently, energy and environmental concerns have made day lighting a rediscovered aspect of building lighting design. The physics of natural lighting has not changed since its original use, but the building design to use it has. Ander, G. (2001).Day lighting is often integrated into a building as an architectural statement and for energy savings. However, benefits from day lighting extend beyond architecture and energy. The psychological and physiological aspects of natural light should also be considered. William (2015) the comforting space and connection to the environment provided to building occupants provides benefits as significant as the energy savings to users.

Natural lighting design has recently taken on a new importance, beyond these aesthetic and psychological aspects, with the advent of energy shortages and sustainability concerns. The alternative to day lighting, the use of electric power for library lighting, contributes to the strain on Nation's electric generation capacity as well as the inefficient use of non-renewable energy resources. Darling et al (2008). Furthermore, the cost of lighting a library has become a major burden to institutions and will continue to increase in the future. Daylight, which is free, provides the opportunity to greatly reduce these negative impacts created by the overdependence on electric lighting sources.

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Overtime Energy requirement for building servicing dominate the building sector on a national scale, although lighting does not account for 5% of national energy consumption. Shola, O. (2013). A clearer explanation is that the focus on passive natural lighting activity has been the residential sector and that of lighting as energy consumer in that sector is quite minimal. As interest in the passive natural lighting extends to the public building sector, lighting becomes a significant building load both directly or indirectly by virtue of its impact on cooling loads because approximately 50% of the building resource energy maybe attributable to lighting. Green Building Tech (HK, 2007),

Day lighting or natural lighting can provide substantial energy and cost saving, reduce building peak loads, increase task contrast and visibility, improve overall lighting quality and positively enhance psychological and physiological status of users. The aim of this paper therefore is to examine design consideration in integrating natural lighting in library of tertiary institutions with a view to contribute to factors for energy efficiency of the building. The scope of this study and all it content is limited to states and federal universities within north central Nigeria. The research is based on findings gathered from observations and study of related literature on natural lighting, which can be summarized as:

1. The types of natural lighting strategy integrated in the design of those buildings as relates to openings and sizes.
2. How natural lighting is optimized.

Principles of Natural Lighting

Light is a form of energy manifesting itself as electromagnetic radiation and is closely related to other forms of electromagnetic radiation such as radio waves, radar, microwaves, infrared and ultraviolet radiation and X-rays. The only difference between the several forms of radiation is in their wavelength. Hafer, F. (2013). "Natural lighting or Day lighting" refers to the use of sunlight, moonlight, skylight, and overcast sky illumination to provide functional interior lighting that is appropriate to specific programmatic areas and comfortable to substantial energy savings. Thermic (1994)

There are challenges of adapting natural lighting design on a building. Firstly, it is the responsibility of designer to consider the design of the building for the day lighting design adapted to every construction process and design stages. Next is an obstacle of daylight to come deep inside of the building section. Obstacle of daylight shading can affect the building where terrain or trees is one of the obstacles for low to mid rise project, while obstruction for large building always comes from other adjacent large building. Heat loss during cold weather from windows and overheat during summer cause from larger opening reducing thermal comfort in the building. Lastly is glare and contrast problem cause by daylight that entering the building.

Kruegle (2007) stated that natural light sources comprise the sun, moon (mirrored stars, and thermal (heat).The sun is the source of energy that lights the outside scene source, it would save cost and electricity used for lighting Görgülü & Ekren, (2013).

Openings that allow daylight in to building interiors are important for the vision and extension they provide with the outdoors. Daylight is very important for its quality. Reviews of person's response to indoor environments recommend that natural lighting is required because it fulfils two basic people's requirements: to be able to look at both a task and the space well. Boyce (1998),

The level and distribution of natural light within a space depends primarily upon the following three factors: The ratio of openings to geometry of the space, the location and orientation of window and other opening and the characteristics of the internal surface are the factors that determine the level and distribution of natural lighting at the building. Rayman.P. (2012) Daylight design prepared enough light suits with activities carried out in the building following the requirement for room space, design and aesthetic of the buildings. Buildings such as Office building usually only needs lighting that lights throughout the floor where the height of the floor to the ceiling not too high and the window opening usually elongated along the wall. While for residential building, it only need light that is sufficient just only for a room even though it only has one window because it only need lighting from one or two directions. Robertson, (2002).Public buildings such as tertiary institution generally requires relatively deep or deep floor plan with a relatively high floor to ceiling height, with windows usually along one wall only. Industrial buildings generally try to provide high levels of Omni-directional light to all parts of spaces that often have large

internal volumes and relatively high ceilings. Residential buildings usually have many relatively small rooms with exposure in only one or two directions. The aim is to provide adequate light levels even if the only window, for instance, faces away from the sun.

According to Ferna,(2012). Natural lighting design is an important issue for sustainable buildings which includes both setting natural and artificial lights as well as meeting energy distribution goals. The availability and the characteristics of the daylight are depending on latitude, climate, weather, time of the year and time of the day. In some climates the daylight can be predictable in other climates very unpredictable.

Library of Public Universities in North Central

North Central Nigeria (also known as the Middle-Belt region) is located with the gps coordinates of 9° 53' 24.8064" N and 8° 52' 44.1372" E. It consists of the seven states situated geographically spanning from the west, around the confluence of the River Niger and the River Benue. These states are: Kogi, Nassarawa, Benue, kwara, plateau states and the federal capital territory Abuja with a population of about 20,306,336 according to 2006 national population census.

It has a wide variety of public universities which are spread across the States; these institutions are both federal and state government owned with academic activities on temporary and permanent sites. Also, it has two of the newly created federal universities located in kogi and nassarawa states. Therefore, north central Nigeria was selected due to the climate and wide variety of public universities which are spread across the States, thereby providing a mix combination of library buildings both on permanent and temporary sites that will be considered in this study.

RESEARCH METHOD

In this study, it is considered to formulate recommendations and considerations for designing naturally light users spaces in a library with passive design approach and tried to incorporate factors influencing the design principles to be evaluation criteria and after analysing the information obtained, we reach the recommendations for the design of energy efficient spaces of library building. According to the study, the methodology requires manner that we can cover all sides of the issues. Therefore, the methodology in this research is descriptive, survey one and the method of gathering information over the description and in the survey sections would be study of related literature and checklist for field, respectively.

A structured observation schedule was developed and administered on respective library buildings selected from five public universities out of a study population of 13 public universities and it was done on the basis of observing and documenting what is obtainable on site while comparing to the laid down requirement according to natural lighting design considerations. The data was collated, sorted out based on the institutions and entered in for analysis purposes while the results are presented in tables and charts. Pictures of some selected design variables presented as plates to explain further the issues within the discussion of results with the view of establishing recommendations of the research.

Table .1.0: Institutions Studied

Name of Institution
University of Abuja
Nassarawa state university,Keffi
University of Illorin
Federal university of Agriculture Makurdi
Benue state University

Source: Authors' fieldwork, 2017

RESULTS AND DISCUSSION

The main question of this study: what are the design variables to be considered appropriately for integrating natural lighting in library for tertiary institutions with architectural passive approach? To answer the main question, it should be known that what are those design variables and their effect in the design of library spaces? And what are principle requirements and considerations established by Passive design approach.

According to Loe (1999), openings can be categorized into four basic types. These include: side windows, clerestory windows, roof light and borrowed light. This provides bases for establishing design variables shown in the table 2.0 below.

Table .2.0: design variables according to observation schedule.

Name of institutions	External window(side window) 0	clerestory	High level	skylight	Roof light	courtyard	Borrowed light opening	Screen wall	Corner windows	Solar shading
University of Abuja	x	o	x	x	x	x	x	x	o	x
Nassarawa state university Keffi	x	x	x	o	o	o	x	x	o	o
University of Illorin	x	o	o	o	o	o	x	o	o	x
University of agriculture Makurdi	x	o	x	o	o	o	x	o	o	x
Benue state university	x	o	x	o	o	x	x	o	o	x
total	5	1	4	1	1	2	5	2	o	4

Source: Authors' fieldwork, 2017

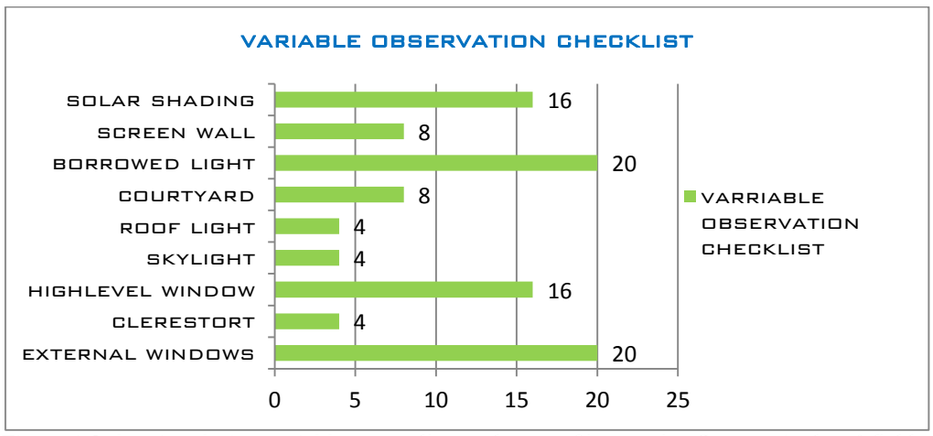

Figure 1.0 showing design variables according to degree of integration Source: Authors' fieldwork, 2017

It can be observed from figure 1.0 that majority of the building studied apply external windows and borrowed light respectively while roof light which is one of The most effective means of lighting integration according to Green building Tech, (HK, 2007), has one of The least application. Solar shading control was also widely adopted this is because natural lighting integration is never complete without appropriate solar control techniques due to changes in sun movement which occurs at different time of the day.

Table .3.0: window openings to sizes.

Name of institutions	900x900(mm) 0	1200 x1200	1500 x1500	1800 and above
University of Abuja	x	x	x	x
Nassarawa state university Keffi	0	0	0	x
University of Illorin	o	o	x	x
University of agriculture Makurdi	x	0	x	x
Benue state university	o	o	x	x
total	2	1	4	5

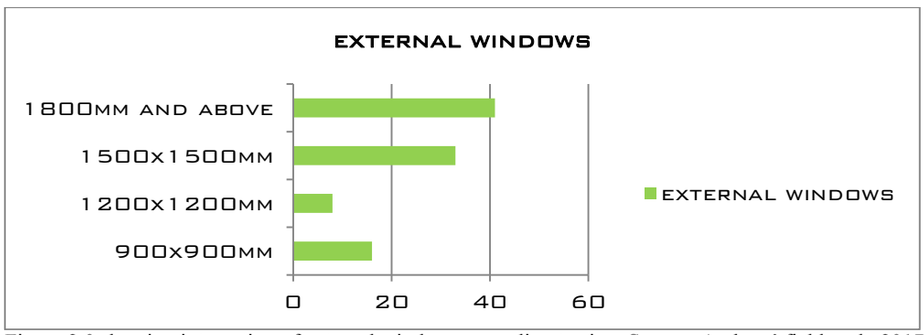

Figure 2.0 showing integration of external windows according to sizes Source: Authors' fieldwork, 2017

From figure 2.0from the chart it is shown that windows sizes of 1800mm and above was widely used for natural lighting and ventilation follow by 1500x1500 mm. Therefore, a geometric size of openings determines the quality of natural lighting distribution. Rayhman (2012)

Design Considerations for Natural Lighting Design in Library

The use of natural light, or day lighting, has traditionally been a desirable building feature and a hallmark of good design. When skilfully introduced, daylight creates an ambience of quiet contemplation and visual comfort, and links the modern library user psychologically with the pre-technological past Dean. E. (2002).Memorable library spaces for centuries have been characterized by volumes and surfaces illuminated with natural light, providing glare-free light in reading Spaces

The light in a library must be adequate for the user to see a particular task, usually reading a book or the text on a computer screen. The efficacy and heat content of daylight require careful control of the daylight aperture size, wherever it is located. The three fundamental design issues in daylight design are:

- Sun control, to mitigate any increase in the cooling load and to control direct glare
- Glare control, to create and maintain comfortable brightness distribution, including no direct views of the bright sky in the normal direction of view.
- Variation control, to avoid any user perception of insufficient local light levels.

Based on Green Building Tech, (HK, 2007), there are two most efficient types of daylight strategies which is lighting from side and lighting from the top. Lighting from the side and from the top are the main categories of the strategies. The system of day lighting will depend on the orientation and the layout and the building surroundings. Lighting from side is a technique that let the sunlight penetrates into a room opening located at the wall perimeter. Lighting from top is a technique that provides daylight from the upper part of the building. It gives an evenly illuminance to the entire interior floor area of a building. . Lighting technique from building top comprises the use of roof monitors, saw tooth roofs and skylights.

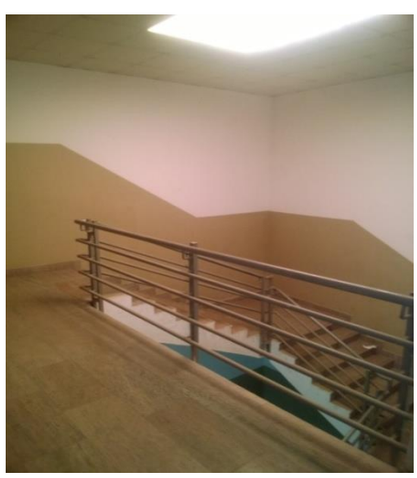

Plate 1.0 interior illumination by skylight and roof light.
Source: Authors' fieldwork, 2017

Skylights can have many forms including dome, pitched and flat panels that are placed in the plane of the building's roof. Horizontal skylights can be an energy complication because they obtain solar heat directly at the noontime. Integration of louver window arrangements can control solar heat gain and glare in skylight. Also, sunlight glazing is placed as near to

the ceiling as possible for bouncing sunlight deep into the room by the ceiling. In this way, higher visible transmission glazing can be used in the sunlight opening.

Plate 2.0 fully illuminated interior achieved by the application of side or external windows. Source: Authors' fieldwork, 2017

According to International Energy Agency, (2001), first thing to control is the amount and distribution of daylight entering a space, the window size and position of the façade determine mostly the utilization of daylight. Secondly, the transmission characterization of the glazing determines the transmittance a day lighting system based on window size. It is then being dimensioned. A day lighting system is an adaptation of the window aimed at improving the amount and distribution of daylight in the space.

CONCLUSION

When designing buildings, emphasis is placed on construction and maintenance costs. However, real people will be working in these buildings, so consideration should be given to their psychological and physiological well-being. The improved health of building occupants benefits employers and building owners because of improved performance.

Therefore, in assessing the potential role of natural lighting in energy conserving structures and specifically passive daylight building, two observations can be drawn, from one perspective the potential saving are enormous, and day lighting as a design strategy has the power to act as a major form and design determinant in the building. Not only are the energy saving potentially large, but peak energy requirement may be reduced and lighting quality may be increased. Balancing this optimistic view is a long list of qualifiers and real obstacles which must be overcome before actual savings can be realized. Day lighting design is a complex multidisciplinary design problem. Most architects will do no better in introducing a well daylit interior than an ordinary builder can do. In both cases a grasp of the fundamental is not sufficient to guarantee good design and performance as the current daylight design in Nigeria is low, interest in day lighting is increasing at a rapid rate according to international energy Agency 2001. Therefore, a detail understanding of the important subtleties is necessary to achieve good result particularly in our public or institutional buildings.

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EVALUATION OF THERMAL COMFORT IN SCHOOL OF ENVIRONMENTAL TECHNOLOGY COMPLEXES IN SELECTED GOVERNMENT OWNED UNIVERSITIES IN SOUTH EAST NIGERIA

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In School built environment, there is strong, consistent evidence of the effect of basic thermal comfort variables like indoor air quality, ventilation, day lighting, and temperature on learning. These physical characteristics affects student cognitive ability and behaviour, if not adequately considered in design can lead to a decline in understanding ability of the students thereby making them less productive in academics. The aim of this study is to evaluate the thermal comfort in school of environmental technology complexes in order to propose a design that will enhance students learning. The research methodology adopted is the mix use method focusing on evaluating the Environmental Faculty or Complex of some selected universities in the South-Eastern part of Nigeria. The research identified some architectural design Considerations that plays vital role in thermal comfort. These Ranges from; the construction methods and materials of the various parts of the building to its finishes, the number of users and sizes of space. This study have shown that physical environment and surrounding settings affects learning. Therefore this research suggest a periodical evaluation of learning spaces and consideration of components that affect learning environments as a check for school designers and owners, educators and teachers in communicating appropriate requirements for attaining student's utmost performance and Positive learning outcomes.

Keywords: School, Environment, Thermal-Comfort, Environmental-Complex.

INTRODUCTION

Thoughts, plans and decision can easily be distracted when the body does not relate or feel comfortable within the environment where it resides. The condition of the environment plays a greater role in optimizing the performance of people while undergoing a mental activity which is a full function of the mind. The mind is the root of understanding since it is the bedrock for every action which includes; thinking, reading, and writing among which education is realize. The mind according to thesaurus dictionary is that which is responsible for ones thoughts and feelings; the seat of the faculty of reason (thesaurus dictionary, 2017). Education is considered to passively begin from the womb, as the unborn child goes through some levels of discipline as the mother taps her stomach when the unborn child begins to inconvenience her causing pains in her womb. Education as described by thesaurus dictionary (2017); refers to the act or process of educating; the result of educating, as determined by the knowledge skill, or discipline of character acquired, (David et al. *2016*). Intelligence and Environment researches investigates the impact of environment on student's intelligence which is one of the most important factors in understanding human group differences in IQ test scores and other measures of cognitive ability. It is estimated that genes contribute about 20–40% of the variance in intelligence in childhood and about 80% in adult. Therefore the environment and its interaction with genes results to a high proportion of the variation in intelligence seen in groups of young children, and for a small proportion of the variation observed in groups of mature adults. Despite the fact that intelligence stabilizes in early adulthood, it is thought that the genetic factors influence more of our intelligence during middle and old age and based on that.

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The importance of the environment dissipates. The interaction of the physical leaning environment and thermal comfort has not been fully considered in the design of school of environmental technology complex in government owned universities located in eastern part of Nigerian, thereby leading to uncomfortable study environments. It is therefore important to evaluate the thermal comfort in these complexes with the view of finding the true state of the complexes in regards to thermal comfort with the use of bioclimatic approach aimed at providing suggestion to enhance students' academic output through the achievement of a thermally sustainable school of environmental complex

Thermal Comfort and the Environment

Human thermal comfort is defined by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) as the state of mind that expresses satisfaction with the surrounding environment (ASHRAE Standard 55 2013). Maintaining thermal comfort for occupants of buildings or other enclosures is one of the important goals of heating, ventilating, and air conditioning design engineers. Heat conduction, convection, thermal radiation and evaporative heat loss are affected by thermal comfort. It is maintained when the heat generated by human metabolism is allowed to dissipate, thus maintaining thermal equilibrium with the surroundings. Any heat gain or loss beyond this generates a sensation of discomfort. It has been long recognised that the sensation of feeling hot or cold is not just dependent on air temperature alone. According to Andris. and Steven ; Socrates, around 400 BC had some thoughts about climatic suitability of houses, focusing on how to build to ensure thermal comfort. The works of Vitruvius (1st century BC) also tailored towards the need to consider climate in building design, for reasons of health and comfort. This however did not have much influence on the practice of architecture hence until the Industrial Revolution. Thermal comfort was not a practical issue, as there were very few tools available to influence it. During the cold period, a fire was lit to ameliorate the conditions and when the weather becomes hot, the use of hand-held fans was the only relief, or perhaps larger fans operated by obedient servants.

Thermal comfort therefore is determined by the state of mind of an individual whether he or she is hot cold or simply comfortable in their environment (HSE 2012). However, a number of buildings use HVAC (Heating Ventilation Air Conditioning) systems to regulate their environment and achieve a thermal comfort. In recent times however, more energy efficient and environmentally friendly, methods are used to heat and cool buildings.

The major function of a building is to protect its users and indoor space from drastic weather conditions as excessive sun, wind and rainfall. But when this function is defeated, the users become thermally uncomfortable hence, they tend to find alternative sources of heating and cooling. This can be resolved by adopting climate responsive designs which will involve Natural ventilation which will reduce or eliminates the amount of mechanical systems required to cool the building if adequately designed. Temperature could either rise to be too hot or too cold depending on season of the year. Therefore, the factors below should be considered when designing to achieve good thermal comfort (omer, 2008).

1. Building orientation
2. Window sizes and location
3. Construction materials
4. Cross ventilation
5. Roof, walls and floor insulation
6. Additional cooling required during heat periods

The adopted bioclimatic approach in this research entails that every construction be adaptive to its location in terms of terrain, climate, locally available building materials and orientation of building on site, passive design principles and efficient use of ecofriendly and renewable energy systems. In order to do this, there is need to:

1. To determine the extent of thermal discomfort of in the schools of environmental technology complexes

2. To identify the possible causes of thermal discomfort in the complex

Thermal Comfort Bioclimatic Design Approach

Bioclimatic architecture as an approach to achieving thermal comfort is a term which was first used in the early sixties (60s) by the olgyay brothers. They brought into existence the bioclimatic chart which uses the psychometric chart as a basis to relate climate as strategies

to be used to determine thermal comfort of a particular location. According to kane cres (2012) as cited by Adedayo, et al. (2013), the use of micro climate of a region to provide both thermal and visual comfort for occupants with renewable energy (solar) as a means of generating electricity and geothermal system for heating and cooling is an efficient system of ecofriendly design. Building materials and passive architectural design systems are equally considered to be among the parameters. The bioclimatic design approach focuses on both interior and exterior aspects of construction which is achieved by using the vital feature of bioclimatic design to ensure quality landscape construction materials and micro climate of a place are integrated actively with the existing environment (Martinez, 2012).

The physical and chemical properties of the various materials used for construction and the methods used are important aspects of building sustainability, the building orientation, sun shading devices and size of openings needs to be considered in the design process. The sounding environment is affected by the Buildings around it during their active periods because of their necessity to heat and cool and also provide lighting needs. Earth architecture, (2012) highlighted that Materials with less CO_2 discharge should be used in construction to elongate the life span of the building. Furthermore the Energy efficient designs can reduce engaged energy costs by 75% within the life span of a building which only about 1% of its impact on the surrounding is respondent to building materials. Every area has there specific Bioclimatic design measures centred primarily on the climate of the area which can be evaluated as listed below;

1. **Building Envelope and Orientation:**

Heat gain through the building envelope needs to be reduced and prevented from affecting the interior spaces of the structure especially during the hot periods. This can be reduced by the orientation of the building and materials used for construction (Martinez, 2012). Building orientation towards the south and placement of openings is also to be considered.

2. **Landscape:**

Planting trees and incorporating artificial water bodies can also improve the micro climate of the environment.

3. **Energy Source:**

In the research publication by Kane cress (2012), it is suggested that the potentials of the sun should be used as an alternative source of energy and also for lightning up the buildings all through the year rather than depend on artificially generated energy.

4. **Sun shading devices:**

Sun shading devices like vertical, horizontal or egg-creates members can be used to reduce Heat gain into the building during periods of high temperature. Also using materials and paints that would permit less penetration of the solar rays will equally be needful to control the acceptance of heat in the buildings.

5. **indoor air quality:**

Through the use of green/living walls, indoor air quality can also be improved as this will capture airborne particles while providing oxygen to liven up spaces. Air locks can also be installed in doors as it reduces the effect of heat on the building envelope (Moon 2007).

6. **Passive design:**

Appropriate choice of window types and the use of large window openings will allow natural ventilation and accumulated heat during the day can also be given out or balanced naturally at night time.

7. **Heating and cooling:**

Ensure that materials used for glazing allow minimum solar radiation (glare and adequate light in the interior spaces.

Human Performance in Relation to the Thermal Comfort of their Environment

Rammsayer TH, et al. (1995).in a research titled “The effect of cold on human information processing: application of reaction time paradigm,” discovered in thirty healthy male volunteers who performed a stimulus evaluation-response selection reaction time task after exposure to ambient temperatures of either 28 or 5 degrees C. A 0.5 degree C-decrease in

body core temperature resulted in a significant increase in both reaction and movement time indicating a general deteriorating effect of lowering of body core temperature on information processing. Mean reaction times were 538 ms and 549 ms for the control and the cold group, respectively ($p < .05$). The respective mean movement times were 298 ms and 269 ms ($p < .001$). Speed of stimulus evaluation was not sensitive to decreases in body core temperature. However, response complexity and body core temperature showed a significant interaction in their effect on movement time ($p < .05$), indicating that lowering of body core temperature is more likely to affect response-related stages of central information processing rather than stimulus evaluation. Furthermore, movement time appeared to be more sensitive to cold-induced effects on information processing as compared to reaction time. Additional co-relational analyses suggest that the observed effects can be considered as independent of changes in skin temperature and experienced levels of thermal discomfort. Taken together, the results indicate that lowering of body core temperature deferentially affects various stages of information processing.

The most serious level of temperature dysregulation is called heat stroke, and it occurs when the body's temperature reaches an excess of 104 degrees Fahrenheit. During heat stroke, body functions grind to a halt, as the hypothalamus region of the brain shuts down the body's natural coolant system, perspiration. Without sweat, the body can no longer keep its temperature in check, which causes a devastating chain reaction that can be fatal without timely medical intervention.(https://m.accuweather.com/en/weather-news/what-does-extreme-heat-do-to-the-human-body/70002105)

Study Area

South-East Nigeria has the lowest landmass compared to other parts of the country, hence a high percentage of building development is evidently covering up the whole land mass. This has necessitated some developers to neglect the allowance for soft and hard landscape within the area as most of the land owners tries to take full advantage of the land by using up all the land space during construction.

According to previous studies; in the analyses of climatic data of temperature, Rainfall and relative humidity, Nigeria is classified into four broad climatic zones the hot dry, temperature dry, hot humid and warm humid zones. The South-East Nigeria falls into the hot humid/tropical climatic zone with mean daily maximum dry bulb temperature during the dry season not less than 38°C, it has a very small temperature range. The temperature ranges are almost constant throughout the year, in some areas the maximum temperature is 28 °C (82.4 °F) for its hottest month while its lowest temperature is 26 °C (78.8 °F) in its coldest month. The temperature difference is not more than 2°C (5 °F). South-East Nigeria experiences heavy and abundant rainfall accompanied with storms at some times. These storms are usually convectional in nature due to the regions proximity, to the equatorial belt. The annual rainfall received in this region is very high, usually above the 2,000 mm (78.7 in) rainfall totals giving for tropical rainforest climates worldwide.

The study sample is the Environmental complexes of the University of Nigeria Nsuka, Enugu State (UNN), Abia State University Uturu, Abia State (ABSU) and Imo State University Owerri, Imo State (IMSU).

RESEARCH METHODOLOGY

This research featured the mix use method; the Primary data was gathered from observation of the various universities environmental complexes. This enabled both qualitative and quantitative data collation on the user's perception to assessment of thermal comfort in their various study environment. Questionnaires were used for the quantitative data, while observation of the building condition served for the qualitative information. A random sampling technique was adopted to get the required information. The population samples for this research were taken from different departments in the environmental complex, 25 persons from each study area and questionnaires were administered to gain data on the thermal conditions of the complex, possible thermal discomfort if any exist, and the possible causes of discomfort to the users.

DISCUSSION OF FINDINGS

The field survey enhanced the quality of information gathered on the physical form of the buildings. The environmental complexes of the universities in South-East Nigeria have been identified to pose significant level of thermal discomfort to users. Based on a research work of Adedayo et al. (2012); major criteria for assessment of thermal comfort was derived, these are

a. Orientation of building on site to face the north-east and south-west to allow minimum solar radiation into the building.
b. Provision of wider sizes of openings to allow maximum natural ventilation into the building.
c. Use of natural building materials such as bricks, compressed earth blocks for the construction of building envelopes.
d. All openings that allow ventilation such as windows and doors should face directly to an outdoor environment without obstruction to achieve maximum ventilation into the buildings.

The plates below shows the researchers findings in the study areas.

Case Study 1,
Abia State University Uturu (ABSU)

Plate i: Google earth image showing the environmental complex of ABSU
Source: Google Earth Map (2017)

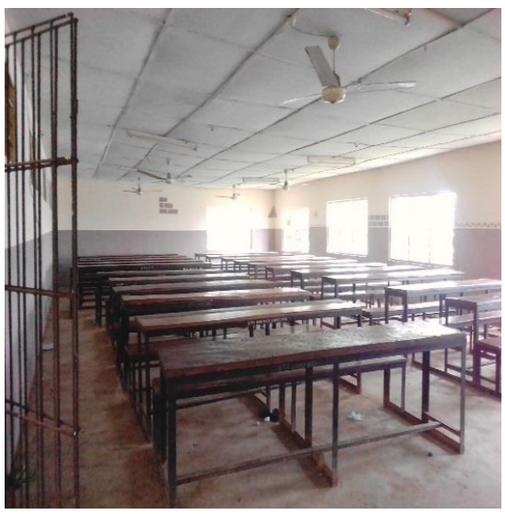

Plate ii: View of the class room showing ceiling material
Source: Author's field work (2017)

Plate iii: View of the courtyard
Source: Author's field work (2017)

Case Study 2,
Imo State University Owerri (IMSU)

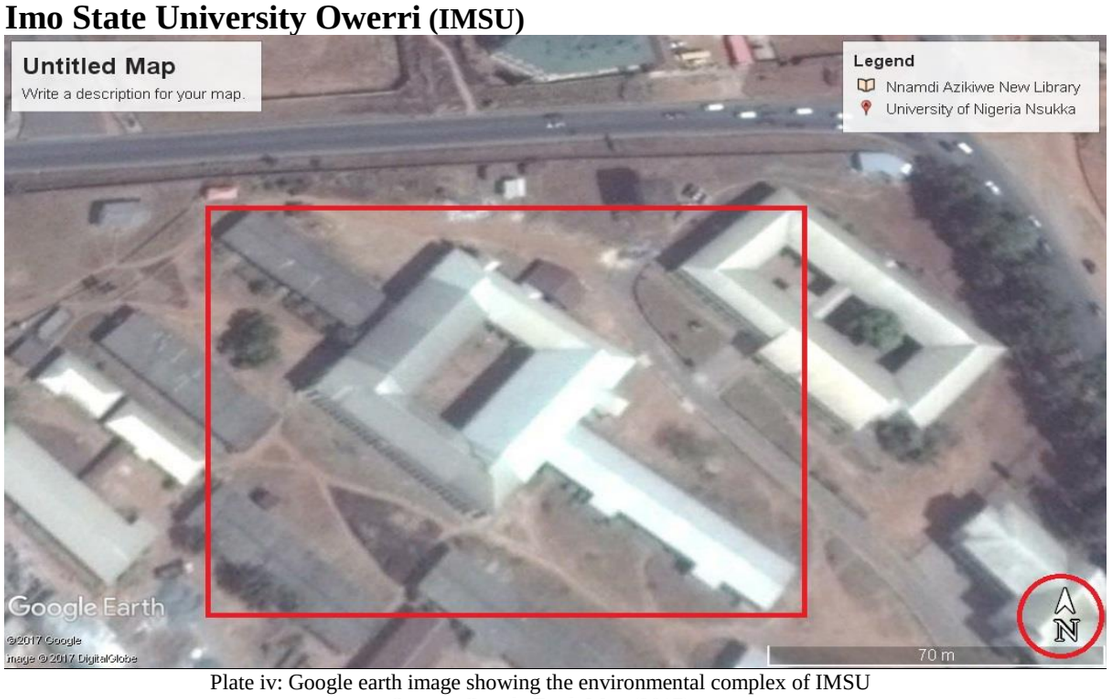

Plate iv: Google earth image showing the environmental complex of IMSU
Source: Google Earth Map (2017)

Plate v: View of the lobby between class rooms
Source: Author's field work (2017)

Plate vi: View of the courtyard
Source: Author's field work (2017)

Case Study 3,
University Of Nigeria Nssuka, Enugu State (UNN)

Plate vii: Google earth image showing the environmental complex of UNN
Source: Google Earth Map (2017)

Plate viii: View of the courtyard
Source: Author's field work (2017)

Plate ix: View of the class room area
Source: Author's field work (2017)

The complexes seen in the case studies on plates i,iv and vii above shows a reasonable compliance to the orientation criteria of buildings on site to face the north-east and south-west direction to allow minimum solar radiation into the building. Plates ii, vi and ix shows Provision of wider sizes of openings to allow maximum natural ventilation into the building but a major flop was discovered on the type of windows provided. The plates shows the presence of sliding windows. Sliding windows reduces the amount of ventilation inlet into the interior spaces because only a part of it can be opened at a time. Plate iii, vi and viii shows the presence of courtyard in all the case studies. Plate v shows that some of the windows on part of the complex on case study 2 do not have direct access to open space or the courtyard. The Use of natural building materials such as bricks, compressed earth blocks for the construction of building envelopes were considered.

Based on the author's field survey, it was discovered that case study 3 considered the major bioclimatic criteria in the design while they were not fully considered in case studies 1 and 2, hence a questionnaire was distributed to the students and staff to obtain their feelings of thermal comfort within the complex. This was targeted to finding users thermal perception of the complex not minding the design inability to fully conform to the major bioclimatic criteria.

Table 1.0: Users Rating of Thermal Comfort in the Environmental Complex

Institution	Hot	Cold	Normal	Warm	Too Cold	Total
ABSU	**9**	**0**	**12**	**4**	**0**	**25**
IMSU	**8**	**0**	**5**	**12**	**0**	**25**
Sub- Total	17	0	17	16	0	50

Source: Author's field work (2017)

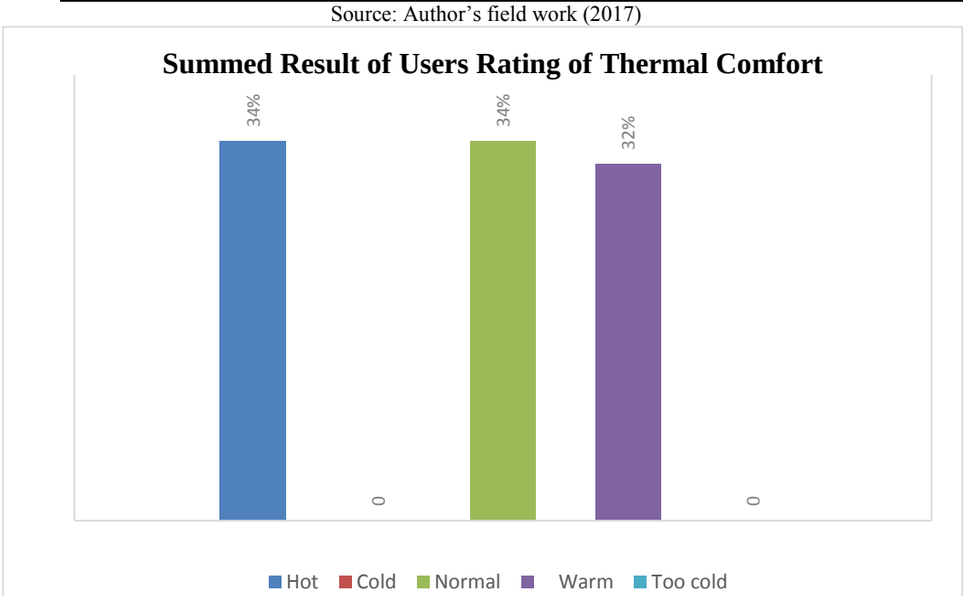

Figure 2: Summed Result of Users Rating of Thermal Comfort in the two study areas.
Source: Author's field work (2017)

Twenty five (25) questionnaires where administered in each of the study areas making a total of administered questionnaire fifty (50). Based on the results shown above, it can be seen that in the two university environmental complexes 34% of the users rated their feeling within the complex to be hot, another 34% rated normal, 32% said they feel warm while no respondent accepted to feel cold or too cold. It can be seen from figure 2 above that the number of users who feel hot and warm are more than the number of persons that feel normal. This indicates that the majority of the users are not thermal comfortable, hence the environmental complex is not thermally comfortable.

CONCLUSION

The Benefits of a thermally sustainable school of environmental cannot be over emphasized. These includes, enhancement of students and staff mental health, increase in desire to study, improves assimilation rate and reduce mental redundancy. The researcher discovered a high tendency for students to be less productive in these study areas as most of them are likely to suffer from heat stroke because they feel hot in the classrooms which negatively affect the processing period of information in the brain affecting their academic outcomes. Therefore there is need for government and university authorities to liaise together to provide a more comfortable environmental complex in South-East Nigeria that has minimum thermal discomfort.

RECOMMENDATION

The study on the evaluation of thermal comfort in the school of environmental technology complex in universities in South-East Nigeria shows a partial compliance to thermal comfort requirements in the indoor spaces based on bio-climatic analytic requirements. Therefore there is need for designers of Environmental complexes to comply with bio-climatic principles as have been identified by Adedayo *etal*. These are as listed below;

a. Orientation of building on site to face the north-east and south-west to allow minimum solar radiation into the building.
b. Provision of wider sizes of openings to allow maximum natural ventilation into the building.
c. Windows that allow for full opening such as casement windows should be in place of sliding windows which reduce the amount of ventilation inlet by closing half of its open-able parts.
d. Use of advanced natural building materials such as bricks, compressed earth blocks should be used for the construction of building envelopes.
e. All openings that allow ventilation such as windows and doors should face directly to an outdoor environment without obstruction to achieve maximum ventilation into the buildings.

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ASSESSMENT ON THE EXTENT OF PASSIVE COOLING STRATEGIES INTEGRATION IN PUBLIC CENTERS ADO-EKITI, EKITI STATE, NIGERIA

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Passive cooling system uses non-mechanical methods to maintain a comfortable indoor temperature in a built environment. Severe energy crisis, global warming, ozone layer depletion has increasable push the cooling load requirements for public buildings. This is as a result of the drastic increase in the use of air conditioning system for cooling the buildings all around the world. Nigeria not being left out of the equation requires even more energy to cool a building because of the poor design integration strategies and power supply glitches. Comfort in public centers in humid environment is measured by the level of it indoor temperature, air velocity, and its relative humidity. Most centers have a record of 37^{o}c of temperature and low humidity during the period of February to early May. The aim of the study is to assess the extent of passive cooling strategies compliance in public centers in Ado Ekiti, Nigeria for the purpose of improving occupant comfort in indoor space. Study adopted descriptive method using post occupancy evaluation method approach in evaluating six standard public centers through structural questionnaire. A checklist that captures the variables of passive cooling was applied by study for purposive sampling base on it size, capacity and level of patronage. Data collected were analyzed by descriptive statistical tool as in SPSS, and result presented in Tables and chat, Result revealed over 90% of the centers do not integrate passive cooling strategies in their design stage, 75% of the developers do not have an idea about passive cooling strategies and it benefit, while 99% need an alternative cool technique to improve the thermal comfort in the indoor space. The study recommends that every architect and developers of public centers should adopt passive cooling design strategies as it alternative cooling system for thermal comfort due to its low cost implication, available, durability and as well the drive of achieving a sustainable eco-environment.

Keywords: Evaluation, passive cooling, integration, thermal comfort.

INTRODUCTION

Power as in electrical energy has been a thing of challenge in developing countries like Nigeria, where most productions process and services depend completely for sustenance. Cooling of Public Space is actively driven by mechanical air condition systems via electrical power energy which is not only cost effective, but not sustainable in present day practice. The sequence of human activities in Public Centers and it larger size of participant today, has call for an alternative means of cooling as passive cooling by designer and builder in the construction industry, in achieving a reasonable amount of thermal comfort with little cost and no environmental pollution. Ancient architects practice varieties of innovative cooling, through natural means as, reconditioning of air flow, air temperature cooling by evaporation cooling, ventilation positioning and size of opening, building orientation and court yard placement within the building (Mehta,2015).. This was achieved with considerable measures on the use of natural indigenous material and environmental climatic factors. Today this strategies is not only call as ancient cooling pattern but tend to be boldly classified as sustainable means of cooling, as it gives essential amount of Cooling in the indoor space for thermal comfort (Ahsan,2009). It plays a suitable alternative to mechanical power air condition in Public Center with low cost value and environmental friendly.

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Passive cooling deals with the control and moderation of heat gain dissipation in an enclosed space in order to improve comfort of the space with low or nil energy consumption and pollution free environment (Damati,et.Al., 2013).. The aim of study is to identify passive cooling strategies and the level of passive measure adopted in public centers design so to achieving absolute thermal comfort. Study tends to consider the environmental climatic factor of the area, and careful select suitable passive measure and building materials that matches the environment.

Most Public Centers experience high amount of heat gain and heat dissipation from it environmental element, building component, orientation, and building materials used. Heat is also gain from occupant body and the interior fabric of the built space. According to Davies and (Jokiniemi, 2008), It is assumed that temperature of an enclosed space of 6meter/ 6meter room space with ten to twenty persons inside tends to increase by 4^{o}c above the normal room comfort temperature of an average of *24°c (about 73.4 degrees Fahrenheit* (°F). if proper cooling measures are not put in place in design of such scale, this will bring some level of discomfort in that indoor space.

Public Center design in Nigeria

Public Centers often tend to record higher temperature of *37°C* during the day at dry seasons in a hot humid environment. The indoor space temperature of public building become unbearable as a result of a high air temperature, low level of relative humidity and the state of air velocity in and out of the space. Passive Cooling seems to be the best option due to its natural ways of cooling, affordability, renewable factor, materials and maintenance value, beauty in landscape, and as well less consumption of energy and pollution free environment.

A Public Centers is a define land area in an environment which is design and constructed to be the focal point for the gathering, integration of people and various human activities. It is usually characterized by buildings and a well landscape environment. It is a calculated flexible space with emphases on multifunctional use, human comfort, ease accessibility to Centers and units in the center, and a proper building orientation. An open space floor plan is mostly adopted for user's specification, with much consideration to surface-value ratio and proper natural cross ventilation system. Centers adopt racking of space in indoor environment for control of air temperature, acoustic balance and visual accessibility within the space. Design standards and functional measures are employ in zoning units, while landscape element are used to connect various zone, define center space and break traffic for easy movement.

Types of Public Center

There are many type of public center in the study area but this research will only focus on six and study them due to its relevance to the researched topic, size, function, and level of patronage. Public center are categorized mainly by its provisional facilities, functional space and size, design component, environmental element, traffic flow and it easy accessibility.

Public Center are classified into two groups, the government own center and the private own centers. The government public centers are mostly 24% of the total number of center in an environment and run by the host community with little or no proper design qualities as in innovations, user comfort perception in design process, and maintenance measures Adebayo (2013). The other 76% are owned by private developers in the environment. This are mostly designed with a specified detailing to meet the end users demands. Innovative design element and pattern modern construction are tested in other to achieve a classified result.

Public Centers in Ado- Ekiti, Ekiti State

Ado-Ekiti is known for their celebrated social cultural activities and it is the major town in Ekiti State. It is located on the 7^{o} 37"23.84" north of the equator and longitude 5^{o} 13" 15.13" of the Greenwich meridian. 390 meter above the sea level south eastern part and 9159 kilometers northern pole with an average indoor temperature of 27^{o}c 27.6^{o}c and outdoor temperature at noon time about 37^{o}C- 39^{o}C (Igi, 2015). It is one of the most populated area with public center in southern part of Nigeria. Ekiti State is a state whose public center is mostly an Events Center and is used as multipurpose halls as well heavily crowded at weekends due to activities like engagement and wedding ceremony, graduation party, freedom party, tradition groups, union day, educational purposes, conference, seminar and religious activities taken place simultaneously. Most of the centers in the study area are owned by private developer with little innovation and less of professional touch in it design

as well finishes. Their main pattern is base on the size of the hall, little innovation as aesthetic, open space hall system, and no user perception in the design. Screed walls as interior finishing and pop high ceiling are mostly used to control temperature which is also a passive cooling strategies for comfort but a poor choice of hard landscape around it environment.. Most halls tend to heat to about 36^{o}C-38^{o}C at noon day due to fair ventilation system and little of mechanical cooling within the indoor space. Passive cooling is requiring in this environment to cover the gap for thermal comfort due to the environmental climatic condition, its rocky and mountainous topographical features.

Figure 1. The study area

Overview of Passive Cooling Strategies.

Cooling is the movement of heat energy from the region of high temperature to the region of lower temperature through conduction, convection, and radiation means (first law of thermodynamics). Cooling of building for thermal comfort must checkmate the air temperature 24^{o}C- 25^{o}C indoor, the relative humidity of 60 percent, air velocity of 60fpm-200fpm and the mean radiant temperature of 37^{o}C to 37.6^{o}C,which could be achieve via active cooling (mechanical) or passive cooling. Passive method seems to be the best for building due to its uniqueness in design, flexibilities to user's perception, energy renewal, low cost of production and maintenance, affordability, effectiveness and as well environmental friendly (Taleb,2014). Passive Cooling strategies focuses on the control of heat gain and the moderation of heat dissipation in view of improve indoor thermal comfort with little or no energy consumption. These strategies are viable techniques which promote the use of natural element in controlling the temperature of a space or an environment. According to (Kamal, 2012) passive cooling can be achievable through some look out measure as site planning, building design consideration, and building component, environmental climatic factor as well the use of natural material which play a vital role in controlling and reducing of building temperature.

Passive cooling strategies

There are many passive variables in achieving high performance of thermal cooling comfort in a public center, but this study will evaluate few of the variable as it strategies for design process. Building Form and Orientation: This deal with the proper orientation of building side against the direction of the sunrise and sunset ray and as well the use of the prevailing southwest trade wind for proper ventilation and night cooling of the building (Wong and Li, 2007). It control the amount of heat gain through the building envelop and can influence the cooling load of the building. Natural Ventilation: this strategy involves the movement of air to increase the evaporative and conductive heat lost from the skin of the occupant in the building as well increase air velocity (Szokolay,2004). According to (Akande,2010) natural ventilation are more effective when they are well position and shaded in design to respond to climatic element in removing warm internal air and replace with cooler external air. 20% of the building surface should be a cross ventilation unity.

Landscape Element and Vegetation: plays vital role in the reduction and control of heat gain in the built environment 10%-50% and also help in channeling the wind direction and flow of air through the building (Eumorfopoulou, et. Al., 2009). Proper orientation of tress with wild canopy and well proportion of plant foliage to the wall sections influence the thermal behavior of the building during day (Damati, et. Al., 2013).

Plate1. Below shows different heat control level via landscaping element and vegetatation.

Thermal Mass: Deals with the adequate even out of variation of internal and external temperature of the building fabric. It absorbs heat gain at temperature rise and vents it at night cooling. The use of insulation in the building envelops to reduce the heat gain through conduction convection. Materials like cellulose, wool, fiberglass, air gap in design and the use of reflective surface material. Light weight and light color wall and green roofing material reduce the direct impact of sun on the building (Olu, et. Al., 2012).

Evaporation Cooling: this strategy has it trace from ancient Egypt and Persia which involves the amount of moisture evaporation into the atmosphere which serves as heat sink. Water is injected into the air from building surface, pools, fountain within the environment to reduce air temperature and improve its quality toward the building and within the building. The use of vegetation for evaporation as trans-evaporation is seen as plant transpire moisture in order to reject there sensible heat, (Muhammad, et. Al., 2013).

Shading and fenestration: shading demotes a device or object with partial or complete obstruction of direct impact of sun ray from the building opening. Due to the three component of the sun, direct, diffuse and reflected radiation. A proper building form and shape should be employed to shade sizeable opening and cast shadows for cooling of fenestration passage. (Wong and Li, 2007) is of a view that position of wild opening is important in public center but should be shade if it position is toward the direction of the sun.

(Geetha and Velraj 2012) broadly categorized passive cooling strategies into two. The heat prevention/reduction method (heat control method), which minimize internal heat gain from the sun to the building by adapting building to it regional climate and micro climate environment via proper landscape element and vegetation, radiation cooling, evaporation cooling, orientation of building and control of wind direction toward cool shading. The second is thermal moderation and heat dissipation method. This moderate and reject heat from the building component, through thermal mass and night cooling, natural ventilation, surface-volume ratio.

RESEARCH METHOD

The research Study adopted descriptive method using post occupancy evaluation method approach in evaluating six standard public centers on the extent of passive cooling strategies integration in each centers. Post occupant evaluation (POE) method has obtain a more qualitative results regard to field data collation, users perception, and data evaluation on relative built environmental studies Adedayo and Anunobi . el (2014). It is generally accepted and wildly used in verifying variable with core effect on extent of compliance on sustainable design process, construction challenges, growth of new innovation, user's perception, adaptable building health and structural maintenance (Zimmerman and Martin,2001). The difference in social cultural activities and classes of public center patronized gives a unique selection of center for respondent to backup the research finding. Structural questionnaire survey and field observation check list was design and administer to respondent from six selected public centers out of a study population of sixteen public centers. This was done base on the standard and class of the building, size and the level at which this centers were patronize.

For proper evaluation of this six selected centers, thirty copies of structural targeted questionnaire base on passive cooling variables adopted was administer to each public centers, making a total of 180 copies of the questionnaire. A total of 108 copies returned given 60% return rate, 34 copies were torn given 18.9% torn rate and 38 copies not return

making 21.1% not return rate. Also the study applies the checklist method in each centers in ascertain the result gotten from the questionnaire were factual. Selection of respondent cut across space users and the centers staffs, bases on their experience in their various centers and should also be consider in the planning design process. Study adopts the Stratified Random Sampling method and also engages four public administration master students as research assistance from Afe Babalola University for proper distribution of the questionnaire in the selected centers. SPSS was used to analysis data collection from centers accordable and result gotten was presented in table and chart for more clarification. Illustrations of picture in plate's format of the study area were inclusive for evaluation. Calculations of variable were mainly likert scale with the view of establishing fact for recommendation.

Table 1 the table below show six selected public centers base on its size, zone and features.

No	PUBLIC CENTERS	SIZE	ZONE
1	Fountain Events and Hotel	1800sitting	BASHIRE
2	BYC Events Center	1200sitting	POLY ROAD
3	Eagle Center	2000sitting	IKERE ROAD
4	Damlake Events Centers	1200sitter	HOUSING
5	AB Foundation	1500sitter	ADEHUM
6	AB Empirical Events And Hotel	1600sitter	ADEBAYO

Source: Authors fieldwork 2017.

RESULT AND DISCUSSION

Result show a range score of the extent of passive cooling strategies integrated in various public centers, as toward achieving absolute thermal comfort in its indoor space. The combination of the result finds gives a base for assumption of the extent of compliance of passive measure in the study area. Result discussion will be analysis in two ways as the first through likert scale measurement for user's perception and the second base on some selected variables studied by the researcher.

Likert scale measurement of extent of passive cooling strategies integration

The likert scale in the study deals with the user's perception on the thermal comfort of the indoor space provided in various centers. A range score of 1-4 was allotted to the different option picked by respondent regard to their understanding on the variable been measured. What each numerical figure stands for, is stated below.

Very Dissatisfied- 1, Dissatisfied- 2, Satisfied- 3, Very satisfied- 4.

Below table enlist few of the embedded variables used in the questionnaire to evaluate the users perception on the level for thermal comfort provided.

Table 2.0 Number of responds on users' opinion on the integration of passive cooling measures

Measure variables	Very dissatisfied (X1)	Dissatisfied (X2)	Satisfied (X3)	Very satisfied (X4)	Total
Score on indoor design	23	32	35	18	108
Score on indoor temperature	38	39	18	10	105
Score on indoor cooling comfort	34	39	32	2	107
Score on natural ventilation and air flow	5	18	78	7	108
Score on effect of landscape elements and vegetation	28	36	31	11	106
Score on interior finishes (thermal mass) for cooling	12	14	11	68	105
Score on time duration for cooling provided	67	18	10	8	103
Score on shading system	25	48	21	10	104
Score on need for an alternative cooling system	4	15	68	18	105
Score on level of knowledge about passive cooling	-	-	-	-	-

Source: Authors fieldwork 2017.

Recorded numbers of respondent from each row will be multiple by the range score allotted to its row in table 3, below the table is the total add up score.

Table 3.0 the sum of the respondent perception on the passive cooling measure for comfort.

Measure variables	Very dissatisfied (X1)	Dissatisfied (X2)	Satisfied (X3)	Very satisfied (X4)	Total
Score on indoor design	23	64	105	72	264
Score on indoor temperature	38	78	54	40	210
Score on indoor cooling comfort	34	76	96	8	214
Score on natural ventilation and air flow	5	36	234	28	303
Score on effect of landscape elements and vegetation	28	72	93	44	237
Score on interior finishes (thermal mass) for cooling	12	28	33	272	345
Score on time duration for cooling provided	67	36	30	32	165
Score on shading system	25	96	63	40	224
Score on need for an alternative cooling system	4	30	204	72	310
Score on level of knowledge about passive cooling	-	-	-	-	-
Total	236	516	912	608	2272

Source: Authors fieldwork 2017.

The use of likert scale interprets the result above base the range of scale stated below.

1.0 - 1.49 Very Dissatisfied

1.5 - 2. 49 Dissatisfied

2.5 - 3.49 Satisfied

> 3.5 Very Satisfied

Table 4.0 the table below shows a summary of high responds of dissatisfied due to the poor plain floor design method adopted in the construction of those centers and mostly a wrong building form and orientation. The temperature heat up to 26^0c in the indoor space at noon due to it poor style of landscaping and shading method applied. Most center window opening is large which tends to allow the flow of much hot air into the space due to the effect of it hard surface landscape and lack of evaporation cooling method. Some of this center study, adopt a fair interior finishes as pop ceiling, screed walls and terrazzo floor finishes which help a little in cooling the fabric of the indoor space. The need for an alternative cooling system is imperative due to the short period of serve provided by mechanical cooling in most centers against its cost implication.

Table 4. Shows a summary respondent of users perception on thermal comfort provided in public center.

Measure variables	Sum	Mean	Interpretation
Score on indoor design	264	2.44	Dissatisfied
Score on indoor temperature	210	2.0	Dissatisfied
Score on indoor cooling comfort	214	2.0	Dissatisfied
Score on natural ventilation and air flow	303	2.80	Satisfied
Score on effect of landscape elements and vegetation	237	2.23	Dissatisfied
Score on interior finishes (thermal mass) for cooling	345	3.28	Satisfied
Score on time duration for cooling provided	165	1.6	Dissatisfied
Score on shading system	224	2.10	Dissatisfied
Score on need for an alternative cooling system	310	2.95	Satisfied
Score on level of knowledge about passive cooling	-	-	No knowledge

Source: Authors fieldwork 2017.

Study ascertain the satisfied of natural ventilation due to the size and height of the windows adopted. The indoor headroom (surface to volume ratio) is up to the required standard for change of air circulation.

Table 5. Study checklist to ascertain the result of the questionnaire for discussion.

Measure variables	Interpretation
rating on indoor design	Very Dissatisfied
rating on indoor temperature	Dissatisfied
rating on indoor cooling comfort	Very Dissatisfied
rating on building form and orientation	Very Dissatisfied
rating on natural ventilation and air flow	Satisfied
rating on effect of landscape elements and vegetation	Dissatisfied
rating on interior finishes (thermal mass)and radiation cooling	Dissatisfied
rating on time duration for mechanical cooling provided	Dissatisfied
rating on shading system	Dissatisfied
Rating on surface to volume ration	Satisfied
rating on need for an alternative cooling system	Very Satisfied
rating on level of knowledge about passive cooling	No knowledge

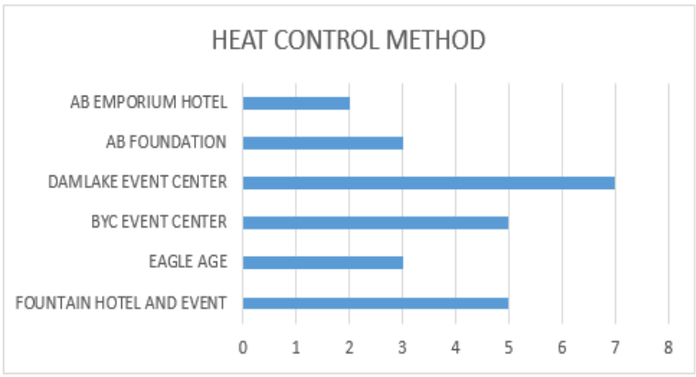
Source: Authors fieldwork 2017.

From the above table, it is clear that a greater numbers of the respondent are dissatisfied with the level of thermal comfort provided in most of the public centers. Passive cooling strategies are not really incorporated in the public design for sustainable cooling but little of it as aesthetics and presentation of innovation. Active power cooling system is what is trending and it is limited in service rendering and most time cost effective on the center provider to run. The request for alternative cooling pattern is imperative as most respondent disclose satisfaction for an alternative cooling that could meet the cooling load require for an indoor space of such function and easily in service cost. For proper analysis, the study tends to evaluate selected centers base on the two categories of passive cooling strategies the heat control method and thermal, moderation method by Geetha and Velraj (2012)

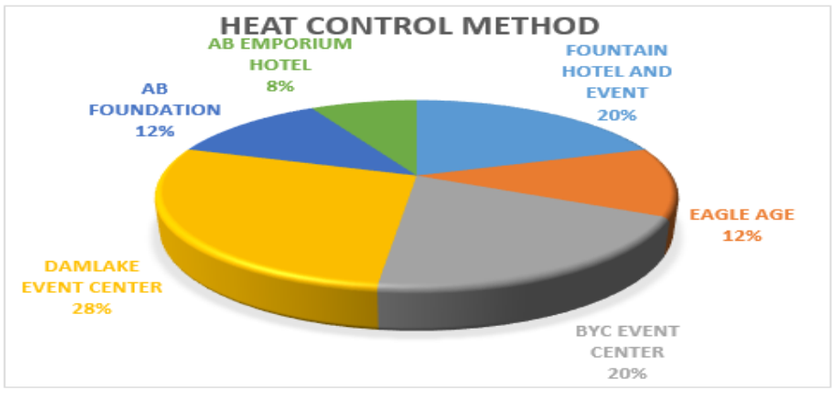
Passive Cooling Strategies Base on Heat Control Method

The heat prevention/reduction method (heat control method), this method minimize internal heat gain from solar radiation on the building envelop by adapting the building to it regional climate and micro climatic environment, through the use of proper landscape element and vegetation, radiation cooling, evaporation cooling, orientation of building and control of wind direction toward cool shading.

Figure 2.0 shows the extent of integration of passive cooling strategies through heat gain control method in selected centers.



Source: Researcher's fieldwork 2016



Source: Researcher's fieldwork 2016

Fig 2: chart above showing percentage of heat control methods used in the selected events centers, Damlake events center have 28%, fountain hotel and events have 20%, BYC events have 20%, AB foundation have 12%, Eagle Age 12% and AB emporium have 8% the lowest heat control measures. Damlake events center have the highest as a result of it design method of landscape element, building orientation, shading and overhang pattern of roof system. Windows size and placement, interior finishes and surface to volume ratio

Passive Cooling strategies Base on Thermal moderation and heat dissipation method

Thermal moderation and heat dissipation method involves minimizing the effect of heat gain within the building through the use of thermal mass, insulation finishing material (the wall finishing- painting, screed of wall pop ceiling, surface to volume ratio, floor tile and other interior decoration) and night ventilation through court yard cooling. The following public centers were studied for thermal moderation and heat dissipation, fountain hotel and events

-1, Damlake events center -2, eagle age -3, BYC events-4, AB foundation-5, and AB emporium hotel and events-6

Figure 3.0 below is an analysis on passive cooling strategies through thermal moderation and dissipation method in selected events centers.

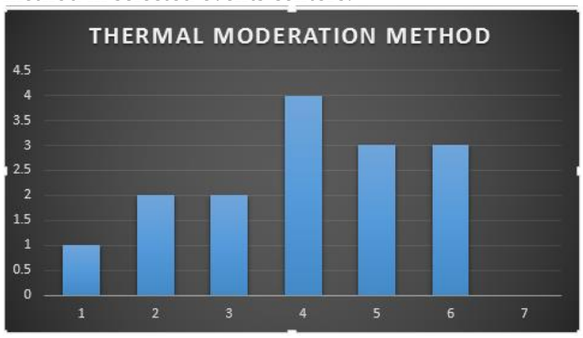
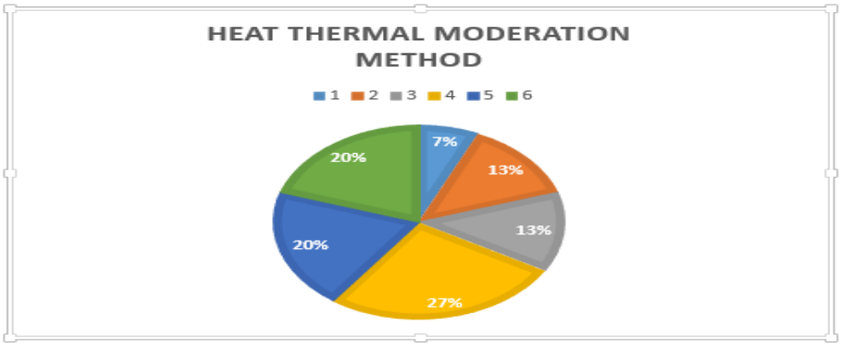


Fig.3 the chart below show the percentage level of passive cooling strategies through thermal moderation and dissipation methods used by various Events Centers. A BYC event is found to have the highest as 27%, AB foundation 20%, AB emporium hotel and events 20%, eagle age 13% , Damlake events center 13% ,and fountain hotel and events 7% due to its poor thermal mass finishing. BYC events centers adopted a well interior finishes in walls, ceilings and floor. Light colour application on building and it component were used, this reduce the heat absorption and repel heat from its fabric,



Source: Researcher's fieldwork 2016

Data drawn from the study and the outcome of the observation schedule checklist analyzed on the two categories of passive cooling method, shows that most of Events Centers in Ekiti were generally designed majorly with little heat control method of passive cooling strategies in mind. This can be deduced from the first category data analysis, as the study comparing both charts which shows that more of heat gain control methods were not used compare to that thermal moderated and dissipation measure as passive cooling techniques. This implies that most designer and developer don't have the knowledge of the importance heat control measure as a strategy for balancing the cooling of the built space. The form and orientation, as well the landscaping of the environment are not been consider as a major look out factor in reducing heat sink and balancing of the building temperature.

CONCLUSION

Public center can be design based on the purpose it serves with applicable passive cooling measures that suite its environment for maximum thermal comfort. The planning and design process of such facilities and services should including considerable passive measure that will promote the use of natural material and as well achieve it main aim. The micro-climatic within the site of interest should be design to flow along with other passive measure like building orientation, landscaping and vegetation, proper natural ventilation methods, thermal mass, and insulation finishes material. This will have great influence on the thermal performance on the building and should be a major design breakthrough for architects and engineers. High temperature and low humidity brings discomfort to building occupants, therefore, a need to focus on cooling strategies that will mitigate this stake and promote comfort requirements of users, minimize energy consumption and environmental pollution**.**

Study strongly recommends a proper sensitization of the importance of passive cooling design strategies to designers, builders and properties developer of public centers for

sustainable building comfort and the adoption of natural building element in building process for promotion, and identification of indigenous innovation.

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USING WASTE HEAT RECOVERED FROM HOUSEHOLD REFRIGERATOR TO HEAT WATER FOR DOMESTIC USE

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In household vapor compressor refrigeration system, heat is rejected from the condenser during condensation process, to the surrounding. This heat energy is wasted but it can be conserved and used for many purposes. In light of this and with a view to conserving waste energy from the condenser of household refrigerator and mitigating the cost of heating water using other energy sources , this paper presents the use of waste heat from the condenser of household refrigerator to heat water through heat exchanger for domestic use, The experimental results revealed that after 60 minutes of operation, part of the heat that is often wasted was able to heat 3 litres of water and raise its temperature to a maximum of 43.8^{O}C through heat exchanger, at the refrigerant condensing temperature of 38.7^{O}C. The Coefficient of Performance (COP) of the refrigerator fitted with shell and coiled tube heat exchanger was found to have improved significantly by 62.24%.

Keywords*: waste heat, recovery, refrigerator, heat exchanger, coiled tube heat exchanger, condenser, water*

INTRODUCTION

All developed and developing countries are using conventional energy rapidly. Due to high rate of consumption of energy, sources available in earth surface will exhaust after some period. Therefore, engineers and scientists are trying to see new possibilities to use sources efficiently and utilize waste heat. (Vedil et al, 2014) . Waste heat is the heat which gets untapped and directly released into the atmosphere. It is released in the form of streams of gases and liquids which leaves the system at a temperature higher than the surrounding (Vedil et al, 2014). A household refrigerator is a common household appliance that consists of a thermally insulated compartment and which when works, transfer heat from the inside of the compartment to its external environment so that the inside of the thermally insulated compartment is cooled to a temperature below the ambient temperature of room.(Patil, et al, 2015). The vapor compression refrigeration process includes four stages i.e. compression, condensation, expansion and evaporation. Out of these stages, heat rejection takes place in condensation process. This heat is rejected into the atmosphere (waste heat) and hence there is an opportunity to recover and re-use that heat so that overall system efficiency can be maximized (Agarwal et al, 2014).

Hot water is required for various applications like processing, cooking and cleaning in any household equipment. In such applications, water is conventionally heated by electrical heating, which is very costly or burning the fossil fuels which pollutes an environment. Judicious recovery of heat from the refrigeration cycle and utilizing these for hot water generation will definitely lead to significant energy saving. (Mali et al, 2017). One way of recovering heat is to use heat exchanger where in high temperature refrigerant loses heat to the cold water circulated through it.

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Musa, et al., (2018). **USING WASTE HEAT RECOVERED FROM HOUSEHOLD REFRIGERATOR TO HEAT WATER FOR DOMESTIC USE.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

Development of such efficient methods to recover this dissipated (waste) heat for heating water reduces extra energy cost incurred to heat the water separately which is used for cleaning milk equipment. Hot water of the order of 45–50 ^{0}C is used for cleaning equipment in milk dairy (Sapali et al, 2014).

A lot of work and remarks has been done and made on using waste heat from the condenser of vapour compression refrigerating system to heat water by many researchers. Notable among these researchers are Jadhav et al (2014) who modified an existing refrigerator by incorporating a hot box & water heater which was based on same principle of vapour compression cycle but with a small change in cycle. They stated that it is evident from their investigation that the machine called as "Refrigerator with hot box and water heater" performs the best result and heat water up to 55-60 degree in water heater and maintain temperature up to 45-50^{0}C in hot box. Patil et al (2015) asserted that practical uses of waste heat from the domestic refrigeration are typically for space heating and water heating in minimum constructional, maintenance and running cost. So they installed a cabin on a domestic refrigerator with the condenser coils of the refrigerator serving as heating coil. According to the researchers, a known quantity of water was poured into the cabin and heated by the condenser coils (due to convectional current) and the overall COP of the refrigerator was found to increase. Stinson et al (1987), conducted a theoretical energy balance, from which the potential for recovery of refrigeration condenser heat was estimated to be up to 60% of the water heating energy requirements. Romdhane(2009), developed a system that can recover heat from the condenser of the refrigerator. In his work air cooled conventional condenser was replaced by another heat exchanger to heat water. The results showed the system was able to produce hot water at a temperature of 60ºC.

Moreso, Mali et al, (2017) remarked that as at the year 2017, a cost of fuel had continued to increase. To recover the waste heat generated from condenser, waste heat recovery in refrigeration system is one of the best way to save waste in application of water heating. Clark et al (1996) remarked that on their developed integrated heat recovery system has been tested under a variety of hot water usage protocols and the resulting data set has provided significant insight into issues associated with commercial implementation of the concept. Momin et al (2014) investigated a waste heat recovery system with thermo syphon and experimented to recover condenser heat from the household refrigerator of 200 litters. They found that the maximum temperature achieved in the water storage tank at average load was 60°C. Tanaji et al (2014) did experimentation and performance evaluations of their developed water heat recovery system by using a water tank for condenser heat absorption of 200litres LG refrigerator. Experiments were performed with and without heat recovery system and result showed that there was 10^{0}C increase in water outlet temperature. Elumalai et al (2015) investigated experimentally the heat recovery by using hot oven and heater of VCR system. The oven recovered the superheat of the refrigerant vapour and utilized it for heating space inside the hot oven. A juice chamber was designed to reduce its temperature by pumping it through heat exchanger attached to evaporator by the researchers. The effectiveness of cooler as well as the effect of operating temperature has been studied. Their result showed that temperature in oven was 48^{0}C and 42^{0}C in water, after a period of 30 minutes running of 165 liters, 124 watts R134a refrigeration system stated by Kumbhar et al (2017). Carbon Trust (2017) remarked that heat recovery equipment can be fitted to existing plant, or companies can specify new plant with heat recovery already integrated. In both cases, the technology allows waste heat to be re-used for space heating or hot water. Therma-stor (2017) stated that by recovering the heat from your cooling system, you can heat water for free. Heat recovery is cost effective technology for restaurants, supermarkets, and food processors any business that needs hot water and uses refrigeration or air conditioning.

In the same vein, Rahman and Adrians (2006) integrated a waste heat recovery device with a split air conditioning system. The result of their experiments showed that the water temperature can be raised from 30 °C to 75 °C in eight hours of operation. Somsuk et al (2006).discussed a similar system that supplies hot water as a byproduct of air conditioning and stated .that depending on the selected flow rate, the system was able to raise water temperature by 10 °C to 16 °C in approximately 20 min. The test results also revealed that for flow rates ranging from 0.5 l/min to 2 l/min, maximum coefficient of performance was obtained at 2 l/min. Westerlund et al 2012 and Polley, (2010) remarked that a basic requirement for WHRS is that the temperature of waste heat must be high enough to serve as a useful heat source. One application, which would greatly benefit from waste heat recovery, is water heating stated by Khaled et al, 2015. The reason was that water heating requires a major share of energy consumption

in buildings where living and food preparation occur Khaled et al, 2015. Sonday et al (2017) indicated in their project that waste heat can be utilized in various ways. In the fast moving world of today where time is short we can use this as food and snacks warmer, water heater, grain dryer. So we can save lot of time and energy.

Abu-Mulaweh (2006) revealed in his designed and developed two types of heat exchangers, concentric type heat exchanger and coiled heat exchanger retrofitted in to the air conditioning system. For thermosyphon heat recovery system that the concentric heat exchanger produce hot water at a temperature of 45ºC and the coil type produce hot water having 40ºC. Different types of heat exchanger have been used to utilize heat from the condenser of refrigerator to heat water. The aim of this research is to utilize waste heat from the condenser of 50 litres LG refrigerator, to heat water through shell and coiled tube heat exchanger, with a view to conserving energy and providing hot water for domestic purpose.

MATERIALS AND METHOD

Materials

The materials and equipment used to carry out this research work includes:

1. LG refrigerator made in China with the following specifications:

Model NO: GC-051SA, Rated Input- 85W

Gross volume-Total- 50L, Refrigerant- R134a, 55g and

Dimensions- 443(W) X450(D) X501(H) mm with the condenser replaced with heat recovery unit (shell and coiled tube heat exchanger) developed by Musa et al, (2018) shown in plate 1.

Plate 1. LP Refrigerator fitted with the developed heat exchanger for Waste Heat Recovery from household refrigerator by Musa et al (2018)

2. Three Litres of water
3. Three digital thermocouples
4, A stop watch

Process of using Waste Heat Recovered from the Household Refrigerator to Heat Water

Warm refrigerant is suctioned into the compressor from evaporator and discharged at high temperature and pressure to the shell and coiled tube heat exchanger of the refrigerator. Refrigerant gives up its latent heat to water in the shell and coiled tube heat exchanger. As the refrigerant loses its latent heat and gets condensed, the water gets heated. The condensed refrigerant passes through capillary tube at a lower pressure and temperature and again goes to inlet of evaporator and thus the cycle continues.

The available heat at the shell and coiled tube heat exchanger for rejection, by the refrigerant, Q_C is given as

$$Q_C = \dot{m}(h_3 - h_4) \quad (1)$$

Heat gained by water in shell and coiled tube heat exchanger, Q_W is given as

$$Q_W = \dot{m}_w(h_{fw} - h_{wi}) \quad (2)$$

Neglecting losses,

The heat rejected by the refrigerant in the shell and coiled tube heat exchanger = Heat gained by water in the shell and coiled tube heat exchanger.

$$\dot{m}(h_3 - h_4) = \dot{m}_w(h_{fw} - h_{wi}) \quad (3)$$

Where $\dot{m}$ is the mass flow rate of refrigerant, in Kg/s, $\dot{m}_w$ is the mass flow rate of water, in Kg/s, h_3 is the enthalpy of the refrigerant at point 3 in the thermodynamic cycle of operation of the refrigerator, where the vapour enters the compressor and is compressed and superheated., h_4 is the enthalpy of the refrigerant at point 4 in the thermodynamic cycle of operation of the refrigerator, where the vapour condenses, h_{wi} is the enthalpy of cold water in the shell and coiled tube heat exchanger in KJ/Kg and h_{fw} is the enthalpy of hot water in the shell and coiled tube heat exchanger in KJ/Kg

EXPERIMENTAL METHOD

The experimental procedure is as follows;

1. The refrigerator fitted with the shell and coiled tube heat exchanger, was powered or put on and allowed to run for ten minutes for the system to normalize.

2. Three litres of water was measured with a graduated cylinder and poured into the shell and coiled tube heat exchanger which then served as the new condenser of the refrigerator

3. After pouring the three litres of water ,into the shell and coiled tube heat exchanger, Digital thermocouples were used to measure the temperatures of the refrigerant at condenser inlet and outlet(condenser inlet temperature and condenser outlet temperature) and water in the condenser(shell and coiled tube heat exchanger) in every five minutes ,until sixty (60) minutes of refrigeration operation was attained. The time was measured with a stopwatch.

Determination of recovered heat in the shell and coiled tube heat exchanger fitted to the refrigerator

Given that

The volume of water = 3litres, density of water $\rho_w = 1000Kg/m^3$, specific heat capacity of water, $C_{Pw} = 4.18KJ/KgK$. Initial temperature of water in the shell and coiled tube heat exchanger, $\theta_1 = 28.8^0C$, The final temperature of water in the shell and coiled tube heat exchanger after 60 minutes of operation of the refrigerator, $\theta_2 = 43.8^0C$. Duration of operation of the refrigerator, t = 60minutes

The heat absorbed by the water $= \dot{m}_w C_{pw}(\theta_2 - \theta_1) = \rho_w V\frac{Cpw(\theta 2 - \theta 1)}{t} = \frac{1000\times0.003\times4180(43.8-28.8)}{60\times60} = 52.25W$

Heat absorbed by water = heat recovery achieved.

Heat recovery achieved, $Q_{ac} = 52.25W$

Determination of Coefficient of Performance of the refrigerator fitted with the shell and coiled tube heat exchanger

The coefficient of performance (COP) of the original refrigerator with finned tube condenser has been determined to be 2.36 by Musa et al (2018) and let it be termed old COP.or COP_{old}

According to Walawade et al (2013) the condenser heat is utilized which is part of compressor work. So the shell and coiled tube heat exchanger heat utilized is the heat recovery achieved, absorbed by water and is part of the compressor work.

The COP of the refrigerator fitted with the shell and coiled tube heat exchanger, which is termed the new COP, $COP_{new} = \frac{\text{Heat extracted in refrigeration(Refrigerating effect)in} \frac{J}{S} \text{ or W}}{\text{Workdone by compressor in} \frac{J}{s} \text{or W} - \text{heat recovery achieved in} \frac{J}{s} \text{or W}}$

$= \frac{\dot{m}R_n}{\dot{m}W - Q_{ac}}$

where the refrigerating effect, R_n = 103.93KJ/Kg, Work done by the compressor, W = 44.12KJ/Kg and Mass flow of air, $\dot{m}$ = 0.0019Kg/s determined by Musa et al(2018)

$$COP_{new} = \frac{0.0019 \times 103930}{0.0019 \times 44120 - 52.25} = 6.25$$

% Improvement in COP = $\frac{COP_{new} - COP_{old}}{COP_{new}}$ x 100 = $\frac{6.25 - 2.36}{6.25}$ x 100 = 62.24%

RESULTS AND DISCUSSION

The variation of condenser inlet and outlet temperatures as well as the temperature of water in the condenser (coiled tube heat exchanger) with time is shown in figure 1.

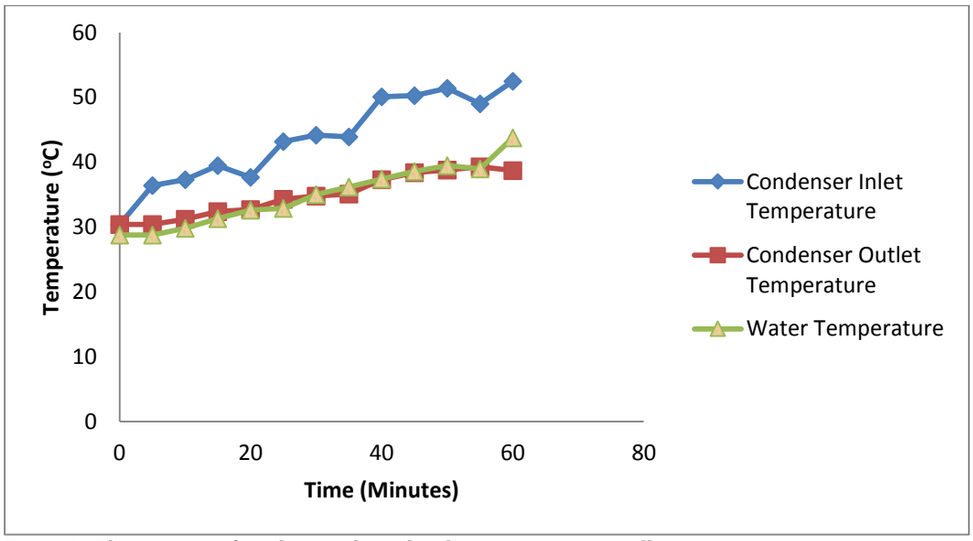

Figure 1: The variation of condenser inlet and outlet temperatures as well as the temperature of water in the condenser (coiled tube heat exchanger) with time

It can be seen from figure 1 that the condenser inlet and outlet temperatures and water in the coiled tube heat exchanger increased with time. It is evident in figure 1, that after 60 minutes of operation, the waste heat through coiled tube heat exchanger was able to heat 3 litres of water and raise its temperature to a maximum of 43.8OC at the refrigerant condensing temperature of 38.7^{O}C. The maximum temperature of water obtained in this work is higher than the maximum temperature of 42^{0}C of 165litres of water heated by similar system by Elumalai et al (2015) but lower than the maximum temperature of 44.3^{0}C of 5litres of water, 45^{0}C of 100litres of water, 58^{0}C of 200litres of water and 60^{0}C of 100litres of water, heated by similar systems by Biswas and Joshi(2017), Patil and Dange(2013), Shreejith et al(2014) and Momin et al(2014 respectively. However, the hot water obtained in this work can be utilized for domestic applications like preparation of foods and beverages, bathing, laundry, cleaning.

It can be seen by the calculations that 52.25W waste heat was recovered to heat three litres of water in sixty minutes of operation of the refrigerator. It can also be seen in the calculations that the COP of the refrigerator fitted with the heat recovery unit (shell and coiled tube heat exchanger) improved significantly by 62.24%.

CONCLUSION

Hot water heaters used in our homes most especially in rural areas, are mainly electric water heaters, gas water heaters and kerosene fired water heaters. All the aforementioned types use a lot of energy with serious cost implication. If alternative water heater that use smaller

amount of energy or waste energy are used, instead of the convectional types, the total energy use in our homes will decline. This research work utilized waste energy from the condenser of refrigerator called waste heat to heat water through coiled tube heat exchanger, which was fitted and used to replace the initial condenser of LG refrigerator, without altering its performance. The waste heat through coiled tube heat exchanger is capable of heating 3litres of water and raising its temperature to $43.8^{O}C$ during 60 minutes of refrigerator operation.

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A REVIEW OF LITERATURES ON ENERGY PERFORMANCE IN LOW INCOME HOUSING, USING RETROFITING TECHNIQUES IN VIEW OF OPTIMIZING ENERGY EFFICENCY

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Imperative to react to the state of rapidly dwindling natural resources, environmental pressures and climate change posing fundamental threat to economic systems and human survival in Nigeria and globally. Until fairly recently, considerations for existing residential buildings have received less attention. In Nigeria, thousands of households of low income buildings spends large sums of their earnings on energy bills, while getting less energy-driven services for their appliances and utilities to meet their needs. This study is mainly a literature review on energy performance in low income housing, which explores possible alternatives for less dependence on national energy supply with more environmental benefits through sustainable retrofit and resource-efficiency interventions for low-income houses. The objective is to address issues relating to energy generation, conservation and other associated resource management with a view to achieving the development of low carbon and more eco-friendly built environment. Via the findings, it was concluded that if policies and regulatory mechanism are put in place for low-income housing in Nigeria, this would deliver pathway to improving energy efficiency of the low income housing.

Keywords: Low income houses, Energy conservation, Retrofitting, Sustainability.

INTRODUCTION

Globally, it is acknowledged that there is need to devote much attention to how buildings are designed and constructed to reduce their energy consumption. A major issue arising from the concern about climate change is the reduction of energy use in residential buildings. Presently, it is estimated that nearly half of million tones of CO_2 emissions each year is attributed to energy use by residential buildings. Given that globally by 2050, the number of households is projected to increase by 67%, this make the residential sector a significant area that requires more attention. However, while the reductions in house gas emissions from residential sector is considered critically important; efforts geared towards achieving this is still inadequate to meet the required level of reductions predicted by climate change experts to prevent catastrophic climate change. This brings to fore the need for greater attention to be accorded to existing building stock most especially residential buildings. In the 2030 challenge, the American Institute of Architects (AIA) along with U.S. Building Council advocated that new construction of residential and commercial buildings should use half the fossil fuel of average existing buildings and a gradual increase in performance of the existing buildings so that by 2030 new buildings are carbon-neutral. Meanwhile, achieving the gradual increase in energy performance of existing residential buildings would require leading-edge energy retrofits. Presently, in Nigeria several thousands of housing units for the low income group are designed and constructed with little or no regard for low energy use and other " design considerations. Thus, high levels of additional energy are required to keep the houses cool in the hot season months.

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In Nigeria, the energy inefficiency of the existing housing stock result to the demand for more energy to reach comfortable temperatures. Most times, the required indoor comfort levels cannot be reached without considerable expenditure on energy. Hence, Nigeria is faced with the reality that requires retrofitting and strategies for vast majority of existing houses that provides less adequate internal comfort to reduce their environment burden, the above gaps has necessitated this research.

Aims and Objective

This paper aim is to explore the avenues for retrofitting in Nigeria existing residential buildings. The specific objectives include;

i. To identify areas where retrofits measures can be applied to low income houses with a view to reducing their energy consumption through major renovations.

ii. To identity the features that can be retrofitted into existing residential buildings for efficient energy utilization and conservation.

iii. To highlight the challenges several dividends accruable from buildings.

LITERATURE REVIEW

The Concept of retrofits and Global efforts on existing buildings

Retrofits involve the upgrade of an existing building either wholly or partially occupied to improve energy and environmental performance, reduce water use, and improve the comfort and quality of the space in terms of natural light, air quality, and noise. It can be equally simple as putting in new heating, ventilating, and air-cooling parts, mounting solar panels on a ceiling. According Ma et al. (2012) existing buildings is one of the primary approaches to achieving sustainability in the built environment at relatively low cost and high consumption rates. Although there is a broad range of retrofit technologies readily available, methods to identify the most cost-effective retrofit measures for special projects is still a major technological challenge. Across the world, several attempts have been made in developed countries like the US, Australia and UK towards improving energy efficiency of existing buildings. These attempts include approaches such as provision of policy guidance, financial and technical support to implement energy efficiency measures. Likewise, a substantial number of works by numerous authors (Asadi et al., 2012; Flourentzou and Roulet, 2002; Goli et at., 2011) have been carried out to explore energy efficiency through diverse avenues directed for improved performance in energy use of existing residential houses.

Cohen *et al*. (1991) investigated saving energy and efficiency in cost retrofit options of individual single family buildings and analysed metered energy consumption with the real cost of installation. The author's findings indicated that insulating ceilings and walls are cost effective retrofit and window replacement a feasible retrofit option but has a result of smaller normalised annual energy saving (of between 2-5%. Gorgolewski (1995) produced method to optimise renovation strategies for housing retrofit by adopting a life cycle cost approach to evaluate and compare performance of different retrofit measures. The outcomes indicated that the paybacks are higher than the entire retrofit measures.

Goldman *et al*. (1998) reported findings from their studies on the retrofit of US multifamily buildings. The authors' results were based on analysing data that were measured and obtained from a record of different apartments. It was found that it cost much less to retrofit a fuel-heat buildings when compared to electric-heat buildings with the payback periods for the two buildings indicating six (6) and twenty to twenty five (20-25) years respectively. Al-Ragom (2003) examined residential buildings retrofit in hot and arid climates the study revealed that significant energy reduction is achievable if the cost of implementing the retrofit cost was supported fully by the government. Alanne (2004) performed an analysis of a Finnish apartment and tested the applicability and functionality of a multi-criteria ‘knapsack' model proposed by the author. The model was developed to aid in the selection of the most viable renovation actions in the conceptual phase of a renovation project. Mahlia *et al*. (2005) used annualised costs and cash flow in calculating the economic impact of lighting retrofits in residential sector in Malaysia. The authors presented the cost-benefit analysis and emission reduction of lighting retrofits. Their findings indicated that in the retrofit of efficient lighting systems, cost-benefit was a determinant factor for saving energy.

A different method undertaken by Zavadskas *et al.* (2008) was adopted to know the effectiveness of retrofitting houses on the basis of expected energy savings and increase in the worth of re-furbished buildings in the market. The study found that choosing retrofit situations depends on strategic urban development programmes, renovation cost, heating energy saving and expected increment of market value. Dodoo*et al*. (2000) evaluated the implication of primary energy through life cycle assessment in the retrofit of a four-storey apartment building to the standard of a passive house. The results showed that reduction in final energy use was achieved, although the primary energy is still determined by the type of energy supply system used.

Bin and Parker (2012) observed the environmental performance of a century home and compared its original and after retrofit environmental footprint. The findings indicated through renovation, energy performance of existing buildings' can be enhanced and be made environmentally sustainable sound. Additionally, research on existing non-residential buildings by several other scholars such as Hestnes and Kofoed, (2002); *Chidiac et al.* (2011); and Ardente *et al.* (2011) showed significant reduction in the use of energy from existing buildings is achievable through appropriate retrofit or renovation defined by Flourentzou and Roulet (2002) as the work that require upgrading an existing old building.

In Africa, a few demonstrated pilot projects carried out in South Africa shows both economic and societal benefits of more sustainable design in low-income housing. The interventions into existing houses were not only found to translate into energy savings, but also resulted in water and financial savings and reduced associated illness, safety risks, house gas emissions and environmental impact. Similarly, it was also noted that job creation also became a crucial component in the successful delivery of the projects. Thus, according to Ma *et al*., (2012) retrofit or refurbishing of the building constitutes a type among several methods to achieve a reduction in energy use and the consequent house gas emissions from buildings.

Based on the foregoing, while it is can be seen that there is a global drive for improving the existing building stock yet the available literature indicated that there is less drive and attention paid to improving the environmental performance of existing low cost houses in Nigeria. This is in spite of building retrofit technologies available to maximise energy savings. Thus, this paper has identified and posits the need to find retrofit solutions to reduce energy consumption and rising carbon footprint in existing residential buildings.

Supply side management

The strategies for building retrofit through supply side management comprise of electrical systems, and the use of renewable energy (e.g. solar hot water, solar photovoltaics (PV), wind energy, geothermal energy, etc.) as alternative energy supply systems to provide electricity and/or thermal energy for buildings (Ma *et al*., 2012). Recently, there has been an increase in the attention given to the use of renewable energy technologies as one of the building retrofit strategy due to the greater impact of environmental damage. The application of renewable energy technologies in retrofitting millions of houses in Nigeria will be more beneficial to several households. This is as a consequence of a cost increase in electricity tariffs with energy consumption charged per kilowatt hour without a noteworthy improvement in electricity generation, transmission, and distribution in the state. The Nigerian Electricity Regulatory Commission (NERC) has estimated that about 60% of electric power customers fall within the R2 band (i.e. a consumer who uses his premises as a residence - house) with R2 as one of the categories of residential electric power consumers.

Demand side management

Ma *et al*., (2012) points out that retrofit through demand side management is made up of reduction in cooling and heating demand strategies along with the usage of energy efficient equipment and low energy technologies. The demand for cooling and heating a building can be minimised through building fabric retrofitting and the application of other strategies such as air tightness, windows shading, etc. other low energy strategies applicable to building retrofit projects include natural ventilation, advance control schemes, etc. Ma *et al*., (2012) noted that retrofitting building fabric, building services systems and metering systems will require a reduced cost in investment with considerable environmental benefits when compared with other retrofit interventions such as renewable energy technologies.

Change in occupant's energy consumption pattern

This is the biggest and the most significant strategies for energy conservation and management in low income houses. It requires proper orientation of the building users on their consumption pattern and closely working early and frequently with occupants in the process of retrofitting. This would enhance the occupants' understanding of energy management required at different times of the year through behavioural and system controls.

Implementation Challenges of Retrofitting for Energy Savings in Existing Houses

To execute retrofitting projects and achieving improvements to existing low income houses means having to deal with some challenges. For instance, in Nigeria, the estimated number of existing housing units is about 10.7 million (Pison Housing Company, 2010) putting the existing housing stock at 23 per 1,000 inhabitants (Makinde, 2014) and of these, about 88% are self-built with evidence of poorly constructed and under maintained houses. The success of implementation will largely depend on the combination of readiness and involvement of the federal and state government, support from local authorities, and cooperation of the householders, appliance and energy supply industries. This implies that active stakeholder engagement would be necessary throughout the implementation project and particularly with the community of local residents. Other anticipated implementation challenges include the technical aspects of retrofitting projects in the following areas:

Insulated ceilings

In tropical and sub-tropical climates, insulated ceilings tend to trap heat built up during the day, unless there is effective ventilation and sufficient levels of insulation or heat moderation (through methods that keep summer radiant heat out). Different technologies may be more applicable or appropriate due to difference of climatic zones. For instance, solar water heaters (SWHs) could be the most appropriate intervention in a particular zone while insulated ceilings could be the most applicable in others.

Electrical rewiring

In most cases the occupants of several low-cost houses are not the only electricity users connected to a household meter. It's not unlikely that one or more other informal house shares the same electricity source as a particular tenant might be giving electricity to extended family members or selling it to a neighbouring non-electrified tenant's house. Meanwhile, the number of occupants on these properties can vary significantly, which could affect any retrofit measure on metered data. Thus, electrical rewiring of the entire building may be required in such retrofit where many illegal and non-compliant electrical installations to safety standards exist.

Absence of rainwater harvesting mechanism

In Nigeria, most houses are not designed with guttering or built in such a way to make gutter retrofits simple for rainwater harvesting purposes. Hence, innovative guttering systems would need to be devised as part of retrofitting strategies. However, installing guttering systems to existing houses could become challenging, especially where the houses are not designed with external timber rafters, purlins or trusses to which gutter brackets could be attached. This could result in having functionality problems and may not last as long as conventional gutter systems.

Poor quality roofing

Poor quality roofing can become a significant hazard to workers installing SWHs and can impact the potential success of the SWH installation. Where roof structures are weak, installation of SWHs becomes a challenge as great care needs to be taken to prevent further damage and workers falling through the roof which poses a danger to both people and the property. Furthermore, roof leaks will require some repair before insulated ceilings can be installed. Hence, the budget would need to be set aside for repair of leaks or replacement of roof members.

Recommendations for retrofitting of existing residential buildings in Nigeria

Nigeria's existing housing stock present energy efficiency problems that require urgent attention. This needs to be driven by increasing focus from the Government and the private sector to find ways of helping households save money on their energy bills, decrease their

emissions, and make their homes comfortable to live. To achieve this, the following should apply for effective and sustainable retrofitting of existing residential buildings:

i. Existing energy and water systems should be examined and upgraded to ascertain that they function properly and enhance significant reduction in energy consumption.

ii. Occupancy energy and water consumption patterns should be assessed and efficiency strategies introduced where necessary.

iii. As much as possible areas where natural ventilation and fresh air intake is required should be identified and introduced as replacements to reduce cooling loads.

iv. Solar shading devices should be introduced for windows where practicable.

v. Installation of smart meters to monitor real-time electricity and water consumption, control demand and increase users behavioural energy use awareness should be introduced if the houses are not already metered.

vi. Renewable energy installation options should be encouraged by the government to lessen the long term financial burden of purchasing fossil fuel-based energy. Many domestic activities that take place in Nigeria houses involve the constant use of hot water.

This requires a substantial amount of energy use if the hot water kettle is used. And since most households cannot afford gas and electric cooker, the solar water heaters (SWHs) and pipe reticulation systems could be installed to deliver hot water directly into the house. A 1oo-litre, low pressure, and evacuated tube-type systems with no electrical backup connection is recommended. The solar water heaters have superior performance qualities with the capacity to deliver balanced cold/hot pressure and ‘safe' tempered water at 50 to 60 degrees Celsius.

In most existing low income houses, ceiling conditions are in deplorable conditions leading to excessive heat into the interior. Retrofitted ceilings could make a marked difference to the internal comfort levels of the houses. In place of the present ceiling board in lower income houses, a 30mm thick Iso-board (insulated ceiling board) having a thermal resistance value (called ‘R' value) of 1 could be installed as a replacement for improvement in the interior thermal performance.

A nationwide standard for electrical installation should be developed and their retrofitting coordinated by well-trained registered technicians. Dangerous and exposed electrical wires that prevailed in many of the houses should be replaced to prevent excessive electricity consumption and to ensure safety. It is most likely that many electrical wires have exceeded lifetime. Therefore, qualified electricians should be employed to conduct electrical inspections to produce the required compliance certification during the retrofit.

A national residential lighting energy efficiency standard should be developed to mandate the replacement of incandescent bulbs within a stipulated period with Compact Fluorescent (CFL) bulbs in all residential buildings as they are more energy efficient. The cost of the bulb replacement nationwide should be highly subsidised by the government to encourage com plaice. Dimmable switches should be introduced along with other lighting energy efficiency techniques such as the use of timers or sensors for electrical appliances.

The low pressure solar heating system that delivers water at a low flow rate (less than ten litres per minute) should be installed to encourage water conservation and improve efficiency. Existing inefficient water delivery services should be replaced with water efficient taps having aerators, sensors with designing flow rates. Similarly, PVC pipes should be substituted with High Density Polyethylene (HDPE) pipes. This is considered to have better properties for water conservation through its properties such leak-free performance, better resilience and flexibility than PVC in terms of damage from digging and surges. Additionally, existing old WC should be exchanged with low flush capacity WCs or be incorporated with a dual flush toilet with lesser Litres of water per flush. On the alternative, extra space within the WC tank can be reduced using a lightweight block to minimise the quantity of water used.

Active stakeholder participation should be encouraged with adequate resources directed towards the process. Collaboration with services providers such as electricity suppliers and involvement of the local community leaders through community briefing is essential to en-

sure the achievement and the smooth running of the project. This way, less literate residents would have time to get to grips with the project.

To contribute to the global efforts in alleviating the challenges associated with climate change, Nigerian government needs to explore and employ innovative approaches and tools to lessen its contributions to global CO2 emissions. A synergistic relationship is needed between house owners, housing developers and housing industry take advantage of the opportunities of retrofitting of inefficient existing houses which hold huge prospect for reducing energy consumption. Mean-while, the use of policy to establish and mandate resource conservation and energy management in existing buildings would serve as an effective mechanism through which residential building retrofit can be successfully implemented. Thus, the current proposed climate change policies in Nigeria need to be reviewed to integrate minimum energy use standards for existing buildings. In the meantime, mandatory building codes as a form of regulatory mechanism have the potential to influence the retrofit of existing residential houses. Thus, this regulatory mechanism to the extent that it exists and applied in Nigeria can deliver a pathway to improving energy efficiency of the existing building sector. Retrofitting operations supported by utilities and included in emissions reduction mechanisms are a decisive solution to the problems of energy expenditure and cost.

RESEARCH METHODOLOGY

The methodology was based on secondary data collection approach which includes a comprehensive assessment of scientific literature from Google Scholar, Science direct Scopus and Web of Science in order to make some deduction to enhance the achievement of the aim and objectives of the study. Relevant materials were consulted from refereed journal articles, government reports, books and thesis. A total of 19 literatures on relevant materials in relation to the topic were reviewed.

RESULTS AND DISCUSSIONS FROM THE REVIEWED LITERATURES

The literatures reviewed were discussed under the following headings; the need for retrofitting, the cost benefit of retrofitting, the environmental benefit of retrofitting, and energy conversation benefit of retrofitting and the construction of retrofitting in building.

The need for Retrofitting

S/N	Authors'	Literatures	Remarks
1	The American Institute of Architects (AIA) along with U.S.	Building Council advocated that new construction of residential and commercial buildings should use half the fossil fuel of average existing buildings and a gradual increase in performance of the existing buildings so that by 2030 new buildings are carbon-neutral.	The need for retrofits is to help achieve carbon-neutral built environment
2	Pison Housing Company, 2010) and (Makinde, 2014)	To execute retrofitting projects and achieving improvements to existing low income houses means having to deal with some challenges. For instance, in Nigeria, the estimated number of existing housing units is about 10.7 million (Pison Housing Company, 2010) putting the existing housing stock at 23 per 1,000 inhabitants (Makinde, 2014) and of these, about 88% are self-built with evidence of poorly constructed and under maintained houses.	

3	Ma *et al*., (2012)	The demand for cooling and heating a building can be minimised through building fabric retrofitting and the application of other strategies such as air tightness, windows shading, etc. other low energy strategies applicable to building retrofit projects include natural ventilation, advance control schemes, etc. Ma *et al*., (2012) noted that retrofitting building fabric, building services systems and metering systems will require a reduced cost in investment with considerable environmental benefits when compared with other retrofit interventions such as renewable energy technologies.	

The Cost Benefit of Retrofitting

S/N	**Authors'**	**Literatures**	**Remarks**
4	Ma et al. (2012)	Existing buildings is one of the primary approaches to achieving sustainability in the built environment at relatively low cost and high consumption rates.	Retrofitting of building is a key factor in achieving low housing cost.
5	Al-Ragom (2003)	Residential buildings retrofit in hot and arid climates the study revealed that significant energy reduction is achievable if the cost of implementing the retrofit cost was supported fully by the government.	
6	Cohen *et al*. (1991)	Investigated saving energy and efficiency in cost retrofit options of individual single family buildings and analysed metered energy consumption with the real cost of installation. The author's findings indicated that insulating ceilings and walls are cost effective retrofit and window replacement a feasible retrofit option but has a result of smaller normalized annual energy saving of between 2-5%.	
7	Gorgolewski (1995)	The produced a method to optimize renovation strategies for housing retrofit by adopting a life cycle cost approach to evaluate and compare performance of different retrofit measures. The outcomes indicated that the paybacks are higher than the entire retrofit measures.	
8	Goldman *et al*. (1998)	Findings from their studies on the retrofit of US multifamily buildings. The authors' results were based on analyzing data that were measured and obtained from a record of different apartments. It was found that it cost much less to retrofit a fuel-heat buildings when compared to electric-heat buildings with the payback periods for the two buildings indicating six (6) and twenty to twenty five (20-25) years respectively.	
9	Mahlia *et al*. (2005)	The researchers annualised costs and cash flow in calculating the economic impact of lighting retrofits in residential sector in Malaysia.	
10	Zavadskas *et al.* (2008)	The researcher adopted a different method to know the effectiveness of retrofitting houses on the basis of expected energy savings and increase in the worth of re-furbished buildings in the market. The study found that choosing retrofit situations depends on strategic urban development programmes, renovation cost, heating energy saving and expected increment of market value.	

The Environmental Benefit of Retrofitting

S/N	Authors'	Literatures	Remarks
11	Bin and Parker (2012)	The environmental performance of a century home and compared its original and after retrofit environmental footprint. The findings indicated through renovation, energy performance of existing buildings' can be enhanced and be made environmentally sustainable sound.	Retrofitting in building is important, as it help reduce the emission of carbon gas into the ozone layer, leading to ozone layer depletion and it help to enhance environmental sustainability.
12	Ma *et al*., (2012)	Retrofit or refurbishing of the building constitutes a type among several methods to achieve a reduction in energy use and the consequent house gas emissions from buildings.	
13	(Asadi et al., 2012; Flourentzou and Roulet, 2002; Goli et at., 2011)	The researchers explore energy efficiency through diverse avenues directed for improved performance in energy use of existing residential houses.	

Energy Conservation Benefit of Retrofitting

S/N	Authors'	Literatures	Remarks
14	Dodoo *et al*. (2000)	The investigation of the implication of primary energy through life cycle assessment in the retrofit of a four-storey apartment building to the standard of a passive house. The results showed that reduction in final energy use was achieved, although the primary energy is still determined by the type of energy supply system used.	The use of retrofit as reported by this authors shows that there is reduction in final energy expended.
15	Bin and Parker (2012)	The environmental performance of a century home and compared its original and after retrofit environmental footprint. The findings indicated through renovation, energy performance of existing buildings' can be enhanced and be made environmentally sustainable sound.	
16	Hestnes and Kofoed, (2002); *Chidiac et al.* (2011); and Ardente *et al.* (2011); Flourentzou and Roulet (2002)	Research on existing non-residential buildings by several other scholars, significant reduction in the use of energy from existing buildings is achievable through appropriate retrofit or renovation defined by as the work that require upgrading an existing old building.	
17	Ma *et al*., (2012)	Retrofit or refurbishing of the building constitutes a type among several methods to achieve a reduction in energy use and the consequent house gas emissions from buildings.	
18	Ma *et al*., (2012)	The researcher points out that retrofit through demand side management is made up of reduction in cooling and heating demand strategies along with the usage of energy efficient equipment and low energy technologies.	

Construction of Retrofits in Building

S/N	Authors'	Literatures	Remarks
19	(Ma *et al*., 2012).	The strategies for building retrofit through supply side management comprise of electrical systems, and the use of renewable energy (e.g. solar hot water, solar photovoltaic (PV), wind energy, geothermal energy, etc.) as alternative energy supply systems to provide electricity and/or thermal energy for buildings.	Retrofits can be constructed using various natural sources of energy which is readily available in our society.

CONCLUSION

From the literature reviewed it was Imperative that rapidly dwindling natural resources, environmental pressures and climate change posing fundamental threat to economic systems and human survival in Nigeria and Globally. Overtime, residential buildings have received less attention. In Nigeria, thousands of households of low income buildings spends large sums of their earnings on energy bills, while getting less energy-driven services for their appliances and utilities to meet their needs. This paper explored alternatives for less dependence on national energy supply with more environmental benefits through sustainable retrofit and resource-efficiency interventions for low-income houses. Via the findings, it was concluded that if policies and regulatory mechanism are put in place for low-income housing in Nigeria, this would deliver pathway to improving energy efficiency of the building sector.

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INTEGRATION OF BIOMIMICRY PRINCIPLES AS A MEANS TO ENERGY EFFICIENCY IN OFFICE DESIGN, ABUJA, NIGERIA

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The relationship and connection between architecture and nature is one that has brought forth many questions, criticisms, and solutions. Nowadays there is a new form of design that was introduced several years ago which requires modern man to look at the natural processes found in nature for inspiration. These processes have been around for decades but only recently has their true potential begun to emerge. The question is, can one take the philosophy behind natures living organisms and use them to aid in the development of mankind? The answer is yes, it is called Biomimicry. This thesis explored elements in nature which can be used to influence the design and function of office buildings. By mimicking elements from nature, the composition can not only respond to the activities within the building, but also to the surrounding environment. It is intended for building to relate to both. This study will display how Biomimicry can be used as an integrative architectural design component in order to achieve complete unity between buildings, users, and the environment and assess energy efficiency in eighteen selected buildings in Abuja central business district. The thesis identified the problem of energy inefficiency of spaces in the selected buildings. This was achieved by analysing the various ventilation means of the buildings, analysing the various types of roofing of the building, assessing the lighting means used within the building and source of power generation for the selected buildings and proposing an architectural design for a mixed-used building within the Abuja central business district with means of energy efficiency. In order to achieve the objectives, descriptive survey methodology was employed through this study, Eighteen buildings were selected in Abuja central business district on the basis of cutting across the five main districts that make up the Abuja Metropolitan area namely: Maitama district, Wuse district, Asokoro district, Central Business district and Garki district. By administering 50 structured questionnaires to users of the buildings, only 128(85%) were returned. The secondary data was collected from related books, journals and seminar papers. The paper concluded on the need for energy efficiency for the buildings and recommended principles necessary for achieving energy efficiency for the buildings

Keywords: Biomimicry**,** Environment, Integration, Mimicking, Philosophy.

INTRODUCTION

In the past, there used to be a common language amongst the built environment. Architects, engineers, designers, and society, understood that buildings were used to function as a form of shelter, creating a physical separation between people and the environment. As time went on the world was introduced to many different styles of architecture and as this happened, the word architecture and the word building slowly began to split into two different meanings. When one thinks of a building we think of permanence. As architects began to become more sensitive to the idea of how important the impact that permanence (a building) had on the society as a whole, architecture began to break away from the typical cube and embarked on thinking outside the box. It started to become more of an artistic expression and the relationship between art, architecture, and nature began to make its presence known. As the quality of materials continued to improve, the limitations from construction became less of a concern. Building forms had the ability to take on more dynamic, intricate shapes. Organic architecture started to appeal to the public and forms began to imitate elements from nature and the natural environment.

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Buildings such as the Disney Concert Hall by Frank Gehry, or the natural materials used by Frank Lloyd Wright in Falling Water (Doan 2007).This was just the beginning of a new revolution that made strong gestures towards a connection to nature. Today there is a new type of ideology that combines biology and architecture in order to achieve complete unity between the building and nature. This type of ideology is called Biomimicry. It is a method of looking at natural processes found in nature and uses these processes to aid in the development of mankind. This paper will focus on a deep exploration of how Biomimicry has been used in the past and how it can be used to generate a sustainable response to an architectural design problem. The final composition will display integrated sustainable and architectural design components in order to achieve a building that creates complete unity between the building, the users, and the environment. (Benyus 1997)

Many buildings lack energy efficiency. Electricity supply for most buildings to function properly is insufficient, Mismanagement from its users is also prevalent. Therefore potential for energy savings is huge, especially in the three main energy demanding sectors, namely household, industry and transportation. Buildings constitute 48% of the world's everyday demand, while industries contribute 25% and transportation 27% (United states environmental protection agency, 2000)

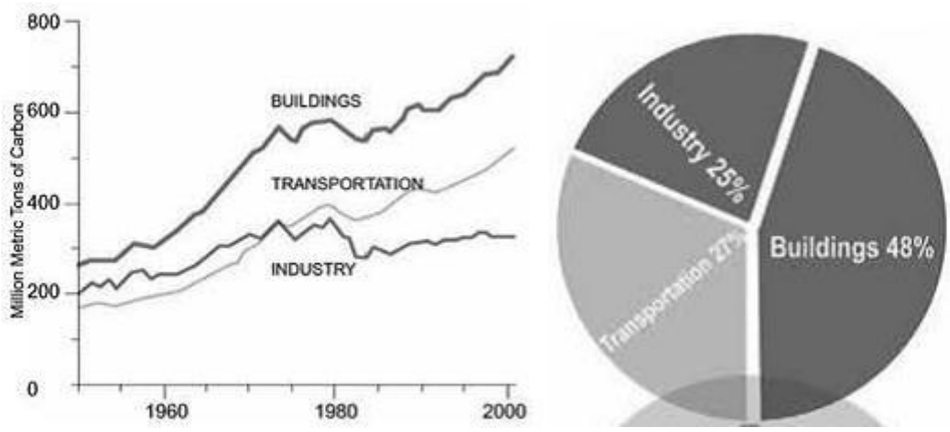

Figure 2: figures showing major energy consumption sectors (source: United States environmental protection agency, 2000)

Therefore there is need for the integration of energy efficient design principles and control methods for building that would not only save energy and reduce costs, but also Increase occupant comfort, productivity and health.

Biomimicry

What is Biomimicry? Biomimicry (from bios, meaning life, and mimesis, meaning to imitate) is a new discipline that studies nature's best ideas and then imitates these designs and processes to solve human problems. The way the design process is approached is that designers look at nature, specifically organisms or ecosystems, to solve a particular human need; and by doing so, converting these types of behavioral processes into man-made design solutions. Imagine it as the combination of biology, nature and architecture into one composition. (Pedersen 2007)

Organism Level

The first level is Organism- this refers to mimicking a specified organism. This could be the entire organism or a portion of the organism. One of the most interesting insects studied and mimicked in design is the Namibian beetle; also known as the African Stenocara beetle. The beetle lives in a desolate desert that rarely sees any rainfall. Since the area is dry for the majority of the year, many animals have to find alternative ways to survive and obtain an adequate water source. When the morning fog rolls in, water droplets from the fog are combined and collected on the beetle's shell. As the water droplets form, because of the shape of the bumps, the water droplets stay in tight spherical beads which make them more mobile and easier to channel towards the beetle's mouth. An example of where this phenomenon is applied is in the Hydrological Center for the University of Nimibia.

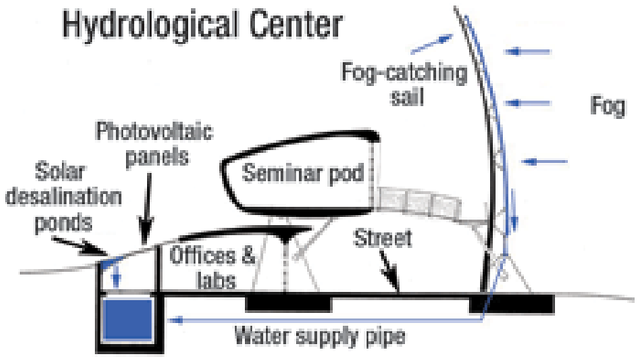

Figure 3: Section of Hydrological Center for the University of Namibia (Image source: Image Source: http://enr.construction.com)

Behavioral Level

The second level is Behavior- this refers to mimicking a specific type of behavior or act that the organism does to survive or replicates on a daily basis in relation to a larger context.

Termite Mound and Temperature Regulation

The behavior of one organism which can be studied to solve human design problems is the termite. The termite's home, a termite mound, was studied to solve the complex problem of heating and cooling a large structure. Extreme termite mounds are formed when the aboveground nests grow past the capacity that was initially made. The nests are made to protect the nesting and royal areas as well as fungus combs (their primary food source). The fungus can only grow and be sufficient if it is kept at exactly 87 degrees F. The temperatures outside of the mound fluctuate greatly due to the location, Africa. At night, the temperature can drop to a chilling 35 degrees F and during the day can reach a scorching 104 degrees F! So the termite keep the fungus at exactly 87 degrees F by opening and closing specific vents which are precisely placed in the mound to regulate the air within the mound itself.(doan 2007)

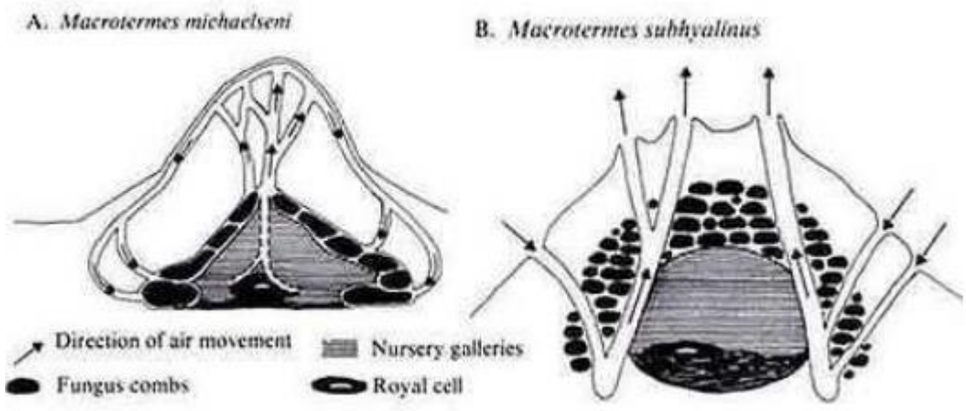

Figure 4: Termite Mound Temperature Regulation (Image Source: Https://Inhabitat.Com/Building-Modelled-On-Termites-Eastgate-Centre-In-Zimbabwe/)

With a system of carefully adjusted convection currents, air is sucked in at the lower part of the mound, down into enclosures with the muddy walls, and up through a channel to the peak of the termite mound. What also makes this design so interesting is that the termites also plug some of the vents and create new ones if the old ones become inadequate and are not functioning to their full potential. It was precisely this type of instinctual behavior of termites that inspired Michael Pearce in his design of the Eastgate Center in Zimbabwe.

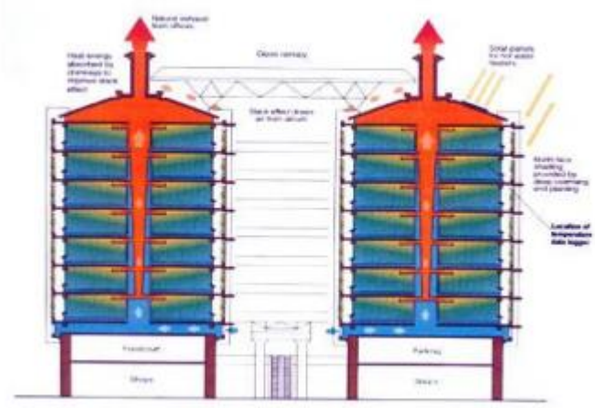

Figure 5: Section of the Eastgate Center showing thermal movement (Image source: https://inhabitat.com/building-modelled-on-termites-eastgate-centre-in-zimbabwe/)

The Eastgate Center is mostly made of concrete which is an excellent material to use as an insulator as well as absorbing heat from the sun. The outside air that is brought into the building is either warmed or cooled depending on the temperature of the buildings mass. If the buildings mass is cooler, than the air that enters the structure would also be cooled. The air is then directed upwards towards the chimney but on its way up to the top it passes into the building's floors and offices. The building is actually made up of three parts two exterior structures and a glass center that connects them together. The glass space in the center also participates in natural convection and is usually open to the local breezes.

Ecosystem Level

The third level is Ecosystem- this refers to mimicking a specific ecosystem and how it functions successfully as well as what elements and principles are required for it to function successfully. Biomimicry in ecosystem level is the trickiest of them all as it involves a total revolution of efficiency, an example of biomimicry on ecosystem level can be seen in the Zira Island Master Plan which was designed by Bjarke Ingels, founder of BIG Architects. It is a perfect illustration of this form of biomimicry. The island has an area of 1,000,000m square and will undergo a full revitalization to become a zero-energy resort and entertainment city. (Sylvia Fe 2016) the design is inspired by the seven peaks of azerbaijan, which form the skyline view, which is visible from the capital of baku. Under this concept Byarke Ingels has developed a sustainable urban development which uses the landscape of the country has a theme in its revitalization. Each mountain is a building in the development and conceived of as an entire eco-system in itself. The island will use solar, wind and wave power to supply it with energy allowing it to operate completely off-grid with zero-energy efficiency. Unlike some of the extravagant development in the Middle East, this new development takes the particular climate of the area into account, hoping to pave the way for future eco-conscious projects. (designboom 2016)

Figure 6: A PERSPECTIVE VIEW OF THE PROPOSED ISLAND (source:http://www.designboom.com)

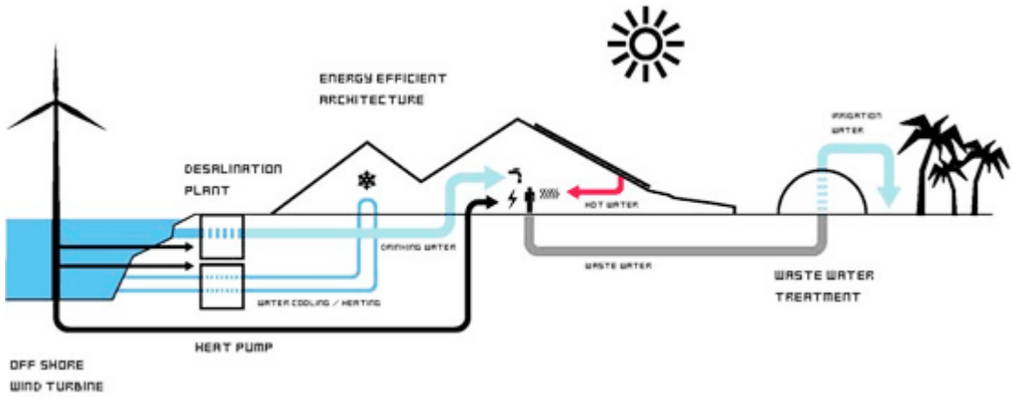

Figure 7: Concept of the energy circle of the island (source:http://www.designboom.com)

METHODOLOGY

The data for this research were gotten from primary and secondary sources. The primary source of data was collected through direct observation, interviews and field measurement. Personal interview played a key role in understanding the each office building visited to ascertain the level of compliance and application of the eco-design parameter employed in those buildings. Observation schedule also give a very good ideas of what is available in each of the office building visited.

Primary Data Categories and Sources

Data	Categories	Source
Number Of Offices	Quantitative	Field Measurement
Lighting System Used (Natural/Artificial)	Quantitative	Observation
Ventilation System Used (Natural/Artificial)	Quantitative	Observation
Types Of Energy Used	Qualitative	Interview
Types Of Cooling System Used	Qualitative	Interview
Types Of Roofing System Used	Quantitative	Observation

The Observation was done physically during the fieldwork for the data required to be achieved. Also to be able to obtain some qualitative feature to explain certain data the use of camera was employed. The secondary data were collected from publications namely; such Journals, textbooks, magazines and unpublished information such as papers, lecture notes. The Quantitative/measurable data is made up of some selected number of offices within the Central Business District of Abuja, Types of power supply and lighting system used in each office block, types of cooling system used, types of ventilation system used, and types of roofing system used. This implies that all can be measured through 0observation and direct counting. While the quantitative data includes the pictures of the offices and the responses from the personal interview.

The following buildings are going to be used as study for this paper

1. Audit House
2. Central Business District
3. Federal Secretariat 1
4. Federal Secretariat 2
5. Federal Secretariat 3
6. Ministry of Finance 1
7. Ministry of Finance 2
8. Louis Edet House
9. NNPC Towers
10. PPPRA

Analysis of Roof type in selected buildings. The buildings were analyzed based on roof type and forms of ventilation if any is provided on the room. It was observed that ten out of twenty or 50% of the selected office buildings used long span aluminum roofing sheets as roof coverings. Aluminum roofing sheets allows considerable heat from the sun and noise when it's raining into the building unless heat and noise insulations and vents are provided to

absorb and vent out the noise and the heat. Therefore Aluminum roofs cannot be an eco-friendly roof cover to buildings in Abuja because of its high level of weather temperature.

BUILDING	ROOF TYPE	OPEN ROOF	GRREN ROOF
Audit House	ALLUMINIUM	N	N
CBN	CONCRETE	Y	N
FED. SEC 1	ALLUMINIUM	N	N
FED SEC 2	ALLUMINIUM	N	N
FED SEC 3	ALLUMINIUM	N	N
FINANCE 1	SLATE	N	N
FINANCE 2	SLATE	N	N
LOUIS EDET	ALLUMINIUM	N	N
NNPC TOWERS	CONCRETE	Y	N
PPPRA	CONCRETE	Y	N

An Analysis of Natural lighting was also carried out, as natural lighting is a key element in sustainable buildings, the analysis was done based on common areas found in all the buildings the research checked the availability of light in the specified areas of the selected office buildings. Most of the buildings or more than 75% of the buildings have achieved natural lighting in the building spaces by harvesting natural light using a courtyard, atrium and short lobbies. One can walk throughout the buildings without artificial light throughout the daytime.

S.NO.	BUILDINGS	OFFICES	LOBBIES	STAIRWELLS	MEETING HALLS
1	AUDIT HOUSE	NL	MIX	NL	MIX
2	CBN	NL	NL	AL	NL
3	FED SEC 1	NL	NL	NL	MIX
4	FED SEC 2	MIX	NL	NL	NL
5	FED SEC 3	NL	NL	NL	MIX
6	FINANCE 1	NL	NL	NL	NL
7	FINANCE 2	NL	NL	NL	NL
8	LOUIS EDET	NL	NL	NL	NL
9	NNPC TOWERS	NL	NL	AL	AL
10	PPPRA	NL	NL	NL	MIX

NL- Natural Lighting, AL- Artificial Lighting MIX- Both Natural and Artificial

An analysis of natural ventilation was also carried out on the selected buildings to see their sources of ventilation, be it natural or artificial, the same spaces were analyzed as listed above. The table above has shown that most of the building spaces are ventilated through natural means as well as artificial means, spaces located within the building core have mostly artificial means of ventilation, and some of the buildings have integrated courtyards which help in providing very adequate means of ventilation as well as lighting

S.NO.	BUILDINGS	OFFICES	LOBBIES	STAIRWELLS	MEETING HALLS
1	AUDIT HOUSE	MIX	AV	NV	MIX
2	CBN	AV	NV	AV	MIX
3	FED SEC 1	AV	NV	NV	MIX
4	FED SEC 2	NV	NV	NV	MIX
5	FED SEC 3	MIX	NV	NV	MIX
6	FINANCE 1	AV	NV	AV	MIX
7	FINANCE 2	AV	NV	AV	MIX
8	LOUIS EDET	NV	NV	NV	NV
9	NNPC TOWERS	AV	AV	AV	MIX
10	PPPRA	AV	AV	MIX	AV

NV- Natural Ventilation, AL- Artificial Ventilation MIX- Both Natural and Artificial

Accessement of Power sources of the building was carried out to show how the studied buildings are powered and if they are powered by any energy efficient means. All building are either powered by the power grid namely PHCN, and supported by a backup generator, no building is powered by any means of renewable energy sources.

A	BUILDINGS	GENERATOR	PHCN	SOLAR	WIND
1	AUDIT HOUSE	YES	YES	NO	NO
2	CBN	YES	YES	NO	NO
3	FED SEC 1	YES	YES	NO	NO
4	FED SEC 2	YES	YES	NO	NO
5	FED SEC 3	YES	YES	NO	NO
6	FINANCE 1	YES	YES	NO	NO
7	FINANCE 2	YES	YES	NO	NO

8	LOUIS EDET	YES	YES	NO	NO
9	NNPC TOWERS	YES	YES	NO	NO
10	PPPRA	YES	YES	NO	NO

CONCLUSION

Nature is always forced to adapt to new things much like humans are. For example, the climate that is always changing and now with global warming it is even more apparent that nature must find its own ways to adapt. Insects, mammals, reptiles, plants, trees, and other types of vegetation have evolved over centuries in order to survive in such a dynamic environment; and those that have not and were unable to adapt die off but still contribute to the equal balance of life. Those types of adaptations and evolving principals in nature should be studied and implemented into the built environment. Creating a sustainable built environment is not done by integrating just solar panels on every building. Humans need to be more in-tune with nature and look at nature for inspiration. Designs that mimic nature's beauty and elegance should not just be on a material or form basis; it should be from a thorough understanding of the philosophy and principals that make those solutions from nature work successfully. Biomimicry principles affecting elements of ventilation, lighting and power generation are key adoptable principles which can be used to cut down on immense power consumption in building and provide healthier and more sustainable alternatives in the office environment.

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APPLICATION OF COURTYARD CONCEPT AS A PASSIVE COOLING SYSTEM CASE OF ARTISAN TRAINING INSTITUTE IN NORTH CENTRAL NIGERIA

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Growing up as a child, I have always seen the building construction industry as a team of magicians who transform the natural into an adorable magnificent built environment. Presently, there has been a declination in the in the quality of construction and artisans involved in the buildings in Nigeria as foreign materials and workers are sought for local building works. Therefore, the need to address the quality of training received by Artisans in the industry cannot be undermined as they play the greater role in construction, finishes and maintenance of our buildings. A study taken on some Vocational and Technical Institutions like the Federal Technical College, Yaba; the Yaba College of Technology (YABATECH), Building Craft Training School, Harvey Road, Lagos and Centre for Science and Technology in India, have shown the use of courtyard concept and green space as a way of integrating the use of urban space. The study looked at defining and discussing the courtyard house as a building form, how the courtyard house acts as a passive cooling system in tropical buildings; ecological design and its applicable principles in the courtyard house The proposal for the Artisan Training Institute for the Construction Industry (ATICI), is an architectural restoration approach for the effective training of the artisans and revival of the construction industry. The objectives of the research report is to determine the benefits of the courtyard concept as a passive cooling system from ecological design point of view that meets the spatial requirements and specialized facilities for theoretical and practical learning and development, a space that integrates the effective use indoor and outdoor urban space; and as an architectural approach in design of space that deal on natural lighting and ventilation (low carbon emission); Community and social, environmental and entrepreneurial development.At the end the report concludes that the courtyard concept is environmental friendly building form that can be considered as a passive cooling system which may help to minimize the non-renewable energy consumptions to conserve the global natural environment healthy, clean, and livable environment for future generations.

Keywords: Artisans, Training, Building, Ecological Design, Courtyard concept, Passive Cooling

INTRODUCTION

Artisans were the dominant producers of consumer products prior to the Industrial Revolution. According to classical economics theory, the division of labour occurs with internal market development. However, according to economist John Nicks, merchants and artisans originated as servants to the rulers. During the middle ages, the term artisan was applied to those who made things or provided services. It did not apply to unskilled labourers. Artisans were divided into two distinct businesses and those who did not. Those who owned their businesses were called masters, while the latter were the journeymen and apprentices. The most influential in this group of artisan are the masters. An Artisan is a skilled craft worker who makes or creates things by hand that may be functional or strictly decorative, for example furniture, decorative arts, sculptures, clothing, jewellery, household items and tools or even mechanical mechanisms such as the handmade clockwork movement of a watchmaker. Artisans practice craft may through experience and aptitude reach the expressive levels of an artist Ojimba D.S. (2012). The building construction Artisan trade which consist of masons, bricklayers, carpentry and wood works, plumbing and piping, iron bending and joinery, electrical fittings, tiling, painting and scree ding (Plaster of Paris),

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Abdul (2018). **APPLICATION OF COURTYARD CONCEPT AS A PASSIVE COOLING SYSTEM CASE OF ARTISAN TRAINING INSTITUTE IN NORTH CENTRAL NIGERIA.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

Interior decoration, landscaping and gardening amongst others have been best learnt by apprenticeship system globally. But today, artisans are being trained in vocational centres and skill acquisition centres. These institutions have been termed as Informal (technical) Education and have been given a general impression by the public that the careers or crafts that fall within this form of education is meant for the less privileged in our society but emphasis must be placed on the vital role such professionals and skilled workers have played in the economic development of every growing and developed nation. . Aniekwu N. & Ozochi C.A. (2010). Therefore the need for an institution that cater for the well-being, training and certification of the Building Construction Artisans arises, so as to sustain global best practices in design, construction and maintenance of the built environment and urban space towards the growth and development of the sector and the economy of our nation.

The aim of this research is to propose the design of an enabling sustainable built environment for the training of the Artisans Training Institute for the Construction Industry (ATICI). To achieve the aforementioned aim, the following objectives are set:

1. Provide a structure that will foster development of skills, provision of career and job opportunity for artisans at the Artisan Training Institutes for the Construction Industry (ATICI) in Nigeria.
2. Revive the disappointing image of Building Construction Artisans that are in practice through a well-structured programme for training, retraining and certification that would lead to economic development.
3. Provide a monitoring, evaluating and research facility on materials and best construction techniques that are applicable in developed nations for encouraging and harnessing of young local skills, building them up in their respective skills and giving them a platform to actualize their dreams and showcase their trade.
4. Providing the required facilities and amenities for training and work place practice by combining the proper use of outdoor and indoor urban space, fostering the development of skills.

METHODOLOGY

Carrying out proper investigation and research the following steps is adopted:

1. Formulation of the research problem: the topic which is a design proposal for a Building Construction Artisan Training Institute serves as an attempted solution to an identified problem which the need to train and equip the local artisans in the building construction industry and establishing the place of the artisan in the development of the building sector and economy.
2. Developing the projects objectives: this deals with acquiring the desired information that would be useful in tackling the identified problem, which include a background check on artisans and their training, study of the project area and site selection to serve as design considerations for the proposal of an adequate facility that can shelter the training institute.
3. Site selection which is to be selected on the need to enforce solution at the head and zone where the construction works and large number of artisans can be found. This would help create awareness and establish the need for the revitalization of the fate of local artisans in the industry.
4. Familiarization with selected site, as several visit would be necessary to enforce effective use and planning if site.
5. Selection of local and foreign cases to study that meets the proposal in terms of building type, scale or scope and have similar cases or problems affecting its function and establishment.

Data Collection

The methods apply here include:

- Primary Survey: by direct involvement with the community, staff and students of Artisan training institute which serve as case studies and artisans in the field through the use of questionnaires and interviews.
- Secondary Survey: collection of information from the relevant government and private institutions that deal directly with the training of artisans which include the

ministry of works, education and the national board of technical education, survey from survey office and the internet.

-

Data Analysis

This would involve the use of statistical and graphical analysis, application of standard tables in analysing the data collected from the research.

Data to be analysed here are:

- Deductions from Studied cases (local and foreign).
- Study area, site analysis and inventory
- Conceptual development
- Spatial analysis
- Design considerations
- Building materials, components and construction
- Structure and services
- Specifications and details.

DISCUSSIONS AND FINDINGS

From the study undertaken from the cases the following deductions was made:

- The use of courtyard is mostly the best designs solution for the Institutional Building so as to achieve effective pedestrian/vehicular circulation and air circulation within spaces.
- Effective ventilation must be provided by means of cross ventilation and other natural effects like stack effect and use of high level windows to take out hot air.
- For effective learning adequate lighting of space is needed this is achieved by proper orientation of the building on site.
- School or learning community is a form of communal living therefore activities to increase communal living and social interaction should be encouraged.
- Proper zoning of facilities will help achieve noise control by use of buffers, there is also the need to maintain minimum room temperature for learning.
- Communal spaces and activities are zoned towards a central point as well as to help monitor activities within the communal space

ANALYSIS AND DESIGN

Nigeria is the largest and most populous country in sub-Saharan Africa. It lies between latitudes 4° and 14°north of the Equator and longitudes 3° and 15° east of the Greenwich Meridian. It has a geographical area of 923,768km2 and a population of approximately 162.47 million by December 2011. It is bordered by Chad and Niger Republics to the north, Cameroon to the East; Republics of Benin and Togo to the west and the Atlantic Ocean to the south. It is made up of several ethnic groups, the major ones being Hausa, Igbo, and Yoruba.

Abuja which is the project location has experiences three weather conditions annually; this includes a warm, humid rainy season and a blistering dry season. In between the two is a brief interlude of Harmattan occasioned by the northeast trade wind, with the main feature of dust haze and dryness. The Rainy season falls between the months of April to October with temperature change of 22°C to 28°C while Dry season has temperature change of 12°C to 40°C. The high altitude and undulating terrain of the FCT act as a moderating influence on the weather of the territory; this positions Abuja within the Guinean Forest-Savannah Mosaic zone of West African sub-region and the savannah zone of Nigerian vegetation. A major interest in the vegetation of Abuja is the mix of the grassy savannah and the rainforest vegetation.

Location, Physical and Regional Setting

Abuja, Nigeria's capital is located 505km to the North-East of Lagos the former capital. It covers a land area of about 8000km and is bounded by four states; Niger, Kaduna, plateau and kwara states. The Federal Capital Territory itself consists of a tilted plain rising from an elevation of 300ft in the southwest corner to above 2000ft of the north- east corner. Rising out of this tilted plain are numerous rocky knolls and inselbergs. The Federal Capital Territory (F.C.T) Abuja is located on the Gwagwa plains in the middle – belt zone of the country. It lies between latitude 9020'N -92.50N and Longitude 6045'E – 7039'E. It has access to all major cities in the country and indeed the continent. The capital city is situated in the North –Eastern quadrant of the F.C.T and occupies an area of about 8000sq.km.

The Abuja master plan borrows wings from Lucio Costa's airplane plan for Brasilia and utilizes the circulation pattern from Tokyo city.

The two major concentric rings of high ways that mark the outer perimeter of Abuja plan is in the form of drawn bow with the outer ring, the express way, the bow, the inner ring distributor as the string and the total city centre an arrow aimed at Aso Hill.

The city is planned in six phases, each with his design proposals for city planning, functions and projected population. The phase that is currently being developed is divided into seven districts namely: Garki 1, Garki 2, Wuse 1, Wuse 2, Asokoro and Maitama.

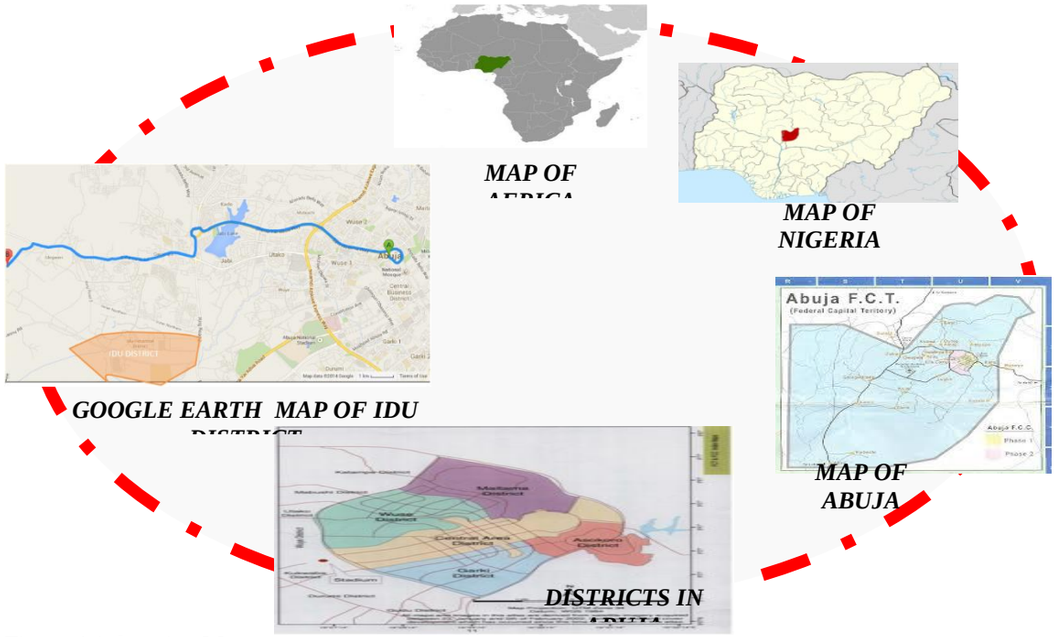
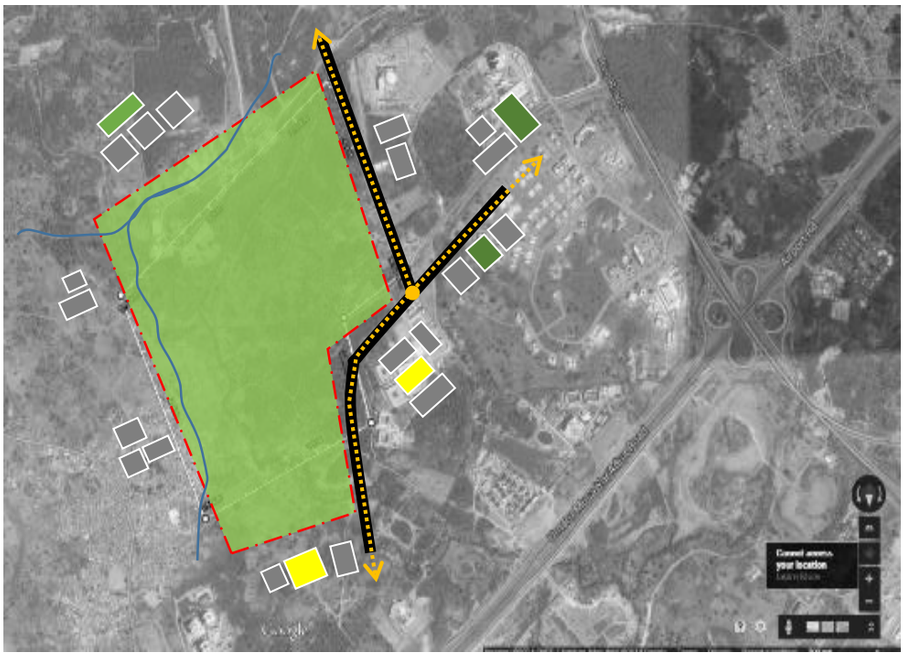


Figure 4.1: location Maps.
Source: Google Earth Maps/ Author 2014

Figure 4.2: Google Map Location of Site. Source: Google Earth Maps/ Author 2014



Climatic Characteristics, Soil and Vegetation
Topography and Ecology

The Gwagwa plains rise from a height of 305m west to 610m in the east. Within the area of Abuja city steep hills of the Gwagwa plains comprises of granite masses rising above the level of the surrounding country. Having very steep sides and culminating in prominent crests or summits escarpments described as steep slopes and cliffs. These occur along the eastern side of the city where two relatively level areas of differing elevations have resulted from erosion or faulting. The major rock units underlying the F.C.T sites are in three categories which are metamorphic, igneous and Sedimentary rocks. Site within the city are characterized with the following geological feature which are not yet to be completed expected to present any serious problem during construction. These Characteristics are; migm-atite, granite, gneiss, and biotic granite.

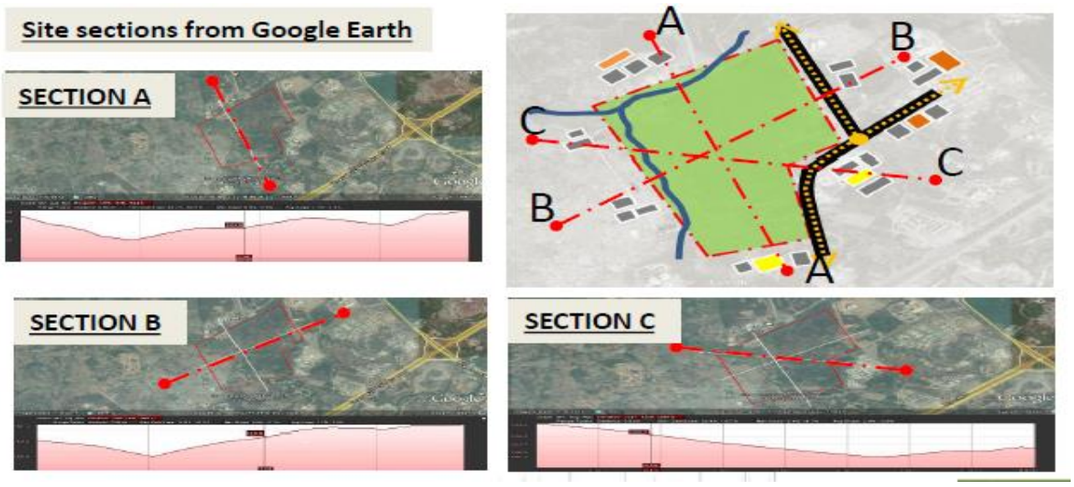


Figure 4.3: Site Section Source: Google Earth Maps

Climatic Characteristics, Soil and Vegetation
Topography and Ecology

The Gwagwa plains rise from a height of 305m west to 610m in the east. Within the area of Abuja city steep hills of the Gwagwa plains comprises of granite masses rising above the level of the surrounding country. Having very steep sides and culminating in prominent crests or summits escarpments described as steep slopes and cliffs. These occur along the eastern side of the city where two relatively level areas of differing elevations have resulted from erosion or faulting. The major rock units underlying the F.C.T sites are in three categories which are metamorphic, igneous and Sedimentary rocks. Site within the city are characterized with the following geological feature which are not yet to be completed

expected to present any serious problem during construction. These Characteristics are; migm-atite, granite, gneiss, and biotic granite.

The vegetation of the capital city is generally characterized predominantly by park savannah type due to centuries of destructive exploration of the original woodland. There are occasional patches of forest or heavily wooded areas.

A comfortable living environment will depend on maximizing the aspect of the environment, which will help to reduce heat and the effect of humidity and protects from rain and dust. Planning with the climatic conditions will be utilized at all scales.

The rainy seasons start around 10th April and tapers off after 20th of October. The mean monthly distribution shows a tendency for concentration in three or four months (July, august and September). This concentration of rainfall shows the need for drainage systems that can handle large volumes of water very quickly.

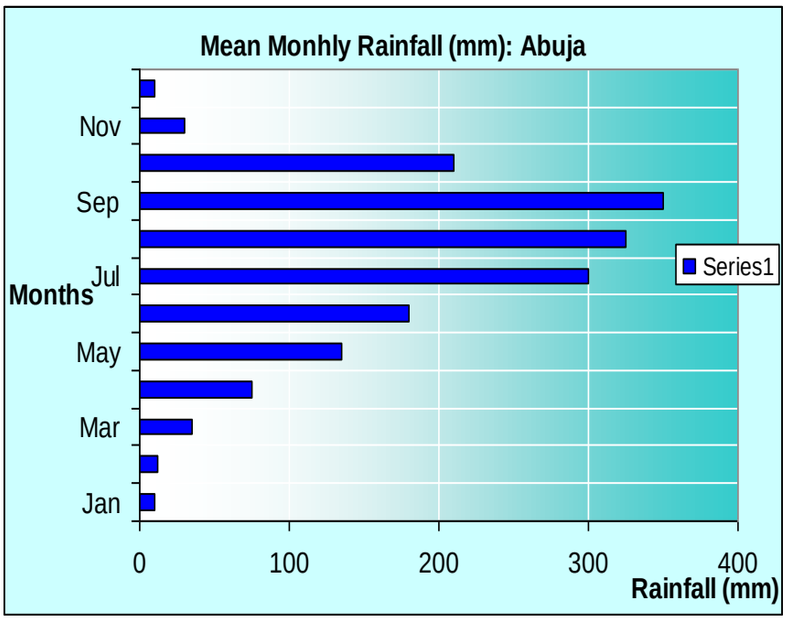


Table 4.1: Mean Monthly Rainfall (mm) Source: http//: www.abujaclimate.com

The F.C.T records its highest temperatures during the dry season. Changes in temperature of as much as 170 degree Celsius have been recorded between the highest and lowest temperature in a single day. During the rainy season, the maximum is lower due to the dense cloud cover. Diurnal range is also much lower, sometimes no more than 70 degree Celsius in July and august.

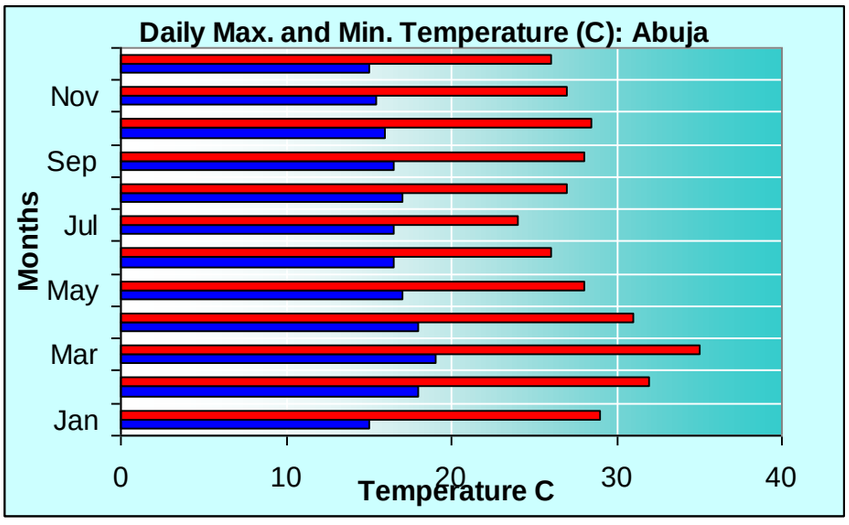


Table 4.2: Daily Maximum and Minimum Temperature (Degree Celsius)
Source: http//: www.abujaclimate.com

SUNSHINE SOLAR DATA

There is a general increase in the total hours of sunshine further north from the Atlantic coast. During the dry months the variation increases from over 275hrs in the city. It declines during rainy season progress. With its peak in august at this time there is actually an

inversion in the city site area where there is less sunshine hours than in the southern part of the F.C.T.

Human sensibility to temperature is greatly affected by Relative Humidity. During the dry season, it falls in the afternoon to as low as 20%. In the city site zone, coupled with the high afternoon temperature, desisting effects of the dry season becomes the result. In rainy season, the relative humidity is much higher, reaching as high as 95%. In the morning hours, these extremes are not within the comfort zone of between 30 - 70 % hence, solutions to arresting such in buildings have to be worked out by the architect. Even with the slightly low temperature, the general feeling is uncomfortable.

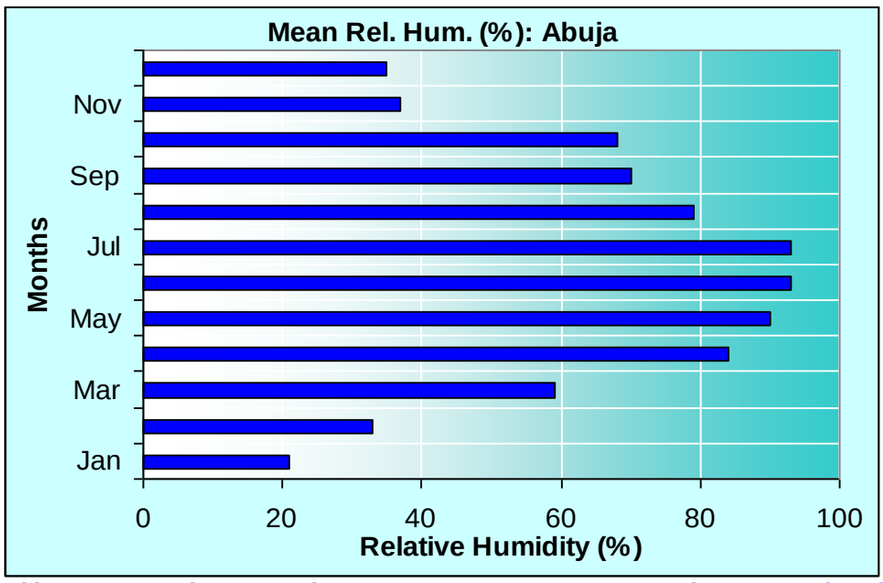


Table 4.3: Mean Relative Humidity (%) Source: http//: www.abujaclimate.com

People and Socio-Economic Activities

Idu Industrial layout which is the proposed project location is known to be the home of the Gwari and Gbagyi People. These two ethnic are the major ethnic groups that were in existence before the creation of Abuja. The major language is Hausa and majority of the people are Muslims. They are Known to be farmers and do not carry luggage on their heads but on their shoulders.

Population and Development

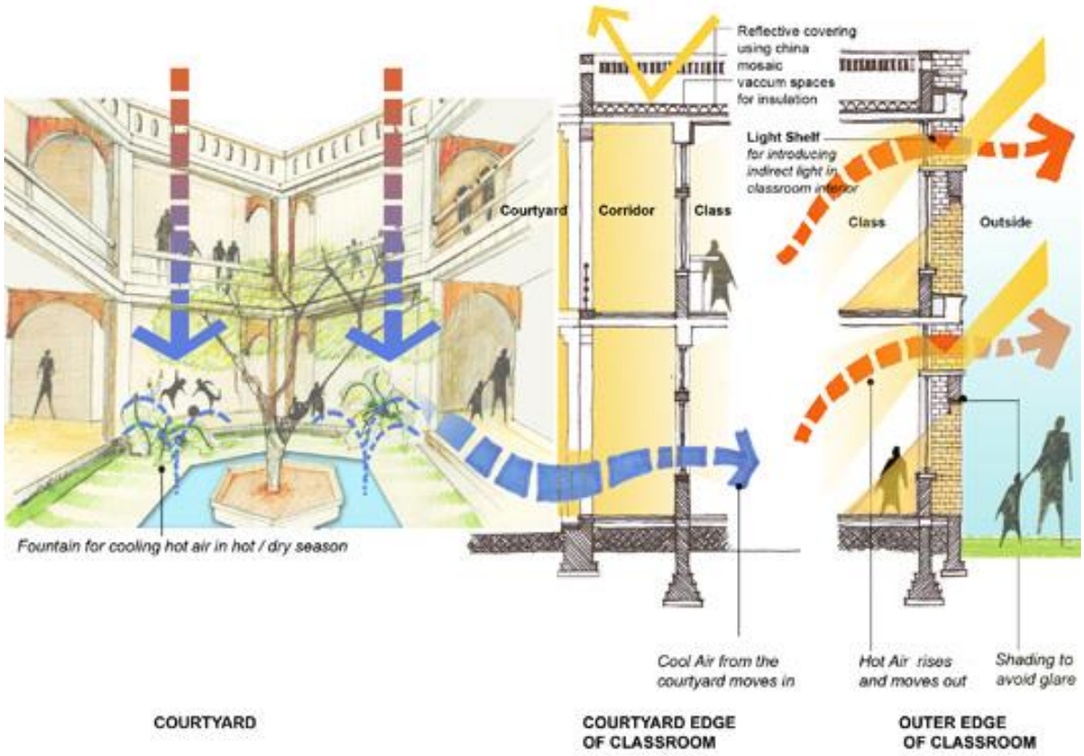
Idu district is one of the fastest growing districts in recent times. With three Universities, the Abuja light rail project, several government institutions and the ever booming real estate developments scattered around, the city is stipulated to have over a million population.

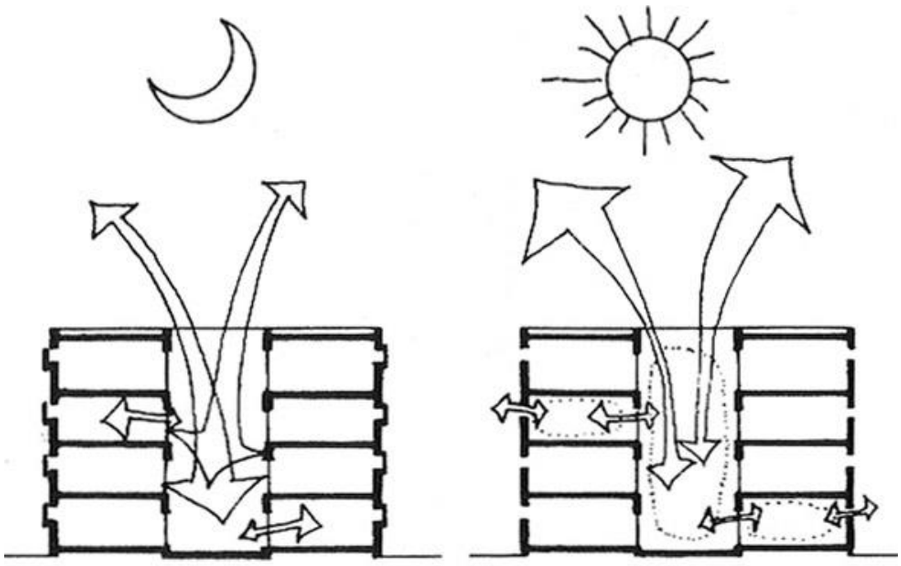
Abuja is expected to have an approximate population of 10million by 2018.

The Use and Principle of Couryard

The Shaded windows and the compact courtyards provides a contextual climatic response to the harsh climate which consists of very hot summers together with cold winters, and an unusually dusty environment. The complex is itself powered from sugarcane waste based energy. In the school building, Passive Cooling is provided by vacuum insulation/ reflective roofs. Water is also being used as a cooling element for the courtyard air which in turn cools the classrooms.

Site Planning and Principle Adopted in This Research





The Courtyard Concept In Design Of Centre For Science And Environment, India
Source: www.cseindia.org

CONCLUSION

The research started with a question on the quality of Artisans in the Construction Industry and kind of training available for them. Having analysed the question, stating the problems and examined the various cases, the research has yielded to an appropriate sustainable solution in the form of a proposed design that encourages and meets the required need for effective training and retraining of Artisans in the building Construction Industry in a built form. It has also incorporated a proposed research centre for building materials and construction techniques as well as a laboratory for testing of these materials and technique. The implementation of this proposal is a key approach that would revitalise the Construction Industry in Nigeria. The local artisans who have been displaced would be retained and equipped to capture the local construction market, it would also revive the informal system of education which has lost its pride and glory. The introduction of testing and research laboratory would restore hope for locally manufactured materials and construction technique. In general this will create jobs for the teeming unemployed population and yield

a gross increase in the development of the building construction Industry in line with the Millennium Development Goal and Vision 2020.

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EVALUATION OF NATURAL LIGHTING AS A SOLUTION TOWARDS ACHIEVING SUSTAINABILITY IN THE DESIGN OF SHOPPING MALLS IN F.C.T ABUJA MUNICIPAL AREA

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The philosophy of natural lighting in buildings' interiors is a significant development in the transition to sustainable buildings. Natural lighting enhances human and environmental sustainability by providing healthier interior spaces and reducing the demand on non- renewable sources of energy. This study assessed natural lighting in ten shopping malls within the Municipal Area of the F.C.T of Abuja. The methodology adopted to carry out this research was a descriptive survey method with the use of questionnaires and structured observation schedules. These were used to obtain knowledge on the source of power supply and assess the design features that were integrated to achieve natural lighting in each shopping mall. Data collected were analyzed by simple descriptive analysis with the use of statistical figures in the form of percentages. Tables were used to visually display the extracted data from the research instruments. The results from this research showed that the major source of power supply was from PHCN. Diesel generators were used as an alternative source of power supply when there was power interruption. This indicates that most shopping malls in the Municipal Area of F.C.T of Abuja, depends largely on electricity from PHCN and non- renewable sources of energy. The results of the evaluation carried out in the ten shopping malls revealed that although fenestrations were integrated in all the shopping malls, natural lighting was inadequate due to; the number of these fenestrations was relatively small when compared to the overall building envelope. Generally, efforts have been made so far to achieving natural lighting in shopping malls. However, there is more to be considered in order to maximize the efficacy of natural lighting. It is hoped that the outcomes from this research provides relevant information and direction for designers on the possibilities of maximizing natural lighting in shopping malls.

Key words: Buildings' interiors, Natural Lighting, Shopping Malls, Sustainability

INTRODUCTION

Prior to the invention of artificial lighting, natural lighting was the primary source of illuminating buildings' interiors. With the advent of electricity, artificial lighting gradually took partial or virtual dominance in illuminating buildings' interiors, consequently increased electrical costs (Brain, 2015). This alongside other non- sustainable building practices especially in the building sector- as they are significant consumers of energy- has led to severe environmental, economic and human detriments through increased greenhouse gas emission, and carbon dioxide (IEA, 2013). The relationship of sustainability and the building sector is best understood by considering the concept of sustainability in broadly two aspects; human and environmental sustainability. Human and environmental sustainability can be achieved by the optimization of passive design strategies. Natural lighting is a passive design strategy that utilizes natural light to illuminate buildings' interiors thereby providing healthier and comfortable interior spaces and reducing the demand on nonrenewable sources of energy (Modscape, 2015). The aim of this research is to evaluate natural lighting as a solution towards achieving human and environmental sustainability in the design of shopping malls.

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Light has been vital to the livelihood and activities of mankind. The perception of natural lighting has evolved over time, from the earliest ancient cave dwellers who experienced day light initially merely as sunrise and its fading away as sunset; to the times when crude openings were introduced in buildings transmitting day light along with heat, cold, and air; to mankind devising a means to cover these crude openings particularly during the pre-sixteenth century, in order to protect the interior spaces against adverse weather conditions with the use of thin slabs of marble, sheets of mica or oiled paper and later shutters that could be opened and closed as when required; to the use of small panes of glass during the roman period and; larger panes of glass during the seventeenth century (WDC, 2007).

The history, evolution and development of windows is synonymous to the history of natural lighting; consequently architecture. Glass which replaced marble, mica, thatch and paper was discovered as early as 3000BC in Egypt and were used mainly for ornamental purposes such as beads, until the roman period where small panes of glass quarrels were used as window openings. Subsequently, during the seventeenth century, larger panes of glass were developed in England which helped to provide advanced fenestration possibilities. Over these periods, the nature of windows informed the appearance of buildings. For instance, during the mediaeval periods, the shape and location of the windows were functionally related to the role played by natural lighting, however; during the renaissance period, window placement was primarily based on the external appearance of buildings, as its seen even today (Phillips, 2004).

The growth of the workplace in the nineteenth century influenced the increasing need for more adequate lighting requirements which was partly solved by providing long horizontal windows, there by leading to higher floor to ceiling depth, consequently; uneconomical space utilization. The need to ensure more economical space utilization led to reduced ceiling heights, and reduced natural lighting in buildings' interiors. The pressure to effectively and adequately illuminate building interiors came from utility companies who saw this as an opportunity to encourage the marketing and sales of artificial and electrical means of lighting in the early twentieth century. Soon, artificial illumination replaced natural lighting and windowless factories and schools were constructed (Brain, 2015).

Meanwhile, the threat posed by energy crisis and substantial petroleum shortages (Macalister, 2011) in the 1970s motivated people to consider alternatives to interior illumination other than artificial means and natural lighting was one of the obvious alternatives towards achieving sustainability. In addition to the economic advantage of the optimization of natural lighting in buildings interiors, natural lighting has positively affected the education, health, and commercial sector- where it has been properly applied. A number of studies have proven that natural lighting leads to increased productivity by workers; higher class grades by students; quicker recovery of patients and the prevention or treatment of rickets- due to the presence of vitamin D in sunlight, seasonal affective disorder, hypertension and circadian rhythm disorders; and also enhances attractiveness and increased sales in shopping centers and malls (Edwards et al, 2002, Wymelenberg, 2014, Dodson E.R, 2010, Brain, 2015).

Successful and effective natural lighting, involves the holistic consideration of; the orientation of buildings with respect to the site; the size and type of fenestrations; the function of a space; the use of solar control or remediation devices and daylight responsive electrical lighting controls; the type of interior finishes to be installed and position of interior partitions (Ander, 2016). Despite the additional cost to the technology of natural lighting by these considerations, there has still been significant reduction in electrical bills, ranging from 15 to 40% in buildings where natural lighting was employed thereby contributing to sustainability (Facilitiesnet, 2009).

Sustainability and Buildings

Buildings have a significant impact on the natural environment and its inhabitants as they; consume resources, generate waste, discharge harmful atmospheric emissions and alter the function of land, as such, builders, designers, and users are constantly faced with the challenge of designing, and constructing buildings that are healthy, safe and comfortable while minimizing any negative effects on the environment and the economy (WBDG, 2017). OECD Project, defined sustainable buildings as those buildings that have minimum adverse impacts on the built and natural environment, in terms of buildings themselves, their immediate surroundings and the broader regional and global setting. Furthermore, according to, Paola Sassi (2006), the two main aims for sustainable architecture design are;

1. Sustainable buildings should minimize environmental impacts associated with their construction, usage or operation and degradation or disposal
2. Sustainable buildings should positively contribute to their social environment by meeting the needs of its inhabitants and enhancing the physical and psychological well-being of its inhabitants.

Summarily, minimizing environmental impacts of buildings without considering its psychological and physical conformability and receptiveness by its inhabitants is a waste of resources and a detriment to the community (Gander, 2016). Hence sustainability in buildings is a holistic approach that aims to create environmentally responsible buildings that also meets the needs of its inhabitants.

Natural lighting technology and design philosophy

A number of studies have shown that effective natural lighting in buildings can be achieved using the following technology and design philosophies (Ander, 2016, Lyons, 2013, ECBCS, 2010)

High performance glazing system

Contrary to the historical use of glass as windows to allow air and light, recent design complexities and differing needs of different designs, has led to the innovation of high performance glazing systems to meet these distinct and varying needs of clarity and view, thermal performance, occupant comfort, and aesthetics (Arsenault, 2016). To achieve natural lighting, the concept will be to carefully choose a high performance glazing system that will prevent or allow heat- depending on the climatic condition while enhancing clarity and light transmittance (Ander, 2016). This can be achieved through spectrally- selective films with double or triple panes. High performance glazing systems are sustainable because they improve the energy performance of buildings by reducing energy consumption and lowering carbon dioxide emissions.

Exterior Shading devices

Exterior shading devices helps to control and diffuse natural light in buildings' interiors, and also prevent the effect of glare on occupants. This often leads to user satisfaction and increased productivity. Examples of such devices are light shelves, overhangs, horizontal louvers, vertical louvers, and landscape features (Prowler, 2016). The position of windows on a building determines the kind of shading device best suited for it. While overhangs, horizontal louvers, and trellis over windows are more suitable for south windows; vertical louvers, horizontal slats, and deciduous trees are more suitable for east/ west facing windows. Additionally, shading devices are not necessarily needed on north facing windows (Brown, 2017)

Daylight redirection devices

Daylight redirection devices helps to transmit light deeper into a space. There are two kinds of redirection devices; light shelves and baffles. A light shelf is a horizontal slat integrated in a window and divides it into a view area on the bottom and a day lit area above eye level. They serve basically two functions, as a shading device for the part of the window below, while bouncing the light upward to improve light distribution and penetration and prevent glare effect on users. When light shelves are oriented vertically, they are known as baffles. (Sustainability Workshop, 2017)

Skylights

Skylights if properly installed are energy efficient devices for effective users' comfort and illumination of buildings' interiors. Unlike vertical windows, they admit more light and distribute it evenly. They come in different types and configuration depending on the design requirements of functionality, aesthetics or performance (Lyons, 2013).

Reflectance of room surfaces

Reflectance values of room surfaces significantly impact daylight performance and transmittance, therefore should be kept as high as possible. It is desirable to keep ceiling, walls and floors reflectances, over 80%, over 50% and around 20% respectively (Ander, 2016).

Tubular daylight devices

Tubular daylighting devices (TDD) are used to collect and channel natural light through the roof of a building into interior spaces. They economically admit light into areas of a building that has no windows or skylight. TDD typically consist of three parts: a collector on the roof to gather sunbeam light and diffuse skylight, a hollow pipe to channel the light down and a diffuser at a ceiling level to spread the light. A typical device can illuminate an area of 14 to $28m^2$. The area coverage is dependent on the floor to ceiling depth, the higher the ceiling; the more widely the light will be uniformly distributed (Laouodi et al 2014).

Natural light responsive electric lighting controls

Natural light responsive electric controls should be integrated with the use of natural light for natural lighting in interior spaces to be effective. These natural light responsive electric lighting controls sense the availability of natural light and moderates, either by reducing or in some cases switching off the artificial lights according to the amount of natural light available. The types available are switching controls, stepped controls, and dimming controls (Ander, 2016).

Open Spaces

The atrium and courtyard are typical examples of central open spaces in building interiors. They help to enhance sustainability by naturally illuminating building interiors (WBDG, 2017). An atrium is an open- air or skylit court space. The types of atria configuration are: centralized, semi- enclosed, attached and linear (Hung, 2003). Courtyards can be defined as an enclosed area surrounded by walls or buildings and open to the sky. The configuration of courtyards can be in U, L, T or Y depending on the design (Almhafdy, 2013). They also enhance visual connectivity with the exterior environment.

RESEARCH METHODOLOGY

The research methodology employed was descriptive survey method with the use of questionnaires and structured observation schedules. A total of ten shopping malls within the Municipal Area of the F.C.T of Abuja were assessed. Elements were drawn into the sample using convenience or accidental non probability sampling. This was because some shopping malls were not willing to disclose vital information needed for the research. Ten questionnaires were administered to the management of each shopping mall, to obtain information on the source of power supply in each shopping mall. Structured observation schedules were used to assess the natural lighting features that were integrated in the design of each shopping mall. The data collected were analyzed by simple descriptive analysis with the use of statistical figures in the form of percentages obtained from the crunched data which was computed and tabulated in Microsoft Excel Spread Sheet Program. Tables were used to visually display the extracted data from the data gathering instruments. The shopping malls that were assessed are listed in Table 1.0 below:

Table 1.0: List of shopping malls assessed

S/No	Name of Shopping Mall in Abuja
1	Novare Gateway Mall Lugbe Airport Road
2	Jabi Lake Mall Bala Sokoto Way Jabi
3	Silverbird Entertainment Centre, C.B.D
4	Next Cash and Carry Bannex- Gwarimpa Express Way, Kado-Kuchi
5	Park n Shop Aminu Kano Crescent Wuse 2
6	Metro Plaza Zakaria Maimmalari Street C.B.D
7	Ceddi Plaza Tafawa Balewa Way C.B.D
8	Sahad Stores Tafawa Balewa Way C.B.D
9	Exclusive Stores Ademola Adetokunbo Crescent Wuse 2
10	Rock of Ages Mall Obafemi Awolowo Way Utako

FINDINGS AND DISCUSSION OF RESULTS

The results obtained using observation schedules were recorded using the following representations:

- Not available
- ✓ Available

Table 2.0: Source of power supply in the shopping malls

S/ No	Name of mall	Source of power supply				
		PHCN	Solar power	Hydro-electric power	Wind turbines	Diesel Generator
1	Novare gateway mall	✓	-	-	-	✓
2	Jabi lake mall	✓	-	-	-	✓
3	Sliverbird entertainment center	✓	-	-	-	✓
4	Next cash and carry	✓	-	-	-	✓
5	Park n shop	✓	-	-	-	✓
6	Metro plaza	✓	-	-	-	
7	Ceddi plaza	✓	-	-	-	
8	Sahad stores	✓	-	-	-	✓
9	Exclusive stores	✓	-	-	-	✓
10	Rock of Ages Mall	✓	-	-	-	✓
	Total	100%		Total		100%

Findings on Table 2.0 shows that the major source of power supply in all the ten shopping malls is from PHCN, while the alternative source of power supply used when there's no light from PHCN are diesel generators. This indicates that the shopping malls assessed, depends largely on electricity from PHCN and non- renewable sources of energy.

Table 3.0: Natural Lighting Design Features

S/N	LIST OF SHOPPING MALLS	EXTERNAL SHADING DEVICES	CLERESTORIES	WINDOWS	OPEN SPACES	SKYLIGHTS	TOTAL
1	Novare Gateway Mall	-	-	✓	-	-	20%
2	Jabi Lake Mall	-	✓	-	-	-	20%
3	Silverbird Entertainment Centre	-	-	✓	-	-	20%
4	Next Cash and Carry	-	-	-	-	✓	20%
5	Park n Shop	-	✓	✓	-	-	40%
6	Metro Plaza	-	-	✓	✓	-	40%
7	Ceddi Plaza	-	✓	✓	✓	✓	80%
8	Sahad Stores	-	✓	✓	✓	-	60%
9	Exclusive Stores	-	✓	✓	-	-	40%
10	Rock of Ages Mall	-	✓	✓	✓	-	60%
	Total	0%	60%	80%	40%	20%	

The results on Table 3.0 show that although there are fenestrations in all the ten shopping malls assessed, shading devices or light redirection devices were not integrated in all the designs. Seven of the ten shopping malls had below 50% of the variables that were assessed in each shopping mall. This indicates that generally efforts have been made so far to achieve natural lighting in shopping malls. However, there's still more to be considered in order to maximize the efficacy of natural lighting.

Table 4.0: Position of clerestories

S/ No	Name of Mall	Position			
		Supermarket	Individual Shop Units	Staircases	Other Spaces
1	Jabi Lake Mall	-	-	-	✓
2	Park n Shop	✓	-	✓	-
3	Ceddi Plaza	-	-	-	✓
4	Sahad Stores	-	✓	-	-
5	Exclusive Stores	✓	-	-	-
6	Rock of Ages Mall	-	✓	-	-

Table 4.0 displays the position of clerestories within the shopping malls. Park n shop and Exclusive stores had clerestories in the supermarket areas. This is a fenestration design possibility that allows natural light into supermarkets where stalls would otherwise obstruct the entry of natural light through windows. Jabi Lake mall had clerestories above the individual shop units. The natural light transmitted through the clerestories contributes to the overall interior environment lighting. Ceddi plaza had clerestories at relaxation spaces while Sahad Stores and Rock of Ages Mall had clerestories at each individual shop units.

Table 5.0: Position of windows

S/ No	Name of Mall	Position			
		South	East	West	North
1	Novare Gateway Mall	✓	✓	-	-
2	Silverbird Entertainment Center	✓	✓	✓	✓
3	Park n Shop	✓	-	-	✓
4	Metro Plaza	✓	✓	✓	✓
5	Ceddi Plaza	✓	✓	✓	✓
6	Sahad Stores	✓	✓	✓	✓
7	Exclusive Stores	✓	✓	✓	✓
8	Rock of Ages Mall	✓	✓	✓	✓

Table 5.0 displays the position of windows within the shopping malls. In all the eight shopping malls listed above, shading devices or light redirection devices were not used to control natural light especially on the east and west facing windows.

Table 6.0: Description of open spaces

S/ No	Name Of Mall	Open Space		Nature of Atrium				Configuration of Courtyard				Total Number Available
		Atrium	Courtyard	Centralized	Semi Enclosed	Attached	Linear	O	U	L	I	
1	Metro Plaza	✓		✓								1
2	Ceddi Plaza	✓		✓								2
3	Sahad Stores	✓	✓	✓					✓			2
4	Rock Of Ages Mall	✓	✓		✓				✓			2

Table 6.0 shows the description of open spaces within the shopping malls. In all the four shopping malls listed above, the atria and courtyards helps to transmit natural light into the building interiors or spaces where they are integrated. In Sahad Stores, some the artificial lights on the passage surrounding the courtyard and relaxation spaces were switched off. In Ceddi Plaza, the artificial lights where one of the atria is located were all switched off.

Table 6.1: Position of atrium

S/ No	name of mall	Position of atrium		Total Number Available
		Relaxation Spaces	Circulation Space/ Centralized	
1	Metro Plaza	✓	✓	1
2	Ceddi Plaza	✓	✓	2
3	Sahad Stores		✓	1
4	Rock of Ages Mall		✓	1

Table 6.1 displays the position of Atrium in the four shopping malls where it was integrated.

Table 6.2: Position of courtyard

S/ No	Name of Mall	Position of Courtyard		Total Number Available
		Relaxation Spaces	Circulation Space/ centralized	
1	Sahad Stores		✓	1
2	Rock of Ages Mall		✓	1

Table 6.2 displays the position of Courtyard in Sahad Stores and Rock of Ages Mall.

SUMMARY OF FINDINGS

The results of the evaluation carried out in the ten shopping malls reveals that although fenestrations are integrated in all the shopping malls, natural lighting is inadequate due to; the number of these fenestrations are relatively small when compared to the overall building envelope. Additionally, skylights are not integrated in the design of 80% of the malls assessed as such natural light is only transmitted through vertical fenestrations while none comes in from horizontal fenestrations. The vertical fenestrations alone are limited as they do not give even distribution of natural light as much as horizontal skylights. Generally, it is observed that there is high demand and use of artificial light in shopping malls, as natural light is used alongside artificial lights or for emergency lights when there is power interruption, and in some cases, it is completely shut out in spaces where there are no fenestrations at all.

RECOMMENDATION

Stake holders, design professionals, developers, building owners and users are all responsible for human and environmental sustainability, during the design, construction, and operation phases of Shopping malls and buildings in general. First and foremost, buildings should be designed with respect to the micro climate to take advantage of the maximum available light so as to minimize electrical bills. Uncontrolled natural light results to excessive brightness and heat transmission into buildings' interiors as seen in some of the selected shopping malls. As such, the negative effects of excessive brightness and heat transmission in interior spaces that comes with natural light should be remedied with; shading devices, and light redirection devices like light shelves. Building orientation should allow for north and south facing glass while minimizing east and west facing glass. High performance glazing systems should be used instead of the common single glazing, as they help to satisfy differing needs of different designs as regards aesthetics, thermal performance, view, occupant comfort and environmental sustainability. Clerestories should be used in areas where obstructions would block the entry of lights through windows. This should especially be integrated in spaces like supermarkets, where stalls are used. Given the health benefits of natural light, light tubes should be used in spaces that are surrounded by other functions and are difficult to position fenestrations.

CONCLUSION

Natural lighting in buildings enhances human and environmental sustainability through improving and maintaining human health and reducing the exploitation of non- renewable

resources. As such, the philosophy of natural lighting if properly employed is a significant contribution to the transition to sustainability in the building sector, and world at large.

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ASSESSMENT OF PASSIVE DESIGN STRATEGIES FOR ENERGY EFFICIENCY IN OFFICE BUILDINGS OF FEDERAL CAPITAL TERRITORY ABUJA

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Energy efficiency strategies refer to measures aimed at improving the energy performance and efficiency of buildings. This study evaluated various energy efficient strategies for office buildings via descriptive survey which utilized observation checklist for quantitative and qualitative data analysis. It also looked at energy as a global issue and various means of achieving energy efficiency while adopting passive solutions in the design of office buildings. Purposive sampling was carried out to study office buildings in the central business district of Abuja. Literature gathered, analyzed and summarized to define energy saving means show that passive strategies for achieving energy efficiency include building form and orientation, passive solar heating, climate and site, use of building materials and passive cooling. Building materials and techniques to a large extent, are highly influential because of their strength, cooling and heat transfer capacity. The expectation is that energy efficiency can be achieved using available resources optimally and providing a model for subsequent applications in office buildings and other public buildings. Use of material and construction techniques to assist designers, builders, clients in creating designs for lesser cost and higher yield is driving the building industry to greater heights. Passive strategies should achieve environmental friendliness, meet current development trends and reduce building carbon footprint and these will be responsible for space, form, and surfaces of the building.

Keywords: *Energy efficiency, passive strategies, renewable resources, energy, integration systems technologies*

INTRODUCTION

Energy efficiency has gained significant attention in the industrial and research community because of the emission of greenhouse gases and the depletion of fossil fuel which is on the increase. Buildings account for 40% of energy consumption (Krarti, 2012; Krarti, 2011; Bribian et al., 2009). If the energy consumed in manufacturing steel, cement, aluminium and glass used in construction of buildings is being considered, this consumption would be more than 50% (Energy Efficiency in Buildings, 2009). Energy efficiency of buildings play a vital role in designing a new building, assessing its energy consumption as per design, and application of energy efficient technologies during construction and operation of the building. The energy efficiency of a building is the extent to which the energy consumption per square meter of floor area or per square meter of envelope area (KWh/m2 yr.) can be reduced compared to benchmarks for that particular type of building under defined climatic conditions. The benchmarks are derived by analyzing data on different building types within a given country.

An efficient building is one that applies energy-efficient technologies while operating as per design, supplies the amenities and features appropriate for that kind of building, and which can be operated in such a manner as to have a low energy use compared to other similar buildings (Olofsson et al., 2004; Meier et al., 2002).

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The concept of "energy-efficient buildings" has some implications that depend on regulations, economics, energy demand and the environment. There are many concepts regarding energy-efficient buildings; the elements can be divided into three parts (Olofsson et al., 2004; Meier et al., 2002).

(a) The building must contain energy-efficient technologies, when operating as designed, to effectively reduce energy use.

(b) The building must deliver the amenities and features appropriate for that kind of building.

(c) The building must be operated in an efficient manner. The evidence of this operation is low energy use relative to other similar buildings.

The building stock includes residential, commercial, institutional, and public structures. Opportunities to minimize energy requirements through energy efficiency and passive renewable energy in buildings encompass building design, building materials, heating, cooling, lighting, and appliances. The means to making buildings contribute less to the carbon footprint and utilize less energy are active and passive.

The amount of energy consumed varies depending on the design of the fabric of the building and its systems and how they are operated. The heating and cooling systems consume the most energy in a building; however controls such as programmable thermostats and building energy management systems can significantly reduce the energy use of these systems. Buildings can also utilize zone heating and cooling systems, which regulate the heating and cooling of unused areas of the building. Eicker, U (2003), in addition to energy conservation and energy efficiency measures introducing renewable energy would be an advantage to the building sector as it will reduce the carbon dioxide emissions, and the energy generated from the renewable energy could be used for heating, cooling, ventilating or lighting.

It is easier to design energy efficient features into new buildings; however existing buildings comprise approximately 99% of the building stock. This sector thus provides the greater challenge for implementation of energy efficiency as well as the greater opportunity for overall energy efficiency gains. (Josifas, 2012) Although energy efficiency initiatives for existing buildings can be demonstrated to be cost effective, there has been limited success in convincing large organizations and building owners to undertake energy efficiency projects such as retrofits, and retro commissions.

Study area

Abuja is located in the North central region of Nigeria within longitude 6 0.45'' and 70.39'' E and latitude 80.25'' and 90.20'' N and it is the Federal Capital Territory of Nigeria with a land mass of approximately 7,315km and a total area of 29,484sqm. With an estimated population of 1,405,201 people (NPC, 2006). It is in the savannah belt with temperate climate. It comprises of six (6) area councils. It is bordered by Nasarawa State on the east, Niger State to the west axis, Kogi State to the south and Kaduna state to the north. These States have impacted on the development of the FCT. Because of its position as the seat of power and administrative headquarters for most government establishments, it witnesses a continuous inflow of people in search of jobs and other sources of livelihood.

MATERIALS AND METHODS

The study employed the use of descriptive survey method to obtain and analyze qualitative data on office buildings and large multiuse building types; buildings that have applied the principles of energy efficiency within them as well as those with architectural potential of integrating energy efficient systems and practices. As regard energy efficiency measures and strategies. Quantitative data was also obtained to ascertain the number of elements under observation. A total number of ten office buildings were selected in the central business district of the Federal Capital Territory, Abuja. The selected office buildings are shown in table 1.0. The kind of activities carried out in the buildings were also noted to be mostly administrative. Observation checklist was used to measure the variable in the study. These are climate and site, building envelope and building systems as it affects the building's energy performance. Data analysis was done using Microsoft excel to generate tables. Pictographic presentation provided information on the buildings under study. The results and discussions are shown in the tables and plates.

RESULTS AND DISCUSSION

The following results obtained from the research are discussed based on observations and highlights of the analysis of passive design strategies employed for energy efficiency in office buildings in FCT, Abuja.

Table 1: Climate and Site

Sn	Study Samples	Building Materials	Type Of Openings	Building Outline/Shape	Landscaping	Preservation Of Site Characteristics	Building Form & Aesthetics
1	NNPC, Abuja	Use of concrete, steel glass & wall tiles	Aluminium glass windows	Rectangular	Minimal Use of natural landscaping elements	Minimal availability trees within site	The building is rectangular in shape is conducive for the tropical climate
2	CHURCH GATE BUILDING, Abuja	Use of concrete, steel glass & wall tiles	Curtain wall Aluminium glass windows	Rectangular	Use of natural landscaping elements was minimal	Minimal availability trees within site	The building is rectangular in shape is conducive for the tropical climate
3	METRO PLAZA BUILDING, CBD Abuja	Use of concrete, steel glass & wall tiles	Curtain wall Aluminium glass windows	Rectangular	Use of natural landscaping elements was minimal	Minimal availability trees within site	The building is rectangular in shape is conducive for the tropical climate
4	BANK OF INDUSTRY BUILDING,CBD Abuja	Use of concrete, steel glass & wall tiles	Curtain wall Aluminium glass windows	Oval shaped	Use of natural landscaping elements was minimal	Minimal availability trees within site	The building is Oval in shape and is not conducive for the tropical climate
5	WORLD TRADE CENTRE, CBD Abuja	Use of concrete, steel glass & alubond	Curtain wall Aluminium glass windows	Rectangular	Site excavation tampered with natural landscape	Minimal availability trees within site	The building is rectangular in shape is conducive for the tropical climate
6	IGI BUILDING, Wuse Zone 4,Abuja	Use of concrete, steel glass & wall tiles	Curtain wall Aluminium glass windows	Rectangular	Use of natural landscaping elements was minimal	Minimal availability trees within site	The building is rectangular in shape is conducive for the tropical climate
7	FIRS BUILDING, Sokode Crescent, Wuse Zone 5,Abuja	Use of concrete, steel glass & alucobonds	Curtain wall Aluminium glass windows	Rectangular	Use of natural landscaping elements was minimal	Minimal availability trees within site	The building is rectangular in shape is conducive for the tropical climate
8	NCC BUILDING, Maitama, Abuja	Use of concrete, steel glass & wall tiles	Curtain wall Aluminium glass windows	circular	Use of natural landscaping elements was minimal		The building is Circular in shape and not conducive for the tropical climate
9	ITF HOUSE, Maitama, Abuja	Use of concrete, steel glass & wall tiles	Curtain wall Aluminium glass windows	Rectangular	Use of natural landscaping elements was minimal	Minimal availability trees within site	The building is rectangular in shape is conducive for the tropical climate
10	FERMA BUILDING Maitama, Abuja	Use of concrete, steel glass & wall tiles	Curtain wall Aluminium glass windows	Rectangular	Use of natural landscaping elements was minimal	Minimal availability trees within site	The building is rectangular in shape is conducive for the tropical climate

Table 2: **Building Envelope**

SN	STUDY SAMPLES	SHADING DEVICES USED	COOLING SYSTEMS ADOPTED	BUILDING ORIENTATION	DAY LIGHTING
1	NNPC, Abuja	Internal window blinds	Mechanical, atrium, window	Conforms to reduce heat, gain daylight and air wash	Curtain wall glazing, Atrium, window
2	CHURCHGATE BUILDING, Abuja	Internal window blinds	Mechanical, atrium, window	Conforms to reduce heat, gain daylight and air wash	Curtain wall glazing, Atrium, window
3	METRO PLAZA BUILDING, CBD, Abuja	External horizontal aluminium	Mechanical, atrium, window	Conforms to reduce heat, gain daylight and air wash	Curtain wall glazing, Atrium, window
4	BANK OF INDUSTRY BUILDINGS, CBD Abuja	External horizontal aluminium	Mechanical, atrium, window	Does not conform with site orientation	Curtain wall glazing, Atrium, window
5	WORLD TRADE CENTRE, CBD Abuja	Internal window blinds and extended balconies	Mechanical, atrium, window	Conforms to reduce heat, gain daylight and air wash	Curtain wall glazing, window
6	IGI BUILDING, Wuse Zone 4,Abuja	Internal window blinds	Mechanical, atrium, window	Conforms to reduce heat, gain daylight and air wash	Curtain wall glazing, Atrium, window
7	FIRS BUILDING, Sokode Crescent, wuse Zone 5,Abuja	External horizontal aluminium	Mechanical, atrium, window	Conforms to reduce heat, gain daylight and air wash	Curtain wall glazing, window
8	NCC BUILDING, Maitama, Abuja	External horizontal aluminium	Mechanical, atrium, window	Conforms to reduce heat, gain daylight and air wash	Curtain wall glazing, window
9	ITF HOUSE, Maitama,Abuja	External horizontal aluminium	Mechanical, atrium, window	Conforms to reduce heat, gain daylight and air wash	Curtain wall glazing, window
10	FERMA BUILDING Maitama,Abuja	External horizontal aluminium	Mechanical, atrium, window	Conforms to reduce heat, gain daylight and air wash	Curtain wall glazing, window

Table 3: **Building Energy Systems**

SN	**STUDY SAMPLES**	ENERGY SOURCE	COOLING AND VENTILATING SYSTEMS	USE OF ENERGY EFFICIENT APPLIANCES	WATER MANAGEMENT
1	NNPC, Abuja	Hydro-Electricity and fossil fuel generator	Mechanical and natural ventilation	LED bulbs, ceiling troffers low energy rating products	Use of underground storage tanks to collect storm water
2	CHURCHGATE BUILDING, Abuja	Hydro-Electricity and fossil fuel generator	Mechanical and natural ventilation	LED bulbs, ceiling troffers low energy rating products	Use of underground storage tanks, overhead to collect water
3	METRO PLAZA BUILDING,CBD, ABUJA	Hydro-Electricity and fossil fuel generator	Mechanical and natural ventilation	LED bulbs, ceiling troffers low energy rating products	Use of underground storage tanks to collect storm water
4	BANK OF INDUSTRY BUILDINGS, Cbd Abuja	Hydro-Electricity and fossil fuel generator	Mechanical and natural ventilation	LED bulbs, ceiling troffers low energy rating products	Use of underground storage tanks to collect storm water

5	WORLD TRADE CENTRE, CBD Abuja	Under construction	Under construction	Under construction	Under construction
6	IGI BUILDING , Wuse Zone 4,Abuja	Hydro-Electricity and fossil fuel generator	Mechanical and natural ventilation	LED bulbs, ceiling troffers low energy rating products	Use of underground storage tanks to collect storm water
7	FIRS BUILDING, Sokode Crescent, Wuse Zone 5,Abuja	Hydro-Electricity and fossil fuel generator, solar panel	Mechanical and natural ventilation	LED bulbs, ceiling troffers low energy rating products	Use of underground storage tanks to collect storm water
8	NCC BUILDING, Maitama,Abuja	Hydro-Electricity and fossil fuel generator	Mechanical and natural ventilation	LED bulbs, ceiling troffers low energy rating products	Use of underground storage tanks to collect storm water
9	ITF HOUSE, Maitama,Abuja	Hydro-Electricity and fossil fuel generator	Mechanical and natural ventilation	LED bulbs, ceiling troffers low energy rating products	Use of overhead storage tanks to store water from public mains
10	FERMA BUILDING Maitama,Abuja	Hydro-Electricity and fossil fuel generator	Mechanical and natural ventilation	LED bulbs, ceiling troffers low energy rating products	Use of reservoir to store water from public mains and rain

The energy efficiency of a building is influenced by climate and site, building envelope and energy systems employed in the operation of the building. Furthermore, these are affected by types of building material, type and size of openings and shape of the building. Factors like daylighting, building orientation, energy saving cooling and heating systems and appliances help keep building energy consumption low and should be adopted by designers and building owners in a bid to reduce the need to power buildings with fossil fuel generators which increase carbon emissions.

CONCLUSION

From design inception, energy efficient strategies are to be taken into account during planning and specifications as it will improve the overall energy performance of the building in its lifespan. These include; the use of atriums to improve ventilation and natural lighting into the central spaces of the building, size and position of openings to allow for adequate natural light and ventilation into the internal spaces, glazing systems and building form and orientation to maximize daylighting potential of the building. Furthermore, preservation of on-site features like trees, water and topography can influence the design for maximum optimization which will direct systems sizing and equipment to reduce energy load and improve the energy efficiency of the building.

Energy efficiency strategies when applied through passive means help cut back on greenhouse gas emissions and achieve user comfort in the building and hence should be topmost priority for building designers. Energy efficiency principles are to be fully considered during design and building operation phase to achieve an energy efficient building. These play a role in influencing design, construction methods and use of materials. The operational and design phases of buildings should be taken into account by professionals in a bid to cut costs on construction techniques, equipment, emissions and building materials. A basis for further research should be established for the future of buildings in order to have an environmental friendly climate by utilizing passive means to achieve energy efficiency for building optimization as against the use of fossil fuels for building operation.

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SUSTAINABILITY, RESOURCE CONSUMPTION AND ECOLOGICAL FOOTPRINT OF BIDA, NIGERIA

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This research appraises the impact of resource consumption on the ecological footprint (EF) of Bida. In achieving this, the resource consumption was used to derive the Ecological Footprint. Descriptive and inferential analyses were carried out on the field survey data used to calculate the EF. In calculating the EF of Bida, household component method was used, this best suit the study because the EF of Bida is categorised under a local EF (Scotti and Bodini, 2009) who classified Municipal EF as local since EF was initially designed to be calculated on national scale. The sampling technique adopted was random sampling with a sample size of 396. The research reveals that people have the tendency to be sustainable in their living and consumption patterns, but did not translate their knowledge to action as the study only shows that they are aware of the impact of unsustainable consumption but their behaviour remains unsustainable. Bida's EF when calculated was 0.669gha per capita and the Bio capacity calculated to be 0.19gha per capita for 2016. The difference in the bio capacity value and EF of Bida gives the sustainability level. The result of sustainability index of Bida shows deficit, which is an implication that Bida is not sustainable. This index is a reflection that Bida will need a 0.669hectares of earth resources or land to sustain an individual and whereas Bida has only 0.19hectares per capita. Its implies that Bida needs $3^{1}/_{2}$ of its present size to make a sustainable town. Food footprint has the largest share of the EF of Bida with 57.25% of the whole EF, Transportation has a share of 15.99%, and Energy has 14.05%. Water footprint has the lowest share of the EF distribution, this is due to the fact that most households in Bida depends on alternative source to public source, and this alternative source user have the energy required for processing the water already summed up under their energy footprint. Since Bida remains unsustainable because of the deficit from the index of Biocapacity that reflects that Bida has a higher footprint index than the EF index., the study recommends that the bio capacity of Bida should be optimised by having a sustainable regional land use planning.

Keywords: Consumption, Ecological footprint, Sustainability, Bida

INTRODUCTION

Culture counts as a way of life. It counts more than ever before, for cities the powerhouses of the contemporary society (Borg and Russo, 2005), and as well local setting. Culture remains important in the way its influences approaches to sustainable living in both the economic giants (cities) and rural environment. Culture is a key issue of concern in consumption rate and habit, the significance of its impact is not limited to natural environment, but also involves the interconnected expenditure of environmental transactions (Alonso, 2015). Although, culture can be referred to as the trait of a particular population, in other words, approaches imbibed in carrying out activities, yet, global traits do not exist (Triandis and Suh, 2002). The differences in traits established the variation in consumption habits of different geographical location, be it micro or macro to vary significantly. Hence, Borg and Russo (2005) reported the defined the culture by UNESCO during the global conference held in 1982 as the peculiar historical development of a community which involves all the specific features, spiritual, material, intellectual or affective, that characterise a society or human group. In recent times, rate of consumption globally has been said to be unsustainable and thus pulls the ecosystem beyond its capacity. According to WBCSD (2008), which reported that the last five (5) decades has seen 60% of services rendered by Earth's Ecosystem to have been degraded, hence further, puts the demand for consumption of material resources needed for industrial growth to have been on the increasing side, thus inflicting Biocapacity of the earth resources. This is expected to rise to 170% of the Earth's Biocapacity by 2040. This trend of human consumption has been identified to be measured best with Ecological Footprint (EF).

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Ecological footprint as an approach to sustainable development puts a check and balance between bio productive spheres and the rate of consumption (Wiedmann & Barett, 2010; Global Footprint Network, 2008). Its early application spans through measuring the environmental impact of activities within a national scale but in recent times, ecological footprint have been structured to measure the performance of a micro environment which had the ability to tell the sustainable level of a small conglomeration or even a product on local scale (Klingsky et. al 2009).

Therefore Ecological Footprint as a concept of sustainability has been defined as: *"the biological productive land an individual, population requires to produce all the resources it consumes and to absorb the wastes it generates using prevailing technology and resources management practice"* (Global Footprint Network, 2009).

Since consumption pattern varies both at local and regional settings, thus sustainability demands particularity in its approach. There seems to be some level of individualism to man's co-existence with life which involves it relationship with his ecosystem and thus demands a special and distinctive approach to managing a habitat in its small form or an environment in the larger state. Ecologies shape cultures; cultures impudence the development of personalities to all human endeavour which includes consumption and approach to sustainable knowledge. Hence the need to appraise the ecological footprint of Bida became necessary.

The specific objectives of this study are therefore to determine the level of sustainability from the resource consumption angle. To achieve this, the research investigate individual ecological footprints (in food consumption pattern, frequency of travel, energy consumption, strength of home installations and and amount of water usage)

Study Area

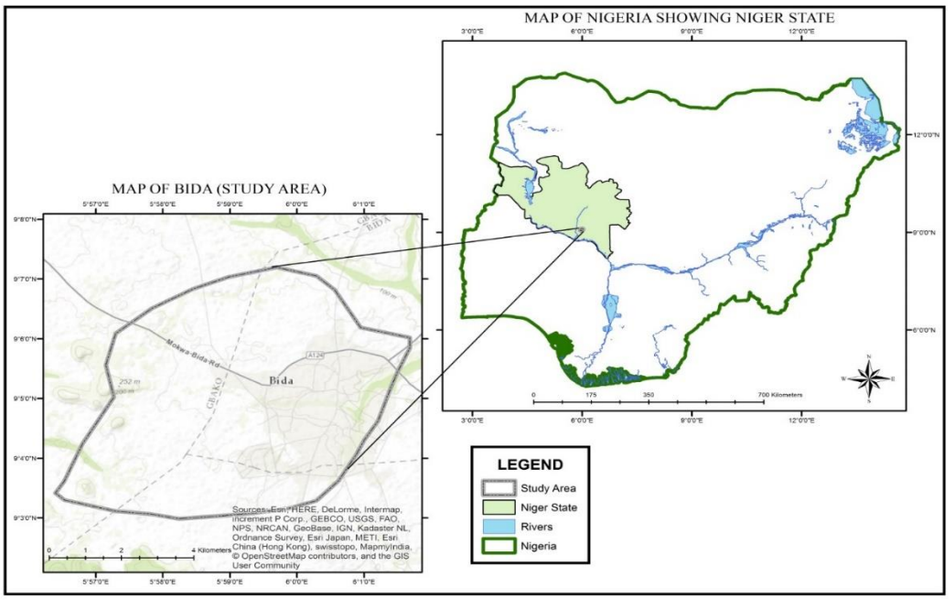


Figure 1.0: Authors produced from ESRI Data, 2017

Major food consumption in Bida

Bida is on latitude $9^{0}06^{'}$N and longitude $6^{0}01$'E which almost places Bida at a centre point of Nigeria. The boundary of Bida town formally starts at 19kms North of River Kaduna but development has cut up beyond this point. The location is at 14km along Mokwa - Bida road. Bida is 86 km South East of Minna, the Niger State Capital. Bida is sited in a location below every other location outside the town (NPC, 2011).

The present day Bida has its boundaries extending beyond the spatial settings of Bida Local Government, it has spread beyond the walls and developments have taken over farmlands. It has a high population density because of the densely populated core there is competition for space allocation. Hence this has extended the development of Bida into Gbako Local Government, Lavun Local Government and Katcha Local Government of the state. Major prominent institutions are found located in these local governments. As at 1980's, the size of the town was around 51km^2 but now the development has extended to 200.50km^2 which is approximately four times its size in 1980's (Maxlock, 1980). Staple food in Bida which are predominantly grains and tubers, which are of secondary importance. The consumption of majorly rice and sugarcane in Bida is as a result of large proportion of expanse of seasonally flooded land in adjourning settlements to Bida. Settlements like Badegi and its rural communities in Lavun local governemtn that adjourns Bida are known majorly for rice production. Settlement on all axis of the town are known majorly to cultivate rice and

sugarcane. These also has influenced the consumption of rice and made it the most common staples in major household as it is readily available locally and the presence of milling outlets made it easy processed to a finishing state hence made it the commonest staple.

Ecological Footprint and the Concept of Sustainable Development

The implications which these two concepts have for future development vary with respect to the concept of wealth and the role of economic activities (Berker *et al*, 2012*)*. However, their subservience to human and environmental needs is seen to be inseparable. Sustainability is conceived to enhance a future with better harmony between human activities and the life-supporting systems of the biosphere (Rochstrom *et al* 2009*)*. Reviews of the range of schools of thought that have been documented over time offered diverging perspectives on the sustainability debate, some contesting and others complementing each other.

Despite the broad interpretability of sustainability, it constitutes a relative consensus between global actors. On the issue of possible resource constraints, the concept of "efficiency" (both inflow and outflow), attempts to build an economic case for reduced resource-use from the relationship with nature's carrying capacity (Rochstrom et al, 2009). Hence, necessitated the need to build indicators of natural capita overuse by economic activities and not as environmental policy advice in terms of measurement of inflow.

Richard (2002) posits and advanced that using sustainable indicators for the assessment of sustainable development has been discovered to only consider the inflow, He advocates that every activities of man should be sustainably carried out which may involve the simplest activities like process of fish harvesting, log falling, and growing foods should all be done in a sustainable manner which was believed will all end in sustainable development. Natural resources account for majorly agricultural concern that involves the forest activities, fisheries, soils and general agriculture.

Ecological Footprint Assessment (EFA), although examines the supply side of sustainability, also covers assessment to consumers by assessing the impact of consumption pattern on the natural resources. Views of EF gives everyone a share of the impact felt by the ecosystem since every activity has it resource sourced from the environment and every activity carried out is on the earth surface (Kissinger et al, 2013)

According to Klinsky et al (2009), while sustainable development gives attention to supply side of the sustainable equation with respect to no other source, EF pays more attention to both the supply and the demand sides of the equation and places the responsibility for sustainable development equally on the consumer. Thus, it examines resource sustainable development component in both ways. To express sustainability in quantitative terms, ecological footprint as a tool is more statistically effective in the computation and measurement of resource generation and use.

Models of EE

The development of EF could be traced back to the 1970's, Although with the introduction of Carrying Capacity Model (Abdul'Razack and Ludin 2014). It has the capacity to estimate the required land that will meet the demand of a particular population. The models of EF are the approaches and methods used or with similar characterises with the EF concept itself. This research considers the use of EF

Table 1: Models of Ecological Footprint

Models	Methods	Scope	Scale	Remark
Carrying capacity	• System dynamic model • I = P*A *T	• Biophysical capacity • Environmental capacity • Maintenance of population	• Global • National • Regional	• Not suitable for measuring sustainability at local level
Land Use Matrix	• System theory • Embodied Land Analysis	Consumption conversion to land Different land types (e.g. arable land, forest land, grazing land etc)	• Global • National • Regional	• Not suitable for measuring sustainability at local level • Enable Bio-capacity measurement
Input-Output	• Ecological balance of Trade • input-Output Accounting Model • Algebraic Mathematics	5 years International trade accounting Network Analysis Statistical accounting	• Global • National • Regional	• Not suitable for measuring sustainability at local level
Ecological Footprints Simulation Model	• Mathematical simulation • Matrix Analysis	Predict EF over time Lifestyle scenario predictions	• Global • National • Regional	• Highly useful for measuring

	• Consumption Computer Programming	Non-monetary Analysis Consumption	of • City • Household • Individual	sustainability at local level • EF Calculator enable

GFN, (2010); Abdul'Razack & Ludin (2014);

REVIEW OF RELEVANT LITERATURE

Wieldman et al (2008) in their research on the EF of Victoria did a comparism between the total footprint of Melbourne resident and the total area of Melbourne and Victoria, the findings revealed that the Melbourne has a total footprint of 6.9gha which stands at 12% larger than the physical land area of the whole state. The differences that could be noted between the consumption pattern in rural area to that of urban area is due to the lifestyle of urban areas that significantly differ from that of the rural area. The need of transportation is said to differ greatly and also in urban centres the complexity of resource usage is very complex which reflect the differences that could be thought of in the EF of the urban centres and rural centres.

Ojedokun and Elugoke (2016) in their research to appraise the level of influence of Human development Index and Ecological footprint indices to achieving sustainability. They further reported that indices as a key to defining standards that are provided by agencies that promote matters of sustainability such as the United Nations Environment Programme – UNEP, United Nations Development Programme – UNDP and Global Footprints Network – GFN. The results of their findings in the determination of the relationship between the HDI and EF of Ile – Ife citizen, A South-Western city in Nigeria revealed that there is a variation in spatial pattern of both human development index and personal ecological footprint across the sampled residential areas in Ile-Ife.

Lin et al (2010) in the need to check the difference from the global figure to the continental figure and lastly the China's ecological footprint index carried out a detail research on Chinas ecological footprint, biocapacity and development, reported that Asia's has an average EF of 1.78gha per capita. This value is of the same with the world's average biocapacity. Asia was reported to have an EF that sums up to 60% of the whole world's footprint. The advantage gained was largely to the population of this which is more than half the world population and it is said to have a little less than 1/3rd of the global biocapacity. Asia's was reported to have EF that is 2.2 times its biocapacity and thus supplement its biocapacity by adopting regional integration. The ability to have a sustainable regional integration resolved the basis for meeting up with the demand for a higher biocapacity. Before the late 18th century, China has more than the biocapacity needed to cater for their resource demand. This trend has since changed as transportation mode has thus skyrocket and contributed mainly to the footprint of China. The research reports that as at 2007, the EF of China has been greatly influenced by the carbon footprint by 57%, and thus attributed the the larger percentage of wealthier citizen in China.

Using data from 69 LCAs, Kissinger et al (2013) worked on accounting for the EF of materials in consumer goods by aiding the development of ecological footprint values for each material that further reflect production data from several countries.

The study reveals climate change as a critical issue for cities to tackle through GHG emissions reduction policy and action, increasing global resource depletion and related ecosystem impacts pose equally imminent and dramatic risks. EFA reveals that the global human population is using earth's resources more quickly than they can be replenished.

Roy and Caird (2011) reported on the household Ecological Footprint in United Kingdom (UK). The outcome of reveals that major energy consumption in the UK is by households, the study also reveals that the indirect energy equals 60% of the direct energy usage. Their findings revealed the role age bracket and household size as factors that determine the man's impact on the environment. The findings revealed that the household size declined in the 1960's from 3 to 2.5 in 1991. They also found out that the present situation in 2011 is that larger population of household are single man household which has increase the demand for houses.

Monika (2009) in the research titled "is their consumption sustainable: An inquiry into the consumption habits of citizens and university students of Szeged. The study revealed the relationship between the EF and Population Distribution of the students, Consumption per capita and Technological efficiency. There research discloses the level of awareness of student in different faculties of the university to consumption. It further tells that Medical student tends to have lower EF, which was attributed to little time they have for social activities. The management students were seen to have a larger EF than any other faculty students.

METHODOLOGY

Both primary and secondary data were used in the analysis of this research. Political ward demarcation was used in the questionnaire administration. Questionnaire was proportioned to the population distribution as gotten from the NPC figure of 2006 was distributed randomly. Structured questionnaire was used to collect household resource consumption. Other secondary data were collected from Global Footprint Network, Food and Agricultural Organisation, like yield and equivalent factor of Nigeria, National Bureau of Statistics, Niger State Environmental Agency and other organisations. The use of Ecological Footprint spreadsheet for calculation was formulated and made available by redefine organization was used (Household Ecological Footprint 2.0 by redefine.org). This sheet estimates the Ecological Footprint of households within a local setting. The sheets calculates the EF components (Food, Water, Waste, Transport, Energy and Housing).

The Ecological Footprint of each estate was calculated using the physical and consumption variables so as to determine the estimate of household and the per capita Ecological Footprint. The physical parameters used are the land for development of each household housing unit. The consumption focuses on food, transport, and utilities (energy and water consumptions), waste and housing. A total of 396 households were sampled using systematic random sampling.

The sample size was arrived at from sample calculator estimate. The data on food consumption was obtained from household expenditure on food. Transport energy, water and electricity usage was also obtained. Data for the total waste collected was collected from Niger State Environmental Protection Agency, Bida branch office. The number of trucks of waste collected was gotten and the volume of the waste collected was arrived at by measuring the length, breadth and height of the container at the back of the trucks to derive the volume in a year.

Specific information gathered includes the number of cars owned by each household and alternative usage to public electricity supply and alternative water supply. Information on total number of employed people per household, total households working, The amount of water used, the electricity and fuel for generators were also estimated on yearly basis as obtained from the household consumption. This is to enable the researcher calculate the EF since the EF is calculated on annula basis.

RESULTS AND DISCUSSION

Food Footprint

The approach adopted in calculating the food footprint of Bida involves several steps. The procedure involves calculating the mean daily consumption of food in Bida as well the mean annual food consumption with the different categories of food. The process of categorising the food was adopted from NBS, (2010).

The process of calculating food footprint involves calculating firstly the land needed to produce the food, and secondly embodied energy of food consumption. The embodied energy of the food categories leads to calculating the CO_2 conversion and the energy required to transform each parts of the food. The study reveals that food demands in Bida is in the proportion of 76% to 24% for Processed and Unprocessed food respectively.

Table 2: Annual Food Consumption and Food Ecological Footprint of Bida.

Categories of food	**Per Capita Annual (kg)**	**EF**
Unprocessed Non-Animal Food items	124.11	**0.184**
Processed Non- Animal food items	39.19	**0.058**
Animal based food items	62.06	**0.141**

Source**:** Author's fieldwork, 2017

Housing Footprint

The research adopted the Chamber *et al* (2004) procedure for calculating EF of housing or built land. The assumption was that, built land or housing has to be taken as not disaggregated. It was assumed built land includes all areas that have being built on, contaminated and degraded that could be termed unproductive in a housing unit. Simpson *et al* (1997) as reported by Abd'Razack (2014), the built land includes the garages, veranda and courtyard. The mean housing area in Bida is 203.27m^2, to calculate the housing footprint, Chamber *et al* (2004) puts forward that the crop yield factor will be multiplied with the equivalent factor alongside the household size. The Food and Agricultural Organisation (FAO) is the global organisation vested with the responsibility of deriving and Publishing the equivalent and yield factor for land and the latest released equivalent and yield factor for Nigeria has been adopted for this research since there is no calculation for such factors at a local scale.

Table 3: Derivation of Housing Footprint

Mean housing size		Crop yield factor		Equivalent factor		Ecological (gha/hectare)
203.27	x	1.24	x	2.51	=	**0.063**

Source**:** Author's fieldwork, 2017

Water Footprint

The analysis reveals the per capita annual water footprint average household in Bida have EF of 0.0016gha. EF of water is conventionally calculated by estimating individual household Ecological Footprint; this is done by calculating the required energy for processing of potable water from its treatment to supply to the households. In order to calculate the footprint of water from public sources, the research adopted the volume of water gotten from the household survey and the findings revealed that the total annual water usage per capita is $10.41m^{3.}$ Public water supply in Bida is regarded as the bore hole sunk for community or water supply delivered to household by tankers. Household with public borehole dependence is seen majorly in the core of the city and households with dependence on water delivery are seen majorly within the federal polytechnic staff quarters. The consideration for calculating public water footprint is to be able to account for the energy used in processing the water to these households since the other alternative source involves the use of the energy already accounted for or does not involve the use of energy at all.

Niger State Water Board (NSWB) reported that a total of 370 kWh of energy is required process and transport 1 mega-litre of water in Niger State (NSWB, 2009). Adopting this value in determining the EF of water usage for public water dependant and applying the EF conversion (0.0037), produces 0.061 gha. This implies that the water is supplied with energy of $6.2x10^{-8}$gha/L

To derive the EF of water, the water EF of Bida is then derived by multiplying the per capital footprint of water by the crop land equivalent factor for Nigeria land as reported by Food and Agricultural Organisation to be 2.51 with the annual per capita EF of the public water supply.

Table 4: Water consumption and derivation of water footprint of Bida

Water Conversion Factor	Unit	Value
Average Bida water consumption in Household per capita	L/day	216
Estimated Bida water consumption (Annual/Capita) Public	L/year	$10.41m^3$
Estimated Bida water consumption (Annual/Capita) Alternative	L/year	$13.43m^3$
Ecological Footprint of one (1) litre of water supply	gha/L	6.1×10^{-8}
Annual Ecological Footprint for supply of water per capita (Public) (X)	Gha	0.0006
Annual Ecological Footprint for supply of water per capita Alternative	Gha	0.0008
Bida EF of water (X x 2.51)	**Gha**	**0.0016**

Source**:** Author's fieldwork, 2017

The water from household with alternative source is not taken into consideration to avoid the duplication of footprint since the alternative source that requires energy must have been accounted for in the energy footprint calculation.

Energy Footprint

Table 5.0 reveals the footprint share of each energy source**,** Electricity has the largest energy footprint in Bida with 64% usage, Charcoal energy source has next to electricity with 13% usage, Kerosene has 12% of the whole energy distribution, and Firewood has the lowest percentile with 2% of the whole distribution.

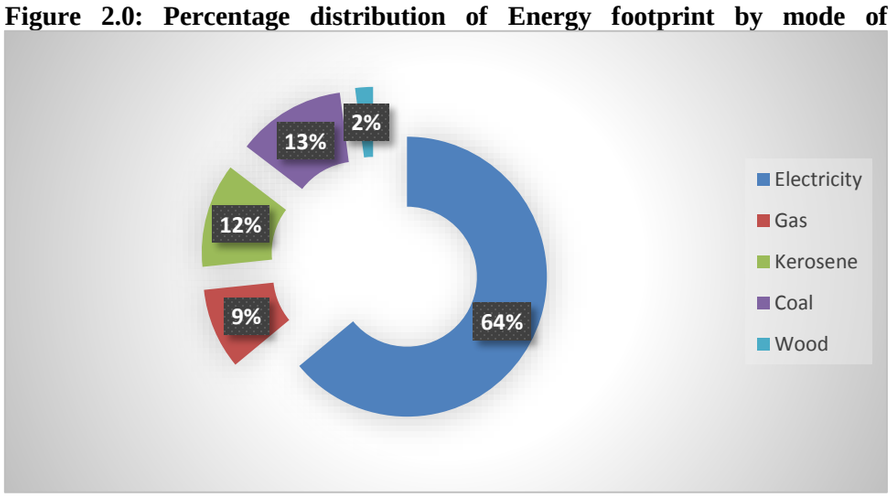
The outcome of the EF of energy puts Bida at a more fair consumer of energy since the value gotten is 0.09gha per capita which is 10% of the energy footprint of Scotland in 2001(Chamber *et al*, 2004), 55.94% of energy footprint of Minna, Nigeria in 2013 (Abd'Razack, 2014).

Table 5.0: Energy Footprint and derivation process

Quantity used Annually	$tCO_2/Yr.(C)$	EF Calculation	EF (gha)
Electricity	0.239	[0.2393/3.66 *x* 0.69/0.95] *x* 1.26	0.05984
Gas	0.035	[0.035/3.66 *x* 0.69/0.95] *x* 1.26	0.00875
Kerosene	0.045	[0.0450/3.66 *x* 0.69/0.95] *x* 1.26	0.01125
Charcoal	0.047	[0.0470/3.66 *x* 0.69/0.95] *x* 1.26	0.01175
Firewood	0.0077	[.0077/3.66 *x* 0.69/0.95] *x* 1.26	0.00193
Total			**0.09352**

Source**:** Author's fieldwork, 2017

Figure 2.0: Percentage distribution of Energy footprint by mode of energy usage.



Waste Footprint

In calculating EF of waste, two factors are very important, the embodied energy of waste products (EF_1) emitted CH_4 from dumpsite (EF_2). Embodied energy can be defined as the energy land required to sequester Carbon di Oxide of the energy release by the decaying waste.

Embodied energy of the products consumed accounts for 28% of waste footprint Indeed, indirect energy and material flows (i.e. embodied energy and embodied materials, meaning the up-stream material inputs used to manufacture consumable products) account for 60% of the embodied energy of EF of waste The degradation of these materials, especially the organic waste produces methane.

The composition of the wastes in Bida was gotten from the NISEPA office in Bida. The research made an assumption that the

Chamber (2004) observed that, quantifying liquid and aqueous waste has remain a difficult task, therefore in calculating the EF of Scotland, the liquid waste only was considered. This is similar in Bida as well.

Bida as an entity has a complex waste management method, the method adopted in waste disposal has made it a difficult task to determine the amount of waste generated in Bida. Bida town centre have fourteen (14) identifiable illegal but traditionally legal dunghills within the neighbourhoods that serves the immediate household. These dunghills with an average radius of 25m. Most of these dunghills serve many purposes to the neighbourhoods, some neighbourhoods where there are absence of public toilet takes advantage of the dunghills for their facae waste.

In the need to exert effort on ensuring effective waste management system, Niger State Government through Niger State Environmental Protection Agency (NISEPA) has shouldered the responsibility of collecting waste within the town; the neighbourhood are encouraged to dump waste along the road at strategic location agreed upon by each neighbourhood. These waste are being collected twice in a week by NISEPA and being deposited in the only legal Landfill along Bida – Minna road.

In deriving the components that makes up the EF of landfill, data was collected from NISEPA on the annual amount of waste collected from the street of Bida and the collection point that are spread round the town. The annual volume of waste transported to dump site in 2016 from Bida was estimated to be 3311.28.09tonnes (NISEPA, 2017).

The recent technological advancement that has led to establishment of many iron ore and plastic recycling methods has resulted in the activities of scavengers salvaging waste for economic purpose. This serves as a means of livelihood for many as they find it easy to collect recyclable materials like metals and plastic, these they later sell and make a livelihood from. The economist (2014) puts the amount of scavenged waste from dump site to be amount to 13%, therefore annually; a total of 430.46tonnes of waste is being salvaged from the two identified dump sites in Bida.

According to Chamber (2004), the of waste deposited in landfill requires three factors, the factors were outlined as:

i. Embodied emission of waste to landfill (EF_1),

ii. Methane emissions (EF_2) and

iii. Recycled waste (EF_3)

Another important factor is the embodied energy for each category of waste generated. The process of deriving the EF of waste involves the generation of waste from multiplying it with electricity value with the carbon equivalent.

Table 6.0: EF of dumpsite waste

Component of Domestic waste	Tonnes of waste	% of waste composition	Embodied energy (Mj/kg)	EF (gha/tonne)	Embodied in Kw/h	tco2
Organic matter	0.0051	46.71	10	0.0021	8.886	0.009
Paper	0.0027	24.77	32	0.0036	15.079	0.015
Textile	0.0016	14.19	95	0.0061	25.644	0.026
Glass	0.0005	4.77	21	0.0005	1.906	0.002
Ferrous	0.0005	4.77	40	0.0009	3.630	0.004
Non-Ferrous	0.0005	4.77	50	0.0011	4.537	0.005
Total	**0.0110**			**0.0142**		

Author's fieldwork, 2017

Table 7.0: EF of dumpsite waste methane emitted

Composition	Embodied of Methane in Kw/h	EF of Methane
Organic matter	5.331	0.0008
Paper	4.047	0.0013
Textile	15.387	0.0023
Glass	1.143	0.0002
Ferrous	2.178	0.0003
Non-Ferrous	2.722	0.0004
Total		**0.0053**

Author's fieldwork, 2017

EF_{waste} = EF_1 + EF_2

EF_{waste} = 0.0142 + 0.0053

EF_{waste} = 0.0195 gha

EF of Transport

Table 8.0 reports the transport footprint of Bida. The two modes of transportation have a sum up total of 0.107gha per capita. Figure 4.5 reveals the percentage distribution of the different mode of transportation. The assumption for transport footprint states that in circumstances where the inflow and outflow of transport mode could not be accounted for, the transport should footprint should be limited to the flow within the geographical boundaries of the considered location alone. In Bida, cars and motorcycle are major mode of transportation and the, although Bida has a Helipad, data gathered from the Helipad revealed that there was no landing and taking off from the Helipad. Also, there is no railway line within the town and none of the respondent submit to commuting by bicycles. The mode of transport submitted by respondents are cars and motorcycle. Car has a total of 59% of the footprint while motorcycle has a percentage of 41% of the footprint distribution. The sum of the Direct and Indirect Energy involved in any transportation mode forms the EF of the modes. Therefore, the major modes of transportation that could be accounted for gives a total of 0.107gha

Table 8.0: Derivation of transport footprint

Modes	Direct Energy	- Indirect Energy	= EF of transport
Car	0.0599	0.0031	**0.063**
Motorcycle	0.0045	0.0395	**0.044**
Total			**0.107**

Source**:** Author's fieldwork, 2017

Ecological Footprint of Bida

Ecological footprint has been reported to be the best tool for measuring sustainability at any level. This has made the tool a good and efficient one. The ecological footprint of Bida presents the different resource consumption across the components of the footprint measurement.

The footprint analysis shows the ranking of the components of the footprint according to their gravity. Food footprint has a 57.25% of the whole footprint of Bida. This is an indication that resource flow for food items is high. It reveals the believe in food as a means of survival in Bida before any other thing. The high importance placed on food consumption has influenced the high percentage of the footprint towards food.

Transportation and Energy are next on the list with 15.99% and 14.05% respectively, this thus tells of the level of resource consumption with different categories in Bida. The influencing factor remains that location with high efficiency gain and technological advancement than in the less advanced region. In calculating the transportaional footprint, two major means of transportation that has energy exchange and flow within Bida was accounted for which was found to have major influence on the transportation footprint, since transportation has been identified to have a major contribution to the EF of any urban settings (Barette, et al 2005).

Water footprint has the lowest share of the EF of Bida with 0.30%. This is an indication that there is no much energy to be accounted for in providing water to household. The footprint calculated was only for people with public source of water supply, this is because the public source of water have water pumped already and does not involve the energy of such households in the pump, therefore the need to account for the energy that would have been used to pump the water used by each households. Then waste has a percentage of 2.99 of the total EF of Bida.

Conclusively, the analysis revealed needed land to cater for per capita consumption in Bida, the research indicates that the per capita demand for a sustainable living in Bida is 0.669ha of land.

The outcome of this research reveals the need to have ecological footprint of each location done. The judgment of the regional EF within a spatial setting may not be the best to judge what a local EF will be. Nigeria in 2013 has a per capita EF of 1.1gha and per capita biodiversity of 0.6gha (GFN, 2017), this shows that a Nigerian needs 1.lha of land for a sustainable living in 2013.

Table 9.0: Ecological Footprint of Bida

Rank	Material Component	EF/capita (gha)	EF Percentage
1	Food	0.383	57.25
2	Transportation	0.107	15.99
3	Energy	0.094	14.05
4	Housing	0.063	9.42
5	Waste	0.020	2.99
6	Water	0.002	0.30
Total		**0.669**	**100.00**

Source: Authors fieldwork, 2017

CONCLUSION AND RECOMMENDATION

Conclusion

The EF of Bida is very important; this will aid check and balance on the town's resource consumption habit against the earth share available per capita.

Bida's EF was estimated to be 0.669gha, this is a close figure to the Nigeria EF which was reported to be 0.6gha (GFN, 2017). The major difference between the Nigeria national footprint and Bida's local footprint is linked with the amount of bio capacity available for them. Nigeria has a bio capacity of 1.1gha per capita while Bida have a bio capacity of 0.19gha per capita which is far less than the one available at the national setting. The derived figure for both the EF and Biocapacity reveals that Bida is unsustainable in its resource consumption when it is compared with the available Biocapacity available. This trend, if not looked into will keep Bida at a large deficit that will keep nothing for posterity. Hence, this calls for a more suitable approach to resource consumption in Bida.

Recommendation

The implication that Bida has a bio capacity of 0.19ha is a big disadvantage, since the national bio capacity is put to be 1.01gha per capita (GFN, 2017). It shows that the resident of Bida has a $1/5^{th}$ of the national footprint share for 2016. The EF of Bida would have been a good determinant for her level of sustainability since it is quite lower than the global footprint and lower than the national footprint, but averagely, the EF per capita of Bida residents is 0.669gha which is far beyond the Biocapacity of Bida.

Generally, the approach to ensure a sustainable Bida can only be achieved through optimisation of regional planning as proposed by Guo J *et al* (2017) this is because the EF of Bida is lower than the national and global footprint figure, but the bio capacity remains low which is an indication of the low yield and earth resources available per capita in Bida. Thus, it is recommended that an optimisation of the bio capacity should be enhanced to increase the yield of the various land classification in the local setting. Yet the need to be cautious in the resource consumption attitude towards each of the components of the footprints is needful.

Food footprint has a largest percentage of the share of EF of Bida, it is be recommended that the residents of Bida imbibe a more sustainable consumption approach. Development should not be in isolation, decision makers should look inward and encourage inter regional developments that will at long run keep Bida on a more sustainable path

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ENVIRONMENTAL CONSERVATION

EVALUATION OF WASTE MANAGEMENT PRACTICES IN GARMENT FACTORIES, KADUNA, NIGERIA

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Waste management is an essential element in building operation that sustains the environment for the continuous survival of man. Waste management practices differ from locations and nature of waste produced. In Nigeria, waste management processes in garment factories are usually limited to the common ways of burning which emits harmful gases into the atmosphere thereby causing pollution to man and the ecosystem. The garment factory which is an extension of the textile industry has fabric as its largest raw material which generates a high amount of waste from it processes. The aim of this research is to investigate and identify the existing waste management practices in garment industries. In achieving these, the descriptive method of research is adopted with the use of observation schedule to examine the various garment factories. The data was analyzed using Micro-soft Excel.The study revealed that the existing waste management practices are limited to burning, reuse and disposal.The paper concludes that the available waste management practices though efficient there are more sustainable options that can be veered.

Keywords: *Fabric, Garment factories, Pollution, Sustainability, Waste management*.

INTRODUCTION

Waste management can be defined as the human control of the collection, treatment and disposal of various wastes. This is in order to reduce the negative impacts waste has on environment and society. Waste is directly linked to the human development, both technologically and socially. Waste management is a practice which focuses on delaying the rate of consumption of natural resources by means of recovering resources. All waste materials, whether they are solid, liquid, gaseous or radioactive fall within the scope of waste management. The management of non-hazardous waste (residential and institutional) in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the government subject to national or international policies (Kayitha and Manimekalai, 2014). Garment factory is an extension of the textile industry. This part of the industry starts where the textile industry ends. Textile industry has played an important role in the development of human civilization over several millennia. Technological developments from the second part of the eighteenth century onwards led to an exponential growth of the textile industry. At the beginning of the twentieth century, the production of man-made fibres started and grew rapidly. They can be used in many applications in apparels, home furnishings and industrial uses. The textile industry is both energy intensive and highly polluting (Rock 2007).

Therefore, it is very important to minimize its impact on the environment by establishing proper waste management systems (Ozturk 2005). Research has discovered that the implications of each strategy (reduce, reuse and recycle) provide recommendations for the development of waste diversion programs and sustainable management. (Dissanayake and Sinha, 2012)

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Garment Factory

Garments are products of sewing cut out patterns from fabrics either by hand or machine to fit any individual or collective size and style. Garment patterns were traditionally cut out by hand but with the advancement in technology and increased demand for garments, the factories now rely heavily on computers to aid in pattern making and layouts to increase production. Garment assembly may employ advanced robotics for relatively simple operations, but more complex work is still done by the individual worker. Garments are made from different types of textile fibres produced. There are the natural textile fibres made from processing the various plants into fibres which are commonly in use and the synthetic textile fibres which are not commonly in use. In recent years, the textile and clothing industry has shown dynamic growth in the global production of textiles and clothing products (Milašius & Mikučionienė 2014).

Processes in Garment Manufacture

The production processes involved in the construction of garment products involves many processes for the transformation of textile material to a finished product. The basic steps for development up to product delivery to the final customer include: collection planning, planning the production process, material stock, design, folding, cutting, preparation for sewing, sewing, finishing, ironing, packing, products stock, shipping to the end user. (Biermann, 2007). During these steps, there is the generation of waste at various points of the process which include fabric, paper, packaging boxes and other materials, making the factory a large generator of waste with negative impacts on the environment (Brasil, 2000).

Waste Management

Waste means any material or by product discarded or is no longer required after a process is completed. From the processes listed above, the areas where waste is largely generated are the cutting section, solid waste are generated and the washing which produces the liquid waste as by products. A broad approach to defining 'waste' can include products that are recoverable. Waste management refers to the process that involves activities to take care of unwanted materials after they are produced which includes the storage, the separation, recycling and the final disposal. Waste is controlled by human in various ways and disposed properly in order to avoid the negative impact it may have on the environment. Waste is linked to human industrial development activities. (McDougall et al, 2001) presented two studies concerning textile recycling conducted by (Lowe 1981) and (Ogilvie 1992). The studies indicated that the energy consumption of producing a woven product from virgin wool was approximately double compared to producing the product from recycled material. According to (Seadon 2010), a sustainable waste management system uses the recycle process that adapts and reduces the waste diverted to the landfills. A sustainable waste management strategy should consider the sustainable development objectives which includes environmental consequences, economic aspects and social issues (Morrissey and Browne 2004; Roussat et al. 2009). The growing consumption of products is an indicator of the increasing amount of waste generated in the world, which has increased environmental awareness and social responsibility, reinforced by strict legislation in developed countries, leading to the creation of more efficient waste management practices (Jordeva *et al*., 2015).

Waste and Fashion

Garment manufacturing and sustainability are often opposing ideas. Garment manufacturing which relates to fashion is a highly resource-intensive and wasteful practice which does not align with sustainability values. Sustainability in the fashion business is still an emerging trend, yet to be established, and many authors have recognized the importance of investigating how sustainability could be achieved (Young et al, 2004; Pears 2006; Fletcher 2008). Reuse or recycling of discarded fashion items reduces the environmental impact significantly compared to the purchase of new fashion products. The widely known sustainable waste management strategy in the fashion industry is referred to as the 3Rs, the waste hierarchy: Reduce, Reuse and Recycle.

One of the strategies of waste management is reuse which is to use the leftover for the same purpose, sometimes with re-distribution and resale (Fletcher 2008). Another strategy is recycling the leftover materials being shredded or pulled apart into small fractions called shoddy or mungo. Recovered fibres from used textiles are mixed with virgin

fibres to produce new fabrics or used to produce other products such as industrial filling, sound insulation panels or carpets (DEFRA, 2006).

Classification of Waste

Waste can be classified into: Industrial waste, Mining solid waste, Agricultural waste and municipal waste. Industrial waste may have benefits in forming a new production chain, through direct sales with the recycling industries or the intermediary general wastes, thus, giving value to the industrial wastes (Alshamrani *et al*., 2007).

Industrial waste is further divided into solid, liquid and gas.

Solid waste

Textile solid waste (TSW) belongs to the industrial and non-dangerous waste category. Conmetro, (2008) argued that waste refers to fabric trims, scraps or parts rejected by defects in manufacturing processes of the clothing factory. The solid textile waste recovery possibilities, (Jeihanipour *et al* 2013) reported on waste, mainly cotton and artificial cellulose fibre composition, and maintains, due to the concentration of this fibre, a significant potential for producing different biofuels, such as biogas. In accordance with concerns on the management of textile waste, a study conducted in the United Kingdom and developed by the Department of Environment, Food & Rural Affairs presented designs for the clothing manufacturing sector. Department of Environment (2008) is aimed at reducing clothing manufacturing impacts on the environment, reporting complete and specific data on the quality and quantity of textile waste in the UK.

Liquid waste

In a developing country like Nigeria, indiscriminate dumping of untreated wastes is still the current practice. Both domestic and industrial waste waters are discharged into rivers, streams and drainage systems. As a result of this practice, pollutants enter the groundwater, rivers and other water bodies causing adverse effects an ecological systems (Uwidia and Ademoroti, 2012; Uwidia, 2011). Ultimately, such water which ends up in our households could affect the aesthetic quality of portable water and pose threats to public health on the side of consumers (Miroslav and Vladimir, 1999).

The waste water generated in the garment factory depends on the raw materials used and the volume of water required. Waste water from printing and dyeing units is often rich in colour, containing residues of reactive dyes and chemicals and also requires proper treatment before being released into the environment (Azymezyk *et al*., 2007; Pala and Tokat, 2002). Textile waste water shows a high toxic level. The toxic effects of dyes and other organic compounds, as well as acidic and alkaline contaminants, from industrial establishments on the general public are widely accepted. Due to increased awareness of worldwide environmental issues, there has been a great interest in ecologically friendly, wet processing textile techniques in recent years (Padama, *et al*., 2006).

Methods of Solid Waste Disposal

The various methods of solid waste disposal range from refuse dispose bins to the recycle. Used textile depending on the quality and conditions take four different paths in order to reduce waste:

i. **Reuse:** Garments wastes are collected depending on the condition are re-used. This process combines the already sewn garments and the waste from the clothing factories.

ii. **Recycling:** The solid waste generated can be recycled into new products. This process involves reducing the negative effect that the waste may have on the environment before it is to be used again. The environmental impact or benefit from recycling of textiles is hard to estimate. Zamani (2011) found out that few processes exist beyond lab scale. Morley (2009) also found out that large scale recycling is used in the production of sound insulation for cars, rags for industries and mattress fillings. In this process, the textiles are shredded before they are used.

iii. **Energy use:** In the attempt to reuse and recycle the textiles, there are some of them which end up in landfills or incinerated for energy. The textiles for incineration come from all parts, from the industry to the end used garments. Stena (2010) explained that in the event where the textile wastes is not all used for energy, it is shredded into tiny bits and used for landfills.

Korhone and Dahlbo (2007) carried out a research that shows the use of textiles waste reduces the amount disposed in landfills. It also reduces the use of new raw materials and thereby decreases the use of natural resources.

RESEARCH METHOD

Descriptive survey research method was used for this study. The research instrument adopted was observation Schedule. The observation schedule was used in this research for the researchers to document the state of waste generated from the factories as observed. A copy of the observation schedule was used to assess the various garment factories visited. Pictures of some selected spaces within the garment factories are presented as plates to explain further the issues within the discussion of results. The population of the study area comprised of seven garment industries in Kaduna city. The selections of factories within Kaduna city were selected using Stratified Random sampling method. The garment factories selected was because they fall among a large scale and small scale according to the production capacities.

Table 1.0 Garment Factories studied

No.	Garment Factory	Location
01	Nigerian Army Ordinance Depot tailoring unit	Kaduna
02	De-lace Garment Manufacturing Company	Kaduna
03	House of Kaya	Kaduna
04	Sunny Garment Manufacturing Company	Kaduna
05	D Oki Garment Company	Kaduna
06	Sahara Fashions	Kaduna
07	Durable clothing Manufacturing company	Kaduna
08	Hall of suits	Kaduna

Source: Author

Table 2.0 Types of waste generated in the garment factories

No	Garment Factory	Fabric	Liquid	Gas
01	Nigerian Army Ordinance Depot tailoring unit	✔		
02	De-lace Garment Manufacturing Company	✔	✔	
03	House of Kaya	✔		
04	Sunny Garment Manufacturing Company	✔		
05	D Oki Garment Company	✔		
06	Sahara Fashions	✔		
07	Durable clothing Manufacturing company	✔		
08	Hall of suits	✔	✔	
	TOTAL	8	3	0

Source: Author

The waste generated as a result of the processes of production of the garment factories are classified in table 2.0 above. It shows the types of waste each factory produces. It is shown below the highest percentage of the waste generated in the factories is the solid waste which is the fabric. A small percentage is the liquid waste gotten from the laundry process of production.

Table 3.0 shows the waste management practices used within the various garment factories. They are the practices engaged depend on the convenience of the factories. The larger percentage of the factories disposes into bins and allow for the garbage trucks to pick up within the scheduled time. The other percentage of reuse in producing smaller items or used in patch work.

Table 3.0 Waste management practices in the garment factories

No.	Garment Factory	Reuse	Disposed	Incinerated	Recycled
01	Nigerian Army tailoring unit	✔			
02	De-lace Garment Company		✔	✔	
03	House of Kaya			✔	
04	Sunny Garment Company	✔	✔		
05	D Oki Garment Company		✔		
06	Sahara Fashions		✔		
07	Durable clothing company	✔			
08	Hall of suits			✔	
	TOTAL	3	4	3	

Source: Author

Table 4.0 shows the preferred practice of waste disposal. There is the tie between the reuse and recycled practices. This is because some of the factories use part of the waste in creating new garment as a design or accessories. The other preferred to recycle the waste. The others prefer to get rid of the waste by disposal in garbage bins. The recycle percentage is only 30%

as seen in figure 2.0 as a result of little knowledge about the more sustainable practices for managing waste.

Table 4.0 Preferred method of the waste disposal

No.	Garment Factory	Reuse	Disposed	Incinerated	Recycled
01	Nigerian Army tailoring unit				✔
02	De-lace Garment Company				✔
03	House of Kaya			✔	
04	Sunny Garment Company	✔			
05	D Oki Garment Company		✔		
06	Sahara Fashions	✔			
07	Durable clothing company				✔
08	Hall of suits	✔		✔	
	TOTAL	3	1	2	3

Source: Author

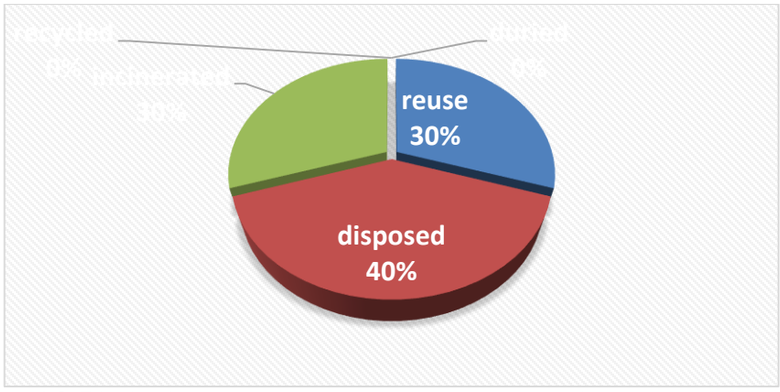

Figure 1.0: Distribution waste management processes adopted in the garment factories.

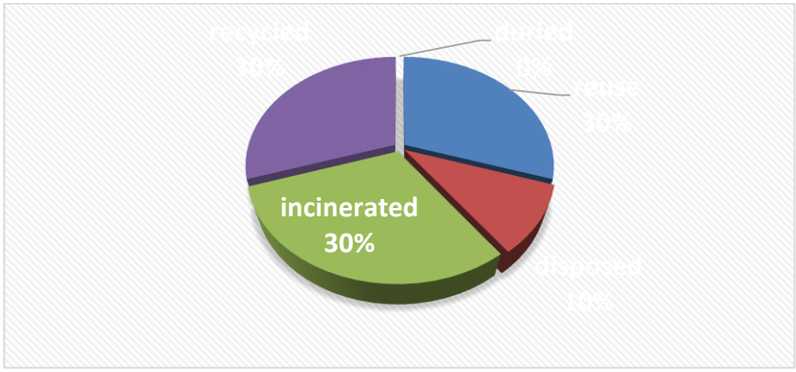

Figure 2.0: Distribution preferred waste management processes in the garment factories.

Plate 1: Showing the burning pit in the Nigerian Army Ordinance Depot

Plate 1: Showing the waste bin in De lace garment manufacturing company
Source: Authors

CONCLUSION

The study revealed that the existing waste management practices are limited to burning, reuse and disposal.The paper concludes that the available waste management practices though efficient there are more sustainable options that can be veered. The need for a more sustainable waste management practice is very paramount in Kaduna. This is also in line with the development goals for the development of sustainable cities and environment in return. This is seen in the Development goals by the United Nations (United Development Program, 2000) goal 11 for the sustainable cities and communities and goal 9 that relates to architectural management.

There is a need to create awareness for the benefits of sustainable waste management practices for the factories in order to give rise to the creation of the recycling units that will reclaim from the waste and in turn reduce the pressure on the raw materials. However there is one of the practices in use that should be encouraged such as the reuse of the fabric waste to experiment on new designs.

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SOCIO-ECONOMIC IMPACT OF FADAMA III PROGRAMME IN TUNGA-KAWO IRRIGATION SCHEME, WUSHISHI NIGER STATE, NIGERIA

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The Fadama project as a rural regional development project sponsored by the World Bank and Nigeria Government has been a remarkable national development project from the fact that it has metamorphosed from Fadama I (1991 – 1993); Fadama II (2004 - 2009); and Fadama III (2009 to date). This paper examines the socio-economic impact of Fadama III on irrigation farming of rice in five selected settlements of Tunga-Kawo irrigation scheme towards the rural regional development of Wushishi Local Government Area of Niger State. From 600 irrigation farmers in the study area, 240 were sampled using purposive sampling technique within four settlements that formed the catchment area for Tunga-Kawo irrigation scheme. The economic impact was assessed with cost and benefit analysis which revealed that an average of NGN1658 were being make form 0.25 hectare of irrigated rice farm size which is above the global poverty line of $1.90 per day as set by World Bank (2015). The social impact was determined by examine the social status through property owned and standard of the building occupied by the farmers and findings revealed that 114 (47.5%) farmers out of 240 were living in their owned built buildings and 23.33% were living in a building built 6-9 years ago and development of 40 modern design (flat) which falls in the period of Fadama III. The paper recommends reconstruction of Wushishi-Bida road and preparation of layout scheme to uplift the social status of the region.

Keywords: Irrigation farming, Rural Development, and Socio-economic Impact

INTRODUCTION

National development has been of paramount important to Nigeria government, previous administrations have developed national development strategies which range from policy development, institutional development, facility development, and capacity development which can be traced from first, second, third and fourth national plan of the Federal Government of Nigeria after her independent, all to increase the socio-economy status of the rural dwellers and national growth of the nation **(**Lawal and Oluwatoyin, April 2011; Iheanacho, 2014). The dichotomy of development in national development cannot be overemphasised; physical and economic development goes hand in hand that is why many past Federal Government administrations have embarked on different projects and programmes back-up with financial implications for the development of Nigeria. Many of these projects focused on rural development (Operation Feed the Nation, Better life for Rural Women) but their impacts were barely felt before they fold up with the expiration of initiating administration. The paper examined the socio-economic impacts of Fadama III irrigation farming of rice on rural development of Tunga-Kawo region of Wushishi Local Government Area of Niger State.

The Nigerian rural areas have been reported to accommodate 49.7 percent of the national population with its vast human and natural resources (World Bank data, 2011). With the vast human and natural resources in rural areas, rural areas contribute to the national socio-economic development, especially the supply of food demand of the nation.

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Agricultural activity has been noted in many literatures has the main livelihood of rural areas in Nigeria, the development of agriculture sector, especially the irrigated agriculture can curtail food shortage in the country. Dauda *et al.* (2009) citing NINCID (2009) asserted that 39.0% of the land mass of Nigeria are potentially suitable for agriculture and only 4.0 and 4.5 million Ha (approximately 4.5 to 5.0% of the land) are suitable for irrigated agriculture, but only 1.1 million Ha can be supported fully by the water available, the remaining 3.4 million Ha are being irrigated through Fadama. Although Fadama has its origin from Hause language which means fertile alluvial plain, Blench and Ingawa (2004) defines Fadama as the marshy area around Nigeria's river systems.

The concept of rural development in the Nigeria context was classified by Onibokun (1993) into three-fold classification: 1) Programmes meant to raise farm output and rural incomes through intensive and extensive agriculture, essentially through agricultural modernization. These include Agricultural Development Projects (ADP) and a host of other similar agricultural programme projects; 2) Programmes aimed at providing basic social amenities in rural areas, this was the period of introduction of integrated Rural Development (IRD) Programmes; and 3) Fiscal policy measures, rural credit programmes and rural industrial efforts (FPRCRI). From Onibokun (1993) classification criteria of rural development in Nigeria, these programmes can be classified as shown in the Table 2.1.

Table 2.1: **Federal Government Rural Development Programmes and Classification**

Programmes	**Years**	**Target Group**	**Nature of intervention**	***Classification**
National Accelerated Food Production Programme and the Nigeria Agricultural and Cooperative Bank	1972	Rural areas	Extension service, credit facility	ADP and FPRCRI
Operation Feed the Nation	1976	Rural and Urban areas	To teach the rural farmers how to use modern farming tools	ADP and FPRCRI
Green Revolution Programme	1979		To reduce food importation and increase local food production	FPRCRI
Directorate of Food, Roads and Rural Infrastructure (DFFRI)	1986	Rural areas	Feeder roads, rural water supply, Electrification	ADP, IRD and FPRCRI
National Directorate of Employment (NDE)	1986	Unemployed Youth	Training, finance and Guidance	ADP, IRD and FPRCRI
Better Life for Rural Women	1987	Rural Women	Skill aquisation, health care and rural development programmes	FPRCRI
People's Bank of Nigeria	1989	The under privileged in rural and urban areas	Encouraging saving and credit facilities	FPRCRI
Community Bank	1990	Rural residents and micro enterprise in urban areas	Banking Facilities	FPRCRI
Family Support Programme	1994	Rural and Urban areas	Healthcare delivery, child welfare etc	FPRCRI
Family Economic Advancement Programme	1997	Rural and Urban areas	Credit facilities to support the establishment of cottage industries	FPRCRI
National Poverty Eradication Programme (NAPEP)	2001	Rural areas	To replace the previously failed Poverty Alleviation Programme	FPRCRI
National Economic Empowerment and Development Strategy (NEEDS)	2004	Rural areas	Rural socio-economic up-liftment	ADP, IRD and FPRCRI

Source: Oladimeji and Abiola (1997) modified by Author (2017).

***** Classified using Onibokun (1993) criteria of rural development in Nigeria.

Sam (2014:6) asserted that different successive administrations in Nigeria developed programmes at poverty reduction and rural development; the strategies have usually been determined by the interpretation given to rural development by the different administration or interventionists.

Irrigation system is of great beneficiary to national development, Norman (1996) identified the following as benefit of irrigation for agriculture: "increasing the range of choice of crops and of livestock, thus providing flexibility in decision-making; focusing more complete and efficient resource use; lessening the danger of crop failure and the range of yield fluctuations, hence reducing uncertainties; increasing the capacity of the land for input of other factors; increasing the size of total farm business; shifting the factor- product curves towards higher input and greater production". In Nigeria perspective, there are many irrigation types base on the tradition and modern systems, but the most common in Nigeria as identified by Yahaya (2002) are; Shadoof, Pump, Gravity or Natural flow (plate i) and calabash/bucket methods which can be referred to as small scale traditional methods. He went ahead to classify a modern irrigation system in Nigeria to include: sprinkler irrigation (plate ii) either overhead or surface pipe; trickle or drip irrigation in which water is supplied to individual plants in use in water scarce areas (Plate III); underground irrigation by placing water at the root zone of plants using perforated plastic tubes through which water is pumped under pressure; and tubewells irrigation. Another type include flood irrigation (Plate IV)

Figure 2.1: Gravity (furrow) Irrigation
Source: Jantin (2014).

Figure 2.2: Sprinkler (pump) Irrigation
Source: Google images

Figure 2.3: Drip Irrigation
Source: Google images

Figure 2.4: Flood Irrigation
Source: Google images

Large-scale irrigation in Nigeria context is usually of 500 hectares and above comprises of the dam as main storage and conveyance and distribution works, operated by a government irrigation agency (Olofin, 1994). The establishment of River Basins Development Authorities in 1979 placed in-charge of the development of irrigation scheme and construction of dam as being pioneering modern irrigation in Nigeria, their inadequate of fund supply has necessitated for international help. The World Bank Aide Programme brought about National Fadama Development Programmes (NFDP) in Nigeria in the early 1990s (first batch in 1993 - 1999) with the aim of increasing the incomes of the users of land and water resources on a sustainable basis (Fadama, 1993) and later metamorphosed into third stage (2009 to date).

Study Area and Methodology

The study areas are Tunga-Kawo irrigation scheme catchment areas as defined by Upper Niger River Basins Development Authority; Bankogi, Dankwagi, Kanko and Kasakogi villages in Wushishi Local Government Area of Niger State. Wushishi Local Government Area of Niger State with projected population of 89,765 people from 81,783 at 0.85% growth rate (NPC, 2006), lies on latitude 9.46°N – 9.92°N and longitude 5.54°E – 6.22°.

The survey method was used as research methodology with the combination of qualitative and quantitative research methods. The interview guide was used to acquire some data from Fadama Area Office and Upper Niger River Basin Area Office both in Wushishi Local Government Area. The population of the study is 600 irrigation rice farmers on Tunga-Kawo irrigation farm area, and 240 were arrived at as sample size using sample size formula. The structure questionnaire was administered to 60 Fadama irrigation rice farmers purposively per settlement in the four study areas. Descriptive method was employed for data analysis and inference was drawn using Cost and Benefit

analysis to determine the profit from irrigation farming while building types occupied by the farmers were used to determine their social status. The social impact of Fadama programme on rural development was based on farmer building status as representative of his social status in the society.

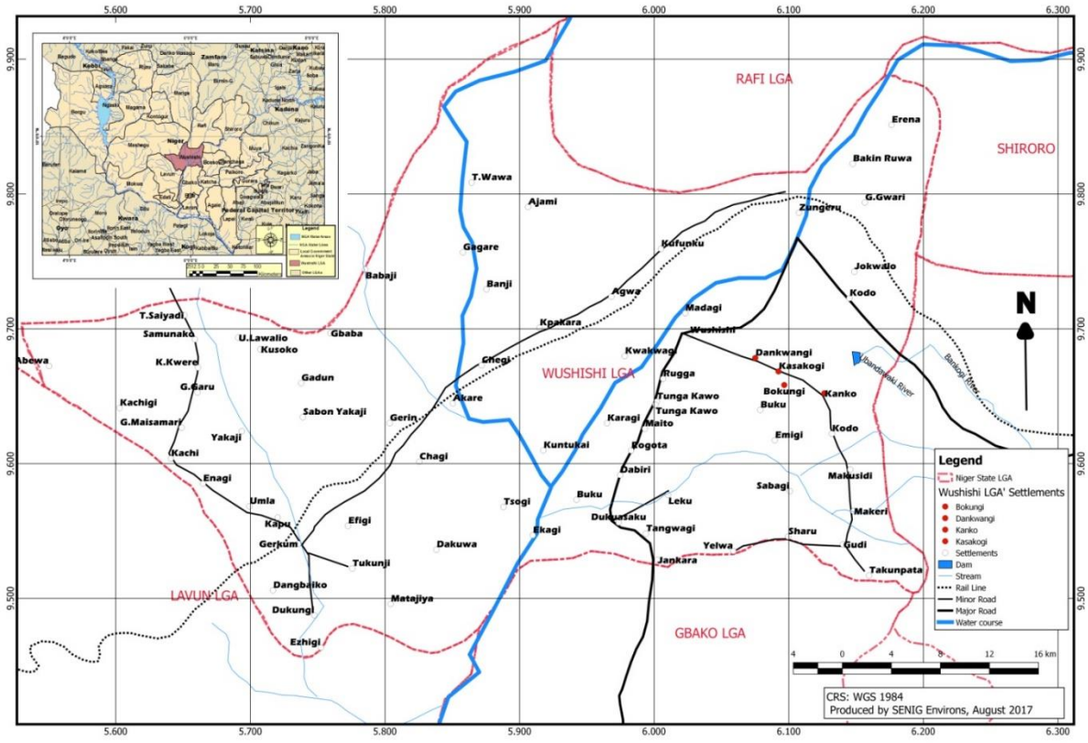

Figure 1.2: Map of Wushishi Local Government Area in the context of study area
Source: NIGIS Agency (2017).

FINDINGS AND DISCUSSION

Contribution of FADAMA III

Findings revealed that the activities of Fadama III in the study area include: enlighten of farmers on modern farming best practices, provision of fund to farmers' cooperative society and processing of rice. (Wushishi Area Officer of Fadama III Interview response, 2017).

The Fadama III has helped to boost the activities of indigenous people of Wushishi Local Government Area in irrigation farming on Tunga-Kawo irrigation catchment area through the provision of farm inputs as presented in Table 1.

Table 1: Farm inputs supplied by FADAMA to Wushishi farmers for year 2017

S/No	Items	1hect./farmer	1 group (10 farmers)
1	NPK fertilizer	4 bags	40 bags
2	Urea fertilizer	3 bags	30 bags
3	Herbicide	5 litres	50 litres

Source: Fadama Area Office Wushishi, Niger State Office (2017)

Economic Impact

Based on 240 farmers sampled in the study area, the average variable cost and fixed cost for the four categories of farm size was calculated and used for cost and benefit analysis as presented in Table 2. Findings revealed that an average of NGN34075 was incurred on 0.25hectare and 134800 were incurred on 1hectare of irrigated farm land which produced gross income of NGN208925 and NGN837200 per season respectively. Using 126 days as the average maturity of rice in the study area as the working days of farmer, it can be inferred that an average of NGN1658 were being make form 0.25 hectare of irrigated rice farm size which is above the global poverty line of $1.90 per day as set by World Bank (2015).

Table 2: Summary of Cost and Benefit Analysis

Farm Size (hect.)	Total Fixed Cost (NGN)	Total Variable Cost (NGN)	Total Cost (NGN)	Gross Income (NGN)	Income Per Day (NGN)	Income Per Day (Dollar)
0.25	4,250	29,825	34,075	208,925	1658.13	$4.74
0.5	8,500	54,850	63,350	422,650	3354.36	$9.58
0.75	12,750	84,775	97,525	631,475	5511.71	$14.32
1	17,000	117,800	134,800	837,200	6644.44	$18.98

Source: Field survey (2017)
1 Dollar = NGN350

Social Impact

The study area is characterised by traditional architecture building design (tenement and compound building) and materials, therefore the study assessed the type occupied or owned by the farmers. The three building type identified in the study areas includes: Tenement building, Compound and Flat building; as presented in the table 3, findings revealed that 27.5% of the farmers in the study areas were living in tenement buildings, 54.17% live in compound building while 18.33% live in Flat building. This indicates that a larger proportion of the farmers live in a traditional building setting.

Table 3: Building types occupied by the farmers

Type of building	Bankogi		Dankuwagi		Kanko		Kansakogi		Total	
	F	%	F	%	F	%	F	%	F	%
Tenement	22	30.14	14	23.33	11	22.45	19	32.76	66	27.5
Compound	34	46.57	37	61.67	31	63.27	28	48.28	130	54.17
Flat	17	23.29	9	15	7	14.29	11	18.96	44	18.33
Total	**73**	**100**	**60**	**60**	**49**	**49**	**58**	**100**	**240**	**100**

Source: Field survey (2017)
F represents frequency

As presented in Table 4, findings revealed that 114 farmers out of 240 were living in their owned built buildings, 29 were renting accommodation while 97 were inherited the accommodation. Based on building type built by farmers, compound building has the highest proportion of 49.12%, Flat has 27.19% while Tenement has 23.68%.

The findings revealed that a higher proportion of farmers built their accommodation indicate that irrigation farming of rice practise in the study as the only major economic activities is profitable enough to transform their housing want to supply.

Table 4: Building types and farmers' status in the building

Type of building	Built by farmer		Rented		Inherited		Total	
	F	%	F	%	F	%	F	%
Tenement	27	23.68	9	31.03	30	30.93	66	27.5
Compound	56	49.12	7	24.14	67	69.07	130	54.17
Flat	31	27.19	13	44.83	0	0	44	18.33
Total	**114 (47.5%)**	**100**	**29 (12.08%)**	**100**	**97 (40.42%)**	**100**	**240**	**100**

Source: Field survey (2017)

Form Table 5, findings revealed that 23.33% were living in a building built 6-9 years ago which falls in the period of Fadama III. This indicates that there has been growth in housing development due to Fadama programme in the study area. It can also be asserted that there is a small introduction of modern architecture building type (Flat building) into the traditional building setting of rural areas that made-up the study areas as indicated by the addition of 40 flat buildings in the last 9 years.

Table 5: Building Life Span

Type of building	Tenement (Rooms)		Compound		Flat		Total	
	F	%	F	%	F	%	F	%
Less than 2 years	7	10.61	11	8.46	8	18.18	26	10.83
2 - 5 years	9	13.64	28	21.54	17	38.64	54	22.5
6 - 9 years	17	25.76	24	18.46	15	34.09	56	23.33
10 years and above	33	50	67	51.54	4	9.09	104	43.33
Total	**66**	**100**	**130**	**100**	**44**	**100**	**240**	**100**

Source: Field survey (2017)

CONCLUSION

The impact of Fadama III on the irrigation farming of rice in the study areas cannot be over emphasised due to other extension services in form of enlightenment and advice giving to farmers

which has helps to improve the commitment and yield of farmer in rice production. The irrigated rice farmers were living beyond global poverty level and the programme has also contributed to the food supply of the Nation. The irrigation farming of rice has the major livelihood activities in the study areas can be concluded to be profitable enough to sustain rural housing transformation of the study area. This paper recommends the rehabilitation of the main road connecting the study areas to Bida and Wushishi which is in deteriorated condition and improvement of electricity supply in the areas as the major complaint from the farmers. Layout scheme is also recommended for the areas in order to prevent organic development. Findings revealed that local processing method were being used for rice processing therefore, the paper call upon private investor to established rice processing mill in the area so as to reduce the stress of farmers and provide good quality rice.

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FACILITY MANAGEMENT

THE CONTRIBUTORY EFFECT OF EXTERNALITIES TO THE VOID PERIODS FOR RESIDENTIAL BUILDINGS IN MINNA, NIGERIA

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A number of residential buildings have been observed to suffer longer void periods in recent times despite the increasing demand for residential accommodation across urban areas. Landlords and real estate investors are sometimes faced with the challenge of replacing tenants within the shortest possible time, thus being unable to adequately recoup the invested capital on residential properties developed in particular neighbourhoods. This study provides evidence on the contributory effect of externalities on the void period for residential buildings in Minna. The sample for the study constituted a total of 207 three bedroom bungalows which fell into void at any point between January 2014 and December 2016 – covering a three year period. Adequate data were provided for 144 of these dwellings which spread across nine neighbourhoods, representing 70% response rate. Data were sourced from practicing estate surveyors & valuers, and estate agents in the study area, as well as occupants of housing units that fell within the sample. The sourced data provided information on the void periods of sampled dwelling units as well as required information on selected externalities. Collated data were analysed using the optimally scaled categorical regression analysis. The regression model explained 51% of the total variation in the void period of residential buildings. Findings revealed that the void periods of residential buildings reduced with closer distances to shopping centers, recreation centers, major roads, and improved electricity supply. On the contrary, educational institutions, health care centers, refuse dumps, security and sources of water supply were found not to have significant contributions to the void period of three bedroom bungalows in the study area. The study recommended that real estate investors' should be mindful of externalities in an area before embarking on real estate developments in order to ensure satisfactory returns on their investment.

Keywords: externalities, electricity, residential buildings, shopping Centers, void period

INTRODUCTION

Residential property markets have received considerable attention worldwide, which may be attributed to the special role of shelter to man. Residential accommodation constitutes a basic necessity to man thus investment in residential properties is considered a major and highly profitable form of investment, as it seeks to address the growing housing demand of man. Over the years, considerable improvements in housing supply have been recorded across many urban areas. This is obviously in response to the growing demands for housing. However, despite the increasing demand for residential accommodation across urban areas, dwelling units have been observed to suffer unusually longer void periods. Also, In addition to providing descent accommodation for the teeming urban dwellers, residential real estate investors also desire timely optimum returns on their investments. It is therefore imperative that appropriate measures are taken to ensure that invested capital is profitably recouped. This can only be achieved when the void period is minimized and when the appropriate sales and/or rental values are realised from these properties. It is however important to note that appropriate values can only be realized in the absence of prolonged void periods (Ogunbajo, 2017).

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Ogunbajo, et al., (2018). **THE CONTRIBUTORY EFFECT OF EXTERNALITIES TO THE VOID PERIODS FOR RESIDENTIAL BUILDINGS IN MINNA, NIGERIA.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

Minna, the capital of Niger State have experienced rapid urbanization and expansion over the years, which have been attributed to the proximity of Minna to the Federal Capital City, and most recently, the insurgency in parts of northern Nigeria have further necessitated the influx of people into the town. The direct implication of this is an increased need for residential accommodation which further necessitated an increase in housing supply. However, a number of residential properties are left unoccupied and suffer longer void periods despite the rising need for residential accommodation. Landlords and real estate investors are sometimes faced with the challenge of replacing tenants within the shortest possible time, (in order to ensure the timely realization/recoupment of invested capital) on residential properties developed in particular neighbourhoods. These investors often do not have detailed understanding of the unique factors that determine these delays. This research therefore, performed a study of the Minna residential property market to determine the primary drivers of void periods with particular emphasis on the externalities in residential neighbourhoods. The research employed a contemporary analytical tool in order to provide evidence on the extent to which externalities contribute in determining the void periods of residential properties or otherwise. It identified externalities sustaining residential properties in the study area and established the proximities of these externalities to tenanted dwellings.

Externalities in relation to residential real estate refers to those external factors (i.e urban infrastructure /amenities and services) that are external to the building, but are integral to and supportive of a residential environment. Bello and Yacim (2014) described it as those components of the environment that makes dwellings habitable to man. According to Babarinde (1998), the efficiency of any urban area depends largely on the provision of efficient amenities and services, thus, the significance of these externalities in the proper functioning of an urban area cannot be over-emphasised. However, a review of existing literature has shown that the true relationship and interconnection between the availability of externalities and void periods has not been fully addressed and well documented.

LITERATURE REVIEW

Concept of Externalities

In its simplest form, externalities as those public works that are required for an economy to function. “Externalities” in relation to residential real estate is synonymous with the term “Urban Infrastructure”. Convery (1998) described it as the physical constructs provided by human endeavour which underpin the economic and social life of a community. It is a very significant determinant of the quality of life, thus plays an important role in creating comparative advantages. According to Srinivasu and Rao (2013), it has to do with the stock of basic facilities and capital equipment needed for the functioning of an area. They include the necessary services and attractions within the neighbourhood that makes life easy and comfortable for the inhabitants, and covers a wide range of infrastructural facilities which include electricity, good road network, telecommunication, street light, banks, fire service, pipe-borne water, drainage, health services, waste/refuse disposal, schools, parking spaces, transportation systems, educational services, markets, policing systems/security, recreational infrastructure and postal services (Saed, Kamariah, Mohammad & Johani, 2015). Externalities are usually provided by public authorities, private entrepreneurs, communities, or a combination of these. As observed by Cao and Zhao (2011), good quality amenities and ancillary facilities influence the progress of the society as a whole as well as the welfare of the citizens. The absence of these facilities will cause a city to lose its enterprise (Convery, 1998). They are vital elements of prosperity of any nation, hence, land has little potential for residential and other uses in the absence of externalities (Saed *et al*, 2015). They are also essential to achieve the development targets of any urban area, thus the provision and maintenance of externalities are absolutely necessary in any urban area if rapid economic growth is to be achieved and sustained.

The Concept of ‘Void period’ in Residential Buildings

Void period describes the period between tenancies when a property is unoccupied by tenants. The UK Housing Association Guide (2015) described a void as any property that is untenanted for a period of time, hence, void periods are simply those periods where a landlord does not have tenants paying rents. In other words, a void period is when a property is unoccupied with no rental income accruing to the landlord. According to Legal for Landlords - UK (2016), void periods are inevitable and will happen to most landlords during

the lifetime of their investment. However, during the lifetime of an investment, void periods can add up and become a significant loss for many landlords. Studies have shown that excessive or lengthy void periods can significantly impact on the viability of investments, thus in order to limit the risks on investment, property experts (Property Hawk, 2012 and the UK Housing Association Guide, 2015) recommended the following to minimize void periods:

i. Realistic rent: Every area has its ceiling rent. It is therefore essential that realistic rents are set for properties in accordance with what is obtainable in the particular areas where such buildings are situated. Hall (2009) believe that it is more cost effective to get a property rented quickly at a slightly lower rent than holding out for a higher rent and risking void period.
ii. Active marketing: Active marketing can also help to drastically minimize void periods.
iii. Good Tenants: Property agents should endeavour to get good tenants, and make further attempts to keep such tenants. Agents should not be careless in selecting tenants out of desperation.
iv. Building condition: Tenants' expectations of rental properties are constantly increasing, thus, for properties to attract and retain tenants, they should be in good and decorative and state of repair.
v. Offering incentives: For instance a discount for the first month's rent or including amenities can help clinch the deal for a potential tenant or help retain an existing one.

The notion of void periods has been a subject of discussion in many academic and professional circles. However, the extent to which externalities determine the void periods of residential properties lacks significant contributions from literature, hence the essence of this study.

METHODOLOGY

The population for the study constituted residential dwellings which fell into void at any time between January 2014 and December 2016 (3 years). Of all the house types in this category, only three bedroom bungalows were sampled due to ease of access and availability of data. A total of 207 three bedroom bungalows were sampled. Data on the void periods (measured in months) of the sampled buildings were generated from the records of estate surveyors & valuers and estate agents in Minna. Other important data were collated from completed questionnaire which were administered on household heads of the sampled houses. A ten (10) item structured questionnaire was employed to obtain primary data on the proximities of the houses to six externalities, viz: Shopping centers, Educational Institutions, Health care Centers, Recreation Centers, Major Roads and Refuse Dumps. Other externalities assessed are Neighbourhood security, Electricity Supply, and Sources of Water supply. A total of 144 questionnaire were well completed and subsequently used for analysis. These represent a 70% response rate.

Proximity of dwelling units to externalities was measured using ordinal variables on a three point scale. Respondents were simply required to tick one of the three options, viz: far, fairly close, and very close. This scale of measurement was derived in accordance with the duration or time taken (in minutes) by an average adult to walk from his/her dwelling unit to the nearest of each of the externalities under consideration. Precisely, a walking distance of 0 – 15 minutes was categorized as very close, 16 – 30 minutes as fairly close, and a walking distance of more than 30 minutes was categorised as far. Similarly, security of the neighbourhoods and sources of water supply were also measured on a three point scale, while the quality of electricity was measured in terms of the number of hours of supply per day from the public mains. The impacts of these externalities on the void periods of residential buildings in the study area was established by regressing the nine externalities (independent variables) against void periods (the dependent variable) using the optimally scaled categorical regression analysis (CATREG).

RESULTS AND DISCUSSION

Assessment of the identified externalities

Nine (9) externalities were identified to sustain residential buildings in the study area and were assessed as follows:

Table1: Assessment of the identified externalities

Externality	Measurement scale	Frequency	Percentage
Shopping centers	Far	59	41%
	Fairly close	49	34%
	Very close	36	25%
	Total	144	100%
Educational Institutions	Far	36	25%
	Fairly close	72	50%
	Very close	36	25%
	Total	144	100%
Health care centers	Far	74	52%
	Fairly close	48	33%
	Very close	22	15%
	Total	144	100%
Recreation Centers	Far	107	74%
	Fairly close	25	17%
	Very close	12	8%
	Total	144	100%
Major roads	Far	32	22%
	Fairly close	50	35%
	Very close	62	43%
	Total	144	100%
Refuse dumps	Far	62	43%
	Fairly close	59	41%
	Very close	23	16%
	Total	144	100%
Neighbourhood security	Not secured	19	13%
	Fairly secured	54	38%
	Very secured	71	49%
	Total	144	100%
Sources of Water supply	Bad	15	10%
	Fair	59	41%
	Good	70	49%
	Total	144	100%
Electricity Supply	0 - 6 hours / day	24	17%
	7 - 12 hours / day	82	57%
	13 - 18 hours / day	38	26%
	19 - 24 hours / day	0	0%
	Total	144	100%

Table 1 showed residents' description of the relative distances of their individual dwelling units to shopping centers, educational institutions, health care centers, recreation ceters, major roads and refuse dumps. It further showed residents' assessment of security within their respective neighbourhoods, sources of water supply, as well as electricity supply.

Measuring the effect of externalities on the void period of residential buildings

The model summary in table 2 showed a R^2 value of 0.510 which implied that externalities explain 51% of the variability in the void periods of the sampled residential dwellings. Other factors which were unaccounted for in the model can be said to be responsible for the remaining 49%. Table 2 also showed a high multiple correlation coefficient (R = 0.714) which translates to a good predictability of the dependent variable (void period of residential buildings) from the independent variables (externalities).

Table 2: Model Summary

	Multiple R	R Square	Adjusted R Square
Standardized Data	.714	.510	.490

The F ratio in table 3 tested whether the overall regression model is a good fit for the data. The table showed that, F (12, 131) = 11.360 and p (0.000) < 0.05. Since the p-value (0.000) is less than the alpha level, it is an indication that the regression is a good fit for the data. The results in the table implied that externalities can significantly predict the void periods dwelling units in the study area.

Table 3: ANOVA test for statistical significance

	Sum of Squares	df	Mean Square	F	Sig.
Regression	73.433	12	6.119	11.360	.000
Residual	70.567	131	.539		
Total	144.000	143			

The standardized beta coefficients in tables 4 explained that the independent variables measured and tested with the regression analysis proved significant in determining the void period of the dwelling units. The probability that these attributes influenced void period purely by chance is less that 5%. Table 4 showed that the externalities which made significant contributions to the void periods of residential houses in the study area are shopping centers, recreation centers, major roads, and electricity supply. These were identified by their p-values which were less than 0.05. The table showed the standardized beta coefficients which aided a comparison of the strength of the effect of each externality to the void period of the sampled dwelling units. The standardized beta coefficients in the table revealed that shopping centers made the strongest significant contribution to explaining void periods in the study area. It recorded the highest beta coefficient (0.312). This was followed by recreation centers, which had a beta coefficient of 0.300, and electricity supply (b = 0.260).

Precisely, results in table 4 clearly indicated that shopping centers, recreation centers, major roads and electricity supply impacted negatively on void periods. In essence, one standard deviation increase in the proximity to shopping centers (ie, closer proximities) yields 0.312 standard deviation decrease in void period, while one standard deviation increase in the proximity to recreation centers and major roads (closer proximities) yields 0.300 and 0.226 SD decrease(respectively) in the void period of this category of houses. Also, one standard deviation increase in the electricity supply (improved service delivery) yields 0.260 standard deviation decrease in the void period of three bedroom houses.

Table 4: Beta Coefficients of the independent variables

	Standardized Coefficients				
		Bootstrap (1000) Estimate of Std.			
	Beta	Error	Df	F	Sig.
Shopping complexes	-.312	.078	2	16.215	.000
Educational Institutions	-.229	.179	1	1.624	.205
Health care Centers	-.086	.112	2	.583	.560
Recreation Centers	-.300	.099	1	9.062	.003
Major Roads	-.226	.105	1	4.644	.033
Refuse Dumps	-.195	.144	2	1.831	.164
Security of the Neighbourhood	-.150	.119	1	1.571	.212
Electricity supply	-.260	.092	1	8.053	.005
Water supply	-.037	.158	1	.056	.813

A comparison of the zero-order correlation coefficients in table 5 further revealed that the identified externalities had separate and distinct degrees of relationship with the void periods of residential buildings. In this regard, negative correlation coefficients implied that the respective externality had negative relationships with void periods, while positive correlation coefficients implied positive relationships with void periods. Negative relationships translated to a decrease in void period with closer proximity to the externalities, while positive relationships translated to an increase in void periods with closer proximity to the concerned externality.

Results in table 5 revealed significant negative relationships between void periods and shopping centers, recreation centers, and major roads. These are evidenced by their zero-order correlation coefficients which are -0.321, -0.364, and -0.219 respectively. It also revealed a significant negative relationship with electricity supply. The negative correlation recorded in these cases implied that the void periods of houses reduced with closer distances to shopping centers, recreation centers, and major roads. Void periods also reduced with improved electricity supply. Electricity supply recorded a zero-order correlation of -0.427. The table further revealed that, out of all the externalities that had significant impacts on the void periods of houses in the study area, electricity supply and recreation centers were the most important. They had the highest importance indexes of 0.218, and 0.214 respectively. The least important is major roads, which had the lowest importance index of 0.088. These findings corroborate the work of McPeake (2015) which identified low demand, resulting from a variety of neighbourhood factors as having profound impacts on the void periods of residential buildings.

Table 5: Zero-order Correlation and Importance Index for the relationship between externalities and the void period of residential buildings

Independent Variables	Zero-Order Correlations	Importance index
Shoping complexes*	-.321	.196
Educational Institutions	-.258	.116
Health care Centers	.125	-.021
Recreation Centers*	-.364	.214
Major Roads*	-.219	.088
Refuse Dumps	-.382	.146
Security of the Neighbourhood	-.168	.049
Electricity supply*	-.427	.218
Water supply	-.182	.013

*Variables with significant impact on the void period of three bedroom houses
Data Analysis, 2017

Other determinant factors of void period

Based on the consensus opinion of estate surveyors & valuers in the study area, other essential factors which also determine the void periods of residential buildings in the study area relates to the condition of the physical components of the house, the size of the dwelling unit, the age of the building as well as the number of toilets. Others are rental values, the demand for a particular house type, as well as individuals' tastes and preferences.

CONCLUSION

This research is an attempt to examine the influence of the quality and proximity to externalities on the void periods of residential buildings in Minna, Nigeria. The study provided empirical evidence on the extent to which void periods are influenced positively and/or negatively by the identified externalities. Issues raised herein indicate that the impact of externalities on void period could be positive and/or negative. Findings further indicate that these externalities have varying degrees of impacts on the void periods of residential buildings. In this study, void periods were modelled as functions of externalities such as shopping centers, educational institutions, health care centers, recreation centers, major roads, refuse dumps, security, electricity, and water supply. The results as indicated by the optimally scalled categorical regression analysis revealed that the identified externalities made significant and distinct degrees of contribution to the void periods of the dwelling units. It is therefore essential that real estate investors' should be mindful of externalities in an area before embarking on real estate developments in order to ensure satisfactory returns on their investment. It is also recommended that concerned Authorities should ensure the efficient allocation of positive externalities across neighbourhoods and the elimination of negative externalities from residential areas if the void periods are to be minimized, and the invested capital is to be profitably recouped.

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THE PROSPECTS OF FACILITY MANAGEMENT IN REAL ESTATE SECTOR IN NIGERIA

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The involvement of Facility Management is controversially accepted by real estate developers and the facility managers have been undervalued by professionals in the same sector as the need for facility managers is only necessitated when buildings are in the near state of collapse only, however the research is aimed at assessing the prospects of facility Managers in Real Estate Sector in Nigeria with a view to improving the provision of real estate in the country. The research adopted the Quantitative research methods, which made use of questionnaires as a means of data acquisition. The questionnaires were randomly distributed among estate developing firms in Abuja registered with REDAN. A sample size of 83 was determined and the questionnaires were randomly distributed. The result was analyzed using statistical tools such as percentage, weighted mean and relative importance index (RII). From the result finding, all the prospects had high significance ranging from RII of 0.68 to 0.83 with investment appraisal (RII=0.83) as the first. The research concludes that Facility management has very high prospect in the real estate sector as the entire prospects identified were of high significance. The research recommends that the government and other relevant bodies such as the international facility management association (IFMA) should collaborate in making facility management an integral aspect of the real estate sector and the involvement of facility managers in the management of every real estate.

Keywords: Facility Management (FM), Real Estate, Prospects, Professionals, Developers

INTRODUCTION

Facility Management is controversially accepted by real estate developers in Nigeria. Hence it is understandable the observed challenge the profession current face (Geierman, 2009). Not too long was its importance recognized as a profession even by the international community (developed world). Although standardization of structural buildings have always been observed by construction stakeholders in developed world, but the more need of facility managers was not taking serious until about two decades back (Sanna, 2010). This arm of real estate sector (facility management) has been believed by professionals and scholars to have come to stay not for a while but as an important component of real estate sector (Sanna, 2010; Edoghogho, 2011).

In 2014, the Nigeria economy as measured by the Real Gross Domestic Product (GDP) experienced an increased growth rate of 6.35 percent in the third quarter which is higher when compared to 1.06 percent growth witnessed in the third quarter of 2013. This growth increase in GDP experienced was attributed to non-oil sector which predominantly could be attributed to real estate sector development (Babalakin & Co., 2004; NBS, 2015). In the case of mega cities in Nigeria like Lagos; have and are still witnessing constructions, renovations, maintenance of housing structures despite the full development one would have thought for the state. For some other states like Abuja, development in the building sector seems to have just started due to continuous movement of people to the nation's state capital (Adewunmi & Ogunba, 2014). In 2014 alone, Abuja as described by estate surveyors and valuers is currently the most profitable and income generating state from real estate sector of all the states in Nigeria (Babalakin & Co., 2004).

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This experienced swift development in the real estate sector is attributed to an increased population and urban migration. Hence, the need for facility managers is vital throughout each building cycle. The significant contribution by facility management to this sector cannot be underrated in the mega city buildings and edifices (Gbadegesin, et al., 2011). Facility Managers have a heavy task in the real estate sector of Nigeria as their job is not only required at the collapse stage of a building only, but at the building cycle of any construction for its cost/benefit analysis, maintenance, facility provisions and even many more (Kelechi, 2013).

Over the years in the Real Estate Sector, the need for facility managers have been undervalued by professionals in the same sector as the need for facility managers is only necessitated when buildings are in the near state of collapse only (Adewunmi & Ogunba, 2014). Awareness, reception and practice will always determine the job security of facility management profession in Nigeria. Despite the promising features facility management poses in the real estate sector and satisfaction recorded by clients in developed countries, the reverse is the case in Nigeria as low patronage or consultancy of facility managers threatens facility manager's job (Oladokun, 2014).

The importance of facilities management is not farfetched in the real estate sector globally. In most developed world today, the profession is significant as it is taken as "yeast is to a baked cake". The notable buildings that many recognize to today are as a result of the unending contribution of facilities management.

LITERATURE REVIEW

Philosophical Background of Facility Management in Real Estate

Real estate has continually played a major role in man's development. It is not by chance that food, shelter and clothing which is believed to be the three basics of mankind's sustenance, also have a relationship to land (Drucker, 2012). For example, food grows out of land as shelter is attached to it, and man's clothing is made largely from what grows out of land. Indeed, whether in ancient times or today's modern system, land constitutes a significant index for man's wealth, and as economic activities have assumed more sophistication over time, land has continued to play a central role in their development (NBS, 2015).

The term 'real estate' is defined as land, including the air above it and the ground below it, and any buildings or structures on it. It is also referred to as realty. It covers residential housing, commercial offices, trading spaces such as theatres, hotels and restaurants, retail outlets, industrial buildings such as factories and government buildings (Ojo, 2002). Real estate involves the purchase, sale, and development of land, residential and non-residential buildings. The main players in the real estate market are the landlords, developers, builders, real estate agents, tenants, buyers etc. The activities of the real estate sector encompass the housing and construction sectors (Indian Report, 2007).

There is hardly any business venture that does not require to be supported by some form of real estate from the small business that requires real estate as offices from where its business can be organized, to the major venture that needs it for its factory. It is therefore not difficult to understand why there is a lot of demand for land (Drucker, 2012). Real estate investment is an investment that is fast growing in any developed and even developing economy. For developed world like United Arab Emirate (Abu Dhabi), real estate investment has since been developed to serve as complementary to income generation to their natural resource endowment (oil and gas)(Jones,2013).

In 2013 alone, Dubai government recorded a contribution of real estate sector to its economy with an increase in 8.26 percent in the year's third quarter thereby being the second most contributing sector after the oil and gas sector (Adnan & Syed, 2008).In India, the government and private developers have seized the opportunity of the nation's population and sudden urban drift by investing in the real estate sector causing the sector a head-to-head with the agricultural sector and increasing the nation's GDP (Indian Report, 2007).

In Nigeria, the testimony seems the same as real estate (informal sector) is fast growing especially in mega cities like Lagos, Abuja, Port Harcourt, Ibadan, Enugu, and the rest. Stakeholders in the real estate sector have hence taken their activity "knives" to have their own share in the development business. Architects, estate surveyors and valuers,

civil/structural engineers, facilities managers, property managers and businessmen have jointly contributed to development of buildings in mega cities (Ezimuo, et al., 2014).

The facility management (FM) as an industry has emerged as one of the fastest growing sector over the decade. However, the scope and identity of FM is still fuzzy as evidenced by the definitions and issues which attempt to describe its scope. In fact, FM is the multi-disciplinary kind of work that covers a wide range of various activities, responsibilities and knowledge. Moreover every aspect of an organisation seems to be drawn into facility management (Patanapiradej, 2012).

The concept of facilities management first appeared in the era of the seventies and eighties of the last century the United States, has developed into an independent industry. The concept of Facilities Management can be traced back to the late 1800s, when the American railroad companies first perceived of the idea of providing facilities as opposed to providing buildings. It was noted that railroads have employed conductors, ticket sellers, engineers, construction workers, accountants, clerks, and payroll officers since the 1800s (Ann-Liisa, 2005).

This literally forms an organization with personnel doing different activities under the same roof. This is when the railroad realized that they need someone who could act on their behalf to coordinate and administer the activities; hence, the emergence of a 'manager.' Coordinating the movement of people and goods, maintaining roundhouses, railroad lines, and stations, and making a profit were now the manager's job (Smithsonian, 1998). This could have been the starting point of origin of the coordinated multi-functional but dispersed firm, which is the basic methodology of a FM organization (Noor, et al., 2014).

As demand for the railroads' services increased, more and more managerial employees were hired and a hierarchy of managers took its place on the corporate organizational chart. By 1840 or 1850, management was a permanent part of the railroads' organization, and managers began to think of railroading as a lifelong career with chances for advancement. This was the beginning of modern business and its offices (Smithsonian Edu, 1998; BIFM, 2010).

Hence the initiation of workplace focus which leads to the arising of the "need" to look into the social welfare of workers, real estate operations and maintenance for the very sole purpose of ensuring sound profitability for the investor through utilization of professional managers who acted on behalf of the owners. This should be considered as the seeding point towards the development of today's facility manager's role (Linda & Joseph, 2007).

Facilities Management is a relatively new profession that some people may not know a lot about either with regards to its current meaning or its history. According to Kent County, Michigan USA FM Department Review (2005), Facilities Management is responsible for planning, development, maintenance, and operations of County owned and leased buildings, infrastructure, and property (Kent County, 2005).

Over the last fifteen years, a diverse mix of office designers, office managers, property managers, building services managers, institutional services managers, consultants in all the above disciplines, commercial suppliers of the different mixes of service and 'in-house' providers have found some common ground in laying claim to being part of FM; a far cry from the office workplace traditions in which the subject originated (Noor, et al., 2014).

Price, (2006) Suggested that the status of Facility/Facilities Management (FM) as a profession or market is still debated in the field of academic inquiry and future direction. This shows the FM subject can be misconstrued and hence, as practitioner of this subject, it is prudent to know how this subject begins in order to be able to understand the true application of FM.

Opportunities/ Prospects of Facility Management in real estate sector in Nigeria

The subject of FM is still new this provides greater opportunities as these have not been established and therefore many areas of FM are more flexible for different techniques and approach practices than in other countries. The opportunities for FM development arise from the following issues, namely (a) the slow economic pace has resulted in slow construction development. Acknowledging the need to increase the construction sector, the government has encouraged consultants and contractors to get involved in more specialized areas, especially in maintenance works and management of services, facades as well as

conservation works in order to ensure that this sector becomes much more competitive in the global world, and (b) the maintenance and services rates are becoming high and FM is seen as a substitute for strategic and proper management that can control and manage overall building costs. In addition to this, FM also provides strategic planning that records all relevant data specific to FM area, (c) for many leading participants in the outsourcing industry today, the well understood tools of performance based or incentive contracting and improved techniques for operational management are now taken for granted as the starting point for services delivered. The top players on both the in-house and industry supply side are now increasingly responding to core business needs. They are doing this by addressing a more strategic challenge using the concepts within the construction industry to construct service agreements that free core business capital tied up in facilities at the same time reducing costs and increasing quality, (d) In several city centres where the city areas are considered dense and compact, disallowing any future construction development to take place. Thus the buildings located within the city centres are forced to be maintained as the cost of demolition is very high. In addition to this, the cost of services and maintenance is also high and therefore FM is seen as an approach to minimize high maintenance cost that may occur due to poor maintenance in the past., (e) Another arising issue is the inability of property or building management to collect the rental rate for space rented, services and bills from the tenants, contributing to insufficient funds to pay for necessary bills. FM is practiced as this can ensure that rental can be collected as a stipulated date, as the failure to provide the rental fee may result in disconnection of services, such as Mechanical and Electrical provided to the tenants. Several opportunities to construct service agreements that free core business capital tied up in facilities, opportunity to Plan for population growth within the estate, involvement in security management, planning for development of buildings in line with strategic objectives, involvement in the decisions of building health and safety requirement, finalize the system and project scope, opportunity to assess the resources available for the estate development, consider staffing plan for managing the estate, involvement in Space management, involvement in Risk management, building code and regulatory compliance, FM is seen as an tool to Essential service provision, projecting the building identity and image of the estate, FM is seen as an approach to Record Preservation of the estate, responding to complaints and suggestions of clients and user's, FM is seen as an approach to minimize high maintenance cost that may occur due to poor maintenance, FM is seen as an approach to the collection of rents as at stipulated date, FM is seen as an approach to identifying new layout for real estate development.

Facility Management is fast growing as a profession and for patronage globally. The need for facility managers as clients to property managers or real estate developers has opened room for the discipline and also the management and maintenance of physical facilities.

The opportunities for FM development globally arise from the following issues, namely

a. The slow economic pace in most developing nations has resulted in slow construction development when compared to the constructions seen in developed world (World Economic, 2011).

Admitting the need to increase the real estate sector, consultants and contractors are encouraged to get involved in more specialized areas, especially in maintenance works and management of services, facades as well as conservation works in order to ensure that this sector becomes much more competitive in the global world (Ezimuo, et al., 2014).

b. The maintenance and service rates are becoming high globally due to sudden give away of buildings into near collapse mostly in developing environments and FM is seen as an alternative for proper management that can control and manage overall building costs.

c. For many leading participants in the outsourcing industry today, the well understood tools of performance based or incentive contracting and improved techniques for operational management are now taken for granted as the starting point for services delivered. The top players on both the in-house and industry supply side are now increasingly responding to core business needs.

d. In some city centres considered to be densely populated and no possibility of any future construction development, the buildings located within the city centres are forced to be maintained as the cost of demolition is very high. In addition to this, due to the cost of services and maintenance being alarmingly high; FM is seen as an approach to minimize high maintenance cost that may occur due to poor maintenance in the past (Akeju, 2007).

e. Another arising issue is the inability of property or building management to collect the rental rate for space rented services and bills from the tenants, contributing to insufficient funds to pay for necessary bills. FM is practiced as this can ensure that rental can be collected as a stipulated date, as the failure to provide the rental fee may result in disconnection of services, such as Mechanical and Electrical provided to the tenants (Akeju, 2007).

f. Facility management as a profession in few decades back is becoming more effective thereby strengthening the standards of our buildings and protecting our national treasures. Legislations are reviewed periodically in built environment as facilities management is also considered as major stakeholders (Usman, et al., 2012). According to Adewunmi, & Ogunba, (2014) other prospect of facility managements in real estate development are:

1. Conservation of built assets
2. Renewal and improvement of works
3. Building operation management
4. Provision and sustenance of space at an economic cost
5. Performance appraisal of properties in your estate
6. Provide satisfying space and internal environment for the entire workforce of the estate
7. Provide satisfying space and internal environment for the support of the core service of the estate
8. Investment appraisal
9. Assessment of property worth in the market
10. Procurement of new construction works and facilities
11. Adaptation of existing structure
12. Contracting out of services in the operations of building and services
13. Asset tracking and register
14. Cyclical maintenance
15. Estate investment programme
16. Estate control plan
17. Estate operational plan
18. Life cycle costing
19. Task implementation monitoring
20. Internal environment monitoring
21. Space design procurement and utilization optimization

Benefits of involving the facility management in real estate development

Durodola (2013) identified the following as benefit of involving facility management in the real estate sector: high real estate performance, functional estates, quality accommodation, adequate and functional facilities, meeting customers' needs, effective security system in place, good and neat environment, Improved health and safety within estates, improved patronage of real estate, extensive responsibilities and authorities for facilities managers, quality services, proactive maintenance, Improved exposure and interaction among real estate operators locally and internationally, strategic planning and implementation all the way, participatory decision making and implementation, national stock of real estate worthy of presentation, qualitative and proactive management of real estate

RESEARCH METHODOLOGY

The researcher of this work aims at using oral interview and structured questionnaires administration to facilities management professionals and other stakeholders in the real estate sector.

The population of the study consist of professionals operating in real estate developing firms in Abuja. These professionals range from builders, architects, quantity surveyors, estate surveyors/valuers and civil/structural engineers.

Sampling Technique and Sampling Size

According to Fellow and Lui, (2007) a sample is required to be consistent, sufficient, efficient and unbiased. Also Abdulazeez (2012) argued that sampling a population is faster, practically less cost and labour intensive than making use of the whole population. According to Real Estate Developers Association of Nigeria (REDAN, 2016) there are five hundred and fourteen (514) registered real estate developers in Abuja and Kish (1965) highlighted that the sample size can be calculated by using the following equation for 95% confidence level.

$$n = \frac{n^1}{[1 + \left(\frac{n^1}{N}\right)]}$$

Where:
n = sample size from finite population
n^1 = sample size from infinite population = $\frac{S^2}{V^2}$

Where S^2 is the variance of the population elements and V^2 is a standard error of sampling population, S= 0.1 to 0.5 and V = 0.05
N = total number of population, S= 0.5 was chosen
$n^1 = \frac{S^2}{V^2}$ =100, N= 514
$n = \frac{100}{[1+(\frac{100}{514})]}$ = 83.3

Thus, a sample size of 83 was determined and the questionnaires will be randomly administered to the estate developing firms.

Questionnaires: The researcher designed both closed ended to avoid deviation from the purpose of the research. These questions are tailored to professional stakeholders in the estate developing firms to sample their opinion on facilities management as a professional and also explore their view of the profession in the real estate sector.

Data Analysis

The data collected from the respondents was analysed statistically by the use of descriptive statistics of frequency, percentages and mean. The following formula was used;

1. Percentage to determine the magnitude of the respondents

$$\% = \frac{n}{N} \times 100$$

2. Mean using the weighted average formula

$$X = \frac{\sum fx}{\sum f}$$

3. **Relative Importance Index (RII)**

Relative importance index was used in the study to rank the factors that affect partnership.

Relative Importance Index (RII) $= \frac{\sum fx}{\sum f} \times \frac{1}{k}$

Where,
∑fx = is the total weight given to each attributes by the respondents.
∑f = is the total number or respondents in the sample.
K = is the highest weight on the likert scale.

The rating of all the prospects for degree of significance was based on the value of their respective relative importance index (RII). The guide for the rating is given in Mbamali and Okotie (2012), as follows: RII < 0.60, item is assessed to have low significance. 0.60 ≤ RII <0.80, item assessed to have high significance. RII ≥ 0.80, items assessed to have very high significance.

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

Questionnaire Design and Response

In order to achieve the objectives of this study, a properly designed questionnaire were distributed. The questionnaires (appendix A) were eighty three (83) and were administered to the respondents that included estate developing firms in Abuja Nigeria. However, not all the questionnaires administered were returned as shown in the table below.

Table 1: Breakdown of Administered Questionnaires

	Respondents
No. distributed	83
No. properly filled and returned	56
Percentage response	67.5%

Source: Field survey 2016

From table 1 eighty three (83) questionnaires were administered to estate developing firms and (56) questionnaires were returned. Based on the assertion of Moser & Kalton (1971), the result of a survey could be considered significant if the response rate not lower than 30-40%. Therefore, the percentage of the returned questionnaires is adequate for analysis.

General Information

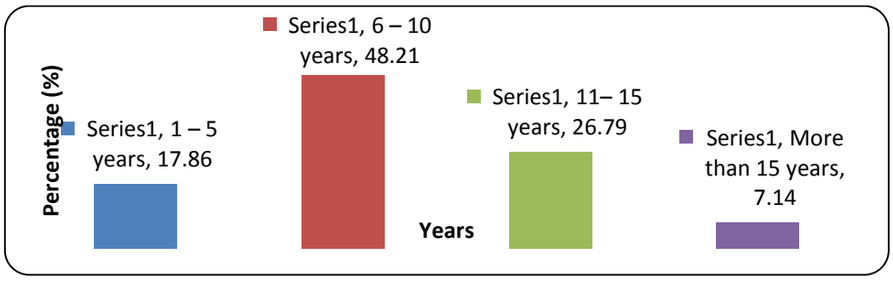
This Section considered certain vital information of the respondents, such as the respondent profession, years of practicing experience in the estate sector. It also includes the respondent's qualification in facilities management and the type of qualification.

Figure 1: Type of Profession

Source: Field survey 2016

From Figure 1 above, architects were the majority of the professionals in real estate developing firms and this was represented with a percentage of 26.79%. Civil/structural engineers and builders both have equal population with percentage of 17.86%. Quantity surveying profession has a percentage of 16.07% and other profession were least with percentage of 7.14%

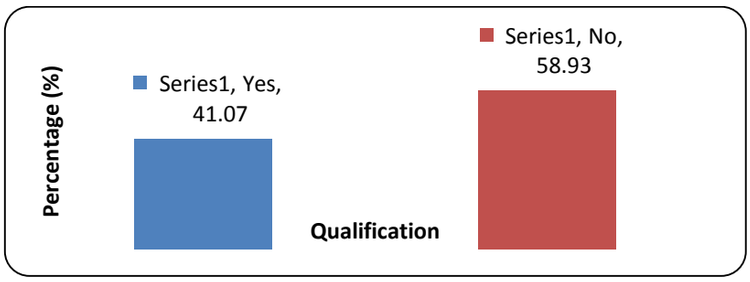
Figure 2: Years of Practicing Experience in the Estate Sector



Source: Field survey 2016

From figure 4.2 above majority of the respondents have been practicing in real estate development for between 6 to 10 years which is represented by a percentage of 48.21%, this is followed by those with experience of 11-15 years (26.79%). 1-5 years of experience have a percentage of 17.86%, while those with more than 15 years have the least percentage of 7.14%.

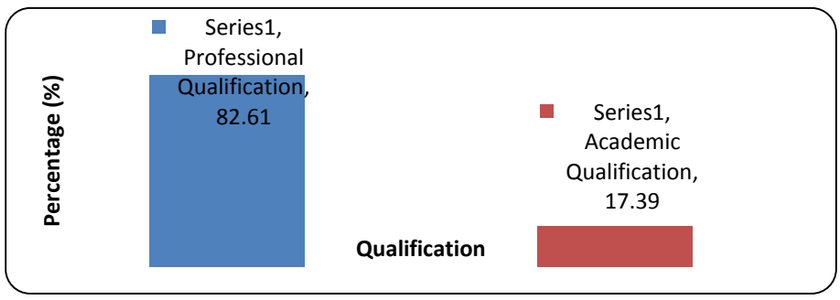
Figure 3: Qualification in Facilities Management



Source: Field survey 2016

From figure 4.3 above showing if the respondents have additional Qualification in Facilities Management. Majority of them (58.93%) do not have any additional qualification in facility management, while others (41.07%) have additional qualification(s) in facility management.

Figure 4: Type of qualification in Facilities Management



Source: Field survey 2016

From figure 4.4 above, among those who have qualification in facility management, majority of them have professional qualification (82.61%) while those with academic qualification have 17.39%.

The Prospects of Facility Management in real estate sector

Table 2: Prospects of Facility Management in real estate sector

s/no	Prospects	Frequency of Response					∑f	∑fx	Mean	RII
		1	2	3	4	5				
1	Conservation of built assets	0	9	15	19	13	56	204	3.64	0.73
2	Renewal and improvement of works	4	11	13	15	13	56	190	3.39	0.68
3	Building operation management	2	6	16	10	22	56	212	3.79	0.76
4	Provision and sustenance of space at an economic cost	4	6	17	10	19	56	202	3.61	0.72
5	Performance appraisal of properties in your estate	3	7	11	18	17	56	207	3.70	0.74
6	Investment Appraisal	0	0	12	24	20	56	232	4.14	0.83
7	Provide satisfying space and internal environment for the support of the core service of the estate	0	0	17	19	20	56	227	4.05	0.81
8	Provide satisfying space and internal environment for the entire workforce of the estate	1	0	16	19	20	56	225	4.02	0.80
9	Assessment of property worth in the market	5	2	17	15	17	56	205	3.66	0.73
10	Procurement of new construction works and facilities	8	0	9	20	19	56	210	3.75	0.75
11	Adaptation of existing structure	2	3	16	17	18	56	214	3.82	0.76
12	Contracting out of services in the operations of building and services	9	2	14	18	13	56	192	3.43	0.69
13	Asset tracking and register	1	1	11	22	21	56	229	4.09	0.82
14	Cyclical maintenance	0	4	17	18	17	56	216	3.86	0.77
15	Estate investment programme	5	5	16	18	12	56	195	3.48	0.70
16	Estate control plan	3	8	9	11	25	56	215	3.84	0.77
17	Estate operational plan	1	5	13	18	19	56	217	3.88	0.78
18	Life cycle costing	9	1	10	16	20	56	205	3.66	0.73
19	Task implementation monitoring	2	5	17	21	11	56	202	3.61	0.72
20	Internal environment monitoring	0	0	19	20	17	56	222	3.96	0.79
21	Space design procurement and utilization optimization	1	9	20	16	10	56	193	3.45	0.69
22	Internal environment modelling	4	0	18	17	17	56	211	3.77	0.75
23	Cost- benefit analysis	8	3	11	9	25	56	208	3.71	0.74
24	Administrative strategy	5	1	16	19	15	56	206	3.68	0.74
25	Condition based maintenance	2	8	11	19	16	56	207	3.70	0.74
26	Response or emergency maintenance	1	3	16	16	20	56	219	3.91	0.78
27	Health and safety monitoring	4	9	13	18	12	56	193	3.45	0.69
28	Cost – in – use assessment	6	5	18	12	15	56	193	3.45	0.69
29	Energy use auditing and control	3	4	19	9	21	56	209	3.73	0.75
30	Life cycle assessment	0	2	21	18	15	56	214	3.82	0.76
31	Estate Data base management	8	10	14	12	12	56	178	3.18	0.64
32	Performance analysis	4	2	16	16	18	56	210	3.75	0.75
33	Investment return rate analysis	3	6	21	8	18	56	200	3.57	0.71
34	Income capitalization	2	8	11	19	16	56	207	3.70	0.74
35	Yield determination	1	3	16	16	20	56	219	3.91	0.78
36	Proper identification of need	4	9	13	18	12	56	193	3.45	0.69
37	Brief articulation	6	5	18	12	15	56	193	3.45	0.69
38	Constitution of Design and construction teams	3	4	19	9	21	56	209	3.73	0.75
39	Contract documentation and execution	0	2	21	18	15	56	214	3.82	0.76
40	Building occupation and evaluations	1	7	13	14	21	56	215	3.84	0.77
41	Work space management	8	0	16	13	19	56	203	3.63	0.73

(where1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree)

From table 4.2 showing the prospect of facility management in the real estate sector, majority of these prospects outlined had high significance as seen: Conservation of built assets (RII=0.73) Renewal and improvement of works (0.68), Building operation management

(RII=0.76), Provision and sustenance of space at an economic cost (RII=0.72), Performance appraisal of properties in your estate (RII=0.74), Assessment of property worth in the market (RII=0.73), Procurement of new construction works and facilities (RII=0.75), Adaptation of existing structure (0.76), Contracting out of services in the operations of building and services (RII=0.69), Cyclical maintenance (RII=0.77), Estate investment programme (RII=0.70), Estate control plan (RII=0.77), Estate operational plan (RII=0.78),Life cycle costing (RII=0.73), Task implementation monitoring (RII=0.72), Internal environment monitoring (RII=0.79), Space design procurement and utilization optimization (RII=0.69), Internal environment modeling (RII=0.75), Cost- benefit analysis (RII=0.74), Administrative strategy (RII=0.74), Condition based maintenance (RII=0.74), Response or emergency maintenance (RII=0.78), Health and safety monitoring (RII=0.69), Cost – in – use assessment (RII=0.69), Energy use auditing and control (RII=0.75), Life cycle assessment (RII=0.76), Estate Data base management (RII=0.64), Performance analysis (RII=0.75), Investment returns rate analysis (RII=0.71), Income capitalization (RII=0.74), Yield determination (RII=0.78), Proper identification of need (RII=0.69), Brief articulation (RII=0.69), Constitution of Design and construction teams (RII=0.75), Contract documentation and execution (RII=0.76), Building occupation and evaluations (RII=0.77), Work space management (RII=0.73)

However, Provide satisfying space and internal environment for the entire workforce of the estate (RII=0.80), Asset tracking and register (RII=0.82), Provide satisfying space and internal environment for the support of the core service of the estate (RII=0.81), Investment appraisal (RII=0.83) were considered to have very high significance.

CONCLUSION

Based on the research findings the following conclusion was made; Facility management has very high prospect in the real estate sector, as all the prospect identified were considered very significant, with investment appraisal as the most significant. The involvement of Facilities management can provide property owners with an integrated management system focused on the efficient management and control of a property or whole portfolio. This therefore imply that with the current evolution and change in facilities management there can be an effective improvement in investment appraisal by creating more emphasis on the continuing value of holding every individual property in the face of change over time as the building ages, taxation benefits are reduced and the cost of maintenance and other recurrent capital expenditure increases. Therefore the research recommends that government and other relevant bodies such as the international facility management association (IFMA) should collaborate in creating a frame work and enforcing legislations that ensures the involvement of facility managers in the Investment appraisal as well as the entire management of estates in the sector, and possibly introduce real estate investment as an integral part of business development and investment courses, as well as in facility management courses, to enlighten the future facility managers of their responsibility in that sector.

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ASSESSMENT OF USER SATISFACTION WITH FACILITIES IN REST-STOPS ALONG KANO-ABUJA HIGHWAY

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Rest – stops are closely linked to highway development in the developed world. They are built primarily, to promote quality of travel experience and safety. However, highway development in Nigeria seems not to tow this line. The available rest–stops are usually incidental spaces, upon which commercial activities developed, hence, they lack formal design and planning. These shortcomings notwithstanding, rest–stop areas appear to be popular among travelers by road in Nigeria, therefore, to further understand the relevance of such locations to travelers, user satisfaction with available facilities in three (3) rest–stops along Kano–Abuja highway were examined. In carrying out the study, 111 questionnaires were purposively administered to patrons of the rest–stops proportionately, based on average passenger inflow per hour in each, to elicit information on the level of satisfaction with facilities in such places and other benefits derived amongst others. The study revealed that though poorly developed; rest-stop areas were well patronized along the route and that 68.33% of respondents (travellers) across all three (3) selected rest-stops were generally satisfied with the range of activities and facilities available. It was also observed that respondents' were unaware of the range of facilities a standard rest–stop should have, a reason which may be responsible for their level of satisfaction with studied locations. Amongst others, the study recommends that highway design and planning in Nigeria should include provisions for standard rest stops, since they have been found to be very useful by the patrons of such facilities.

Keywords: Highway design, rest – stop, road facility, road safety, satisfaction, user

INTRODUCTION

Rest-stop areas are public facilities, located within large thoroughfares and close to highways, at which drivers and passengers can rest, eat or refuel without exiting onto secondary roads (Rest Area History, 2010). They are also referred to as rest and service areas, service stations, service plazas or service centres. In the developed world, rest-stop areas are important components of highway design and planning, wherein concerns related to where they are to be located, how they are to take access, parking capacity, security and safety, landscaping and general management matters are appropriately considered (Rest-Stop Forum, 1999). Because of the perceived importance of rest-stop areas, transport policy development and standards oversight bodies such as Utah Department of Transportation (UDOT) and Department for Transport, Energy and Infrastructure (DTEI) have reiterated the importance of rest-stop facilities and services to fatigue management and general road safety (UDOT, 2007; DTEI, 2003). In Nigeria however, the conscious planning for rest-stops has not really taken root. This situation is similar to many other African countries, except for countries such as Ghana, Kenya and South Africa, where attempts have been made to retrofit rest-stop areas into specially identified routes for specific purposes, such as tourism, even though all are still at the planning stage (Ghana Tourism Board, 1999; Yokoto, 2004; World Bank, 2012). The only attempt at incorporating a rest-stop into highway design and planning in Nigeria is that thought of as part of facilities to be included in developing Lagos – Ibadan express way (Central Bank of Nigeria, 2013), which is still yet to be implemented.

Consequently, it becomes pertinent to invest efforts in studying the attributes of the organically developed and privately owned rest-stops along major thoroughfares, such as the Kano-Abuja highway, mainly because they are providing some semblance of the kind of services rest-stops are expected to provide.

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Hence, it would be quite insightful to explore the satisfaction levels derived by patrons of such areas, regarding the facilities they provide, in other to further understand the relevance of such locations to travelers in the context of Nigeria, since they appear to be popular among road travelers in Nigeria. Therefore, the aim here is to assess user satisfaction with facilities within rest stops along Abuja-Kano highway, with a view to identifying factors that influence level of satisfaction or dissatisfaction of patrons.

The paper consists of eight (8) sections. Section one contains the introduction and the justification for the study. Section two characterizes rest-stops, while section three presents the significance of rest-stops to travellers' safety and overall journey experience. The fourth section contains the methodology of research. The physical, demographic and trip characteristics of the studied rest stops and respondents respectively are presented, in section five. The sixth section contains the results and discussion on findings. The seventh puts forward the recommendations, followed by section seven which presents recommendations, while section eight has the conclusions.

Characterization of Rest-Stops

The American Association of State Highway and Transportation Officials (AASHTO) in a report in 2001 described rest-stops as a "roadside area, with parking facilities separated from the roadway, provided for the motorist to stop and rest for short periods". In the view of the National Association of Australia State and Road Authorities (NAASRA) a rest – stop is no more than a cleared section beside the road with a sign indicating its purpose (NAASRA, 1979). Also, Adesiyun (1980) and Usman (1999) saw rest-stops as supporting facility for travellers and drivers. The basic conception of a rest-stop is similar across the world, even though the facilities they contain and standards applied vary widely, the purpose is mainly to provide a place for motorists to rest, overcome fatigue and seek travel information. Accordingly, there are different categories of rest stops depending on available facilities within them and the purpose for which they have been built.

Rest-stops could be of the types fitted with standard facilities, that may include drinking water outlets, toilets, tables and benches, telephone and information booths and other facilities for travellers, and those with limited or no public facility referred to as parking or scenic areas. In recognition of the importance of rest-stops, AASHTO developed and published a guide for the development of rest-stops on major arterials and freeways of America. The guide provides a structured overview of components necessary to establish and maintain a successful rest-stop program. It describes a comprehensive planning approach to the development of rest-stops and the upgrading of existing ones, to include functional classification and criteria for categorization.

The Department of Transport and Main Roads in the State of Queensland, Australia, in 2014, categorized rest-stops into types A, B, and C, based on their functional requirements which tend to differ according to location, the vehicular mix to be handled, and target users. Type "A" rest-stops usually provide extensive facilities intended to support all potential motorist types, including those wishing to utilize the site for limited camping opportunities. The type "B" sites mainly focus on providing an appropriate number of parking bays with facilities intended to cater for short to medium term rest periods in support of achieving rest during journeys, while type "C" categories are basically locations with adequate number of parking bays at which motorists can safely stop away from the roadway in order to rest. Type "C" rest-stops are provided where on site requirement for facilities is minimal, sometimes because the sites are adjacent to other commercial or civic facilities. Furthermore, the National Association of Australian State and Road Authorities (NAASRA) had attempted a detailed categorization of rest-stops. The categorization is contained in a guide known as NAASRA Guide (1979). According to the guide, a rest-stop area may be one of the following types;

i. *Wayside Stops*, which are small areas where vehicles may park for a short time, usually fitted with fireplaces and rubbish bins.
ii. *Rest-Stops*, which are designated stop areas for vehicles, where general services such as fireplaces, picnic tables, drinking water outlets, toilets and shelter are provided.
iii. *Truck Parking Areas*, usually areas clear of the carriageway of a road provided primarily for the parking of trucks. Generally, rubbish bins are the only facility provided at these stops.
iv. *Service Centres*, represent places where personal and automotive services are available to travellers. Personal services refer to the availability of food and drink, resting facilities, toilets, picnic areas, public telephones and information. Automotive services include the supply of fuel, oil, water, running repairs and breakdown services.
v. *Commercial Service Centres*, which are usually provided by private bodies. These centres can provide an array of services including petrol and motor repairs, restaurants, accommodation, refreshments, camping areas and caravan parks.

Other requirements and parameters, such as contained in Table 2.1, have been used to classify rest-stops, for instance, rest-stop classification in the USA is based on functional need assessment, as shown in Utah state wide rest stop area plan (2007) and the Montana rest stop area strategy plan (2004), similar to the Australian model, where the main considerations in rest-stop classification are type of vehicles to be served and facilities provided. A different classification model is utilized in

Canada, where rest-stops are classified based on average daily traffic served. However, it is pertinent to note that, facilities and amenities within rest-stops are typically the same for commensurate categories, irrespective of method of classification in use.

Table 2.1: Queensland Desired Standards and Facilities for each Rest Stop Type

Facilities	Heavy vehicle			Motorist		
	Type A	**Type B**	**Type C**	**Type A**	**Type B**	**Type C**
All-weather seal	Yes	Yes	Gravel	Yes	Yes	Gravel
Separation for vehicle types	Yes	Desirable	Where Possible	Yes	Desirable	Where Possible
Separation for long term/short term visitors	Yes	Desirable	No	Yes	Desirable	No
Bins	Yes	Yes	Yes	Yes	Yes	Yes
Natural shade/trees (where available)	Yes	Yes	Yes	Yes	Yes	Yes
Tables/chairs	Yes	Yes	Yes	Yes	Yes	Yes
Shelters/artificial shade	Yes	Yes	Yes	Yes	Yes	Yes
Toilets	Yes	Desirable	No	Yes	Desirable	No
Lighting	Yes	Desirable	No	Yes	Desirable	No
On-road signage	Yes	Yes	Yes	Yes	Yes	Yes
BBQ	No	No	No	Yes	Where Possible	No
Playground	No	No	No	Yes	Where Possible	No
Private camping allowed (20 hr max)	No	No	No	Yes	As Appropriate	No
Caravan dump point provided	No	No	No	Yes	Where Possible	No

Source: *Best Practice Guide for Roadside Rest Areas in Queensland* (2014)

Significance of Rest – Stops to Travellers' Safety and Overall Journey Experience

One of the significant roles rest-stops play is the improvement in safety it fosters, attributed to reduction in driver fatigue and fewer vehicles on the shoulder of highways. For instance, Jean (2001) estimated that a 10 min stop every hour would significantly reduce the incidence of road accidents. King (2000) also stated that the presence of properly spaced rest- stops would significantly reduce the number of drivers needing to park on road shoulders, and even attributed the 52 percent increase in road shoulder related accidents in the United States of America to the absence of rest-areas on some interstate highways. More so, the Montana rest-stop area strategy plan also put forward that driver-fatigue and accident rates were reduced by 3.7 percent after the development of rest –stops along highways in five states of the United States of America (USA). The reduction was established to have directly contributed to a national annual savings of over 200 million dollars in road traffic accident related damages. In addition, Drory (1985) opined that rest-stops serve to enhance safety by reducing the psychological effects of other adverse conditions that compel drivers to stop, by providing a safe refuge under hazardous weather, roadway, or visibility conditions.

Other benefits of rest-stop areas such as the comfort and convenience it affords travellers tend to increase quality of travel experience. Also the direct monetary revenue derived from rest-stops, the highway operation and maintenance benefits, the commercial motor vehicle and staging benefits, and the economic and tourism development benefit of rest - stops, is said to have prompted the planning and development of such areas in countries such as U.S.A, Canada, Australia and some parts of Europe and Asia (Jean, 2001; King, 2000). Garder and Nicolas (2002) also aver that rest-stops are facilitators of commerce and tourism and thus contribute to revenue generation, thereby arguing for rest-stop areas to be conceptualized, not only as rest zones, but also as commercial zones. In addition to the aforementioned advantages, rest-stops have other features that contribute to tourist's experience, which can complement inner city facilities, when tourists stay at the outskirts of towns or cities. Additionally, rest areas can help peddle the image of a nation to travellers, because when tourists stop at unplanned and ill serviced rest-stops, the image of the country as a whole would be rather negative. On the other hand, well-planned and maintained rest-stops will provide a good impression on travellers, therefore, rest – stops should be an important element of consideration in highway design and planning.

METHODOLOGY

The main methods used to gather information on the main data parcels for this study are field inspection, observation and questionnaire administration. Observation was used to determine vehicular inflow rates for each rest-stop through vehicular count. This was done along with

determining the number of occupants per vehicle, targeted at determining average inflow of passengers per hour into the rest areas and average number of occupants per vehicle, this exercise guided the amount of questionnaires that were administered per rest stop, with respect to the overall sample size as depicted in Table 4.1. Concomitantly, field inspection yielded an inventory of facilities and general physical development characteristics of the rest-stops, which aided the listing of facilities for respondents' to rate. The respective sample size used for each stop area was determined using Zemke and Kramlinger sample size table for population (1986) as cited in the Ohio State University Bulletin of 1990. Lastly, the opinion of users' regarding identified facilities available in the rest-stops was then sought after using predesigned questionnaires. The instrument utilized the Likert scale to measure the degree of satisfaction of respondents regarding facilities at the rest – stops, with responses ranging from Extremely Satisfied to Extremely Dissatisfied. The Likert scale was adopted for this study because it is a popular and acceptable method of gauging feelings, fears, willingness, preferences and perceptions towards identified phenomenon or conditions (Key, 2002). The questionnaires were administered purposively to willing respondents, until the required number of valid questionnaires for each rest -stop was attained.

Table 4.1: Average Number of Travellers at Rest-Stops

Rest Stop Area	Average Inflow of Vehicles Per Hour	Average Number of Persons in a Vehicle	Population	Sample Size
Dan Kande	120 vehicles	3	120 x 3= 360	40
Annur	80 vehicles	3	80 x 3= 240	27
Barakat	100 vehicles	4	100 x 4= 400	44

Table 4.1 shows the average hourly inflow of vehicles, which are mainly cars, wagons and buses, and the average number of persons in the vehicles counted. Trucks are not accommodated, because they cannot turn into the studied location, nor would they have enough room to maneuver within Dankande, Annur and Barakat rest stops respectively. Hence, none were captured.

After collating all responses, the weighted mean value of total entries for a particular facility, say water facility, is calculated by multiplying the scaling value on the Likert scale with the actual values derived from tallying responses. This is then divided by the total number of scaling values on the Likert scale, as shown in equation 1, which is five (5) in this case. Next, the cut-off point for deciding positivity or negativity of user satisfaction was determined in line with Kittleson and Associates (2013) suggestion using equation 2. With this, the general cut–off point for deciding positivity or negativity of satisfaction was established to be 3.0, meaning that any weighted mean value above 3.0 indicates level of positivity of user satisfaction and below 3.0 indicates level of negativity of user dissatisfaction. A weighted mean of exactly 3.0 describes user satisfaction level that is neither positive nor negative.

$$Q = \sum \frac{(5*1)+(22*2)+(4*3)+(10*4)+(3*5)}{44} = \frac{116}{544} = 2.63 \qquad (1)$$

Where; Q is the calculated mean value.

N = Number of respondents for each stop = 40, 27 or 44 and 111 for cumulative.

fx = Overall X value derived from multiplying Likert scaling variables (SV), that is (1,2,3,4,5) by their respective frequencies, representing the degree of satisfaction or dissatisfaction from Extremely Dissatisfied (ED), Dissatisfied (D), Undecided (UD), Satisfied (S), and Extremely Satisfied (ES). Equation 2 depicts how the general cut – off point for level of satisfaction is derived.

$$Q = \sum \frac{fx}{N} = \frac{15}{5} = 3.0 \qquad (2)$$

Physical Characteristics of Studied Rest – Stops

Three rest-stops namely Barakat, Dankande and Annur were studied, each at different stage of development, with varying physical attributions and array of facilities. The general outlook of each rest-stop is discussed in the following sections.

Physical Characteristics of Barakat Rest Stop

Barakat rest stop is located 106 Km from Abuja, about 56 Km to Dankande rest stop and 125 Km to Annur rest area, which is the closest to the Kano end of the highway. Barakat rest-stop has a mosque and a block of 22 close-up shops offering different kinds of services ranging from food, drinks, provisions and steak meat (suya) among others. There are also temporary sheds owned by individuals or shared by a group of people used as rest sheds for hawkers and other service providers. Plate I depicts the general outlook of Barakat rest-stop. The access roads are basically of laterite finish. The outstanding space is also covered with laterite which serves as both parking area and walk way. Structured or natural shades are largely absent. There are no picnic benches and tables, just as playground equipment were conspicuously unavailable (see Plate II).

Plate I: Close-up Shops at Barakat Rest-Stop

Plate II: Mosque, Circulation and Parking Area

Other available facilities are 22 urinals for male and 8 for female, there are also the same number of toilets available for each gender. Here, three separate restroom facilities are reserved for dignitaries; it means one can infer that some important personalities also patronize the rest-stop. No lighting facility for illumination at night are available, also no fire response unit, health booth, nor internet services are available. However, potable water and electricity are available at Barakat rest stop, the water source is a borehole and electricity is from the national grid, complimented with generators.

Physical Characteristics of Dankande Rest Stop

Dankande is 56 Km away from Barakat rest-stop and 69Km to Annur rest area. Dankande rest area has a range of facilities offering different services. The only permanent buildings at the site are the shops (Plate III), fuel station and mosque (Plate II).

Plate II: Mosque at Dankande Rest-Stop

Plate III: Retail Sheds at Dankande Rest-Stops

The shops at Dankande rest –stop numbered 78, offering restaurant services, provisions, suya, artefacts and toys, the rest area is covered with natural vegetation forming natural shades, and ground surface is covered with asphalt creating all weather access roads for vehicles and parking spaces, although there are no defined walk ways (Plate IV). The facilities available include a picnic area with benches and tables for use of patrons (Plate VI).

Plate IV: Landscaped area at Dankande

Plate V: Parking Area and Refuse Bin at Dankande

Plate VI: Dankande Picnic Area

There are a total of 20 urinals for male and 10 for female, 9 toilets for male and 7 for female. Here too, three separate toilets are reserved for dignitaries. Additionally, there is a fuel station within the precinct of the rest stop and noticeable among the facilities provided are rubbish baskets located at different spots. Water and electricity are sourced from borehole and the national grid respectively. Similar to Barakat rest area, there are no lighting points for night time use, there are also no fire response unit, health booths, nor internet services are available.

Physical Characteristics of Annur Rest Stop

Annur rest area is 69Km from Dankande, 162 Km from Barakat and 145km from Kano. The mosque is the only permanent structure, within the rest –stop area precinct (Plate VII and VIII).

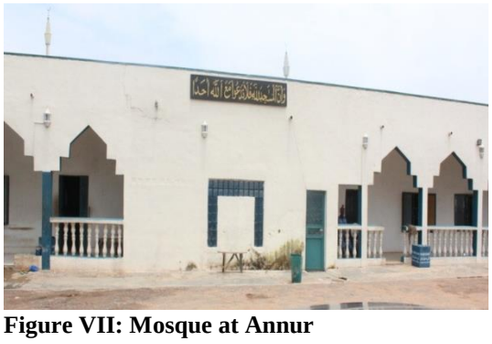

Figure VII: Mosque at Annur

Figure VIII: Annur Shops

There are 22 shops offering different functions similar to other studied rest areas. Here too, there is no structured shade, shade is provided only by a few threes, and there are no picnic benches and tables as in Barakat. Playground equipment was also notably absent in the rest-stop (Plate IX).

Plate IX: Annur Landscape and Parking Area

Restroom facilities available at the site are 20 urinals for male and 6 for female which are all devoid of roofing, however, the 5 toilets for male and 6 for female are with roofing. There are also no lighting facilities for night time illumination. There is potable water and electricity at the rest stop, sourced from water vendors and the national electricity grid, complimented with generators.

Demographic and Trip Characteristics of Respondents

By gender, male users dominate across all rest stop areas. Cumulatively, 61% of the respondents were males, against 39% that were females. It is easy to tie this to the fact that generally the male gender seems to be the most mobile. In the same light, 71.11% of the respondents' are within the 26 – 65 years age range. This agrees with the general belief that this age range falls within the active,

working class population. In terms of educational standing, 81% of respondents' were educated beyond primary school, 35% of whom stopped at secondary school level. Those educated beyond secondary school tend to be more receptive to answering questions. Table 5.1 gives a breakdown of the demographic characteristics of the respondents.

Table 5.1: Demographic Characteristics

Gender	Dankande	Annur	Barakat	Total (%)
Male	57	65.15	62.16	61
Female	43	34.85	37.85	39
Age				
16 -25	25	9.1	40.54	27.43
26 – 45	59	51.51	44.14	51.26
46 – 65	15	36.36	14.41	19.85
> 65	1	13.03	1.5	1.44
Education				
Primary	17	11.22	18.87	17
Secondary	23	29.04	48.84	35
University/College	44	15.18	25.53	30
Postgraduate	16	10.56	17.76	16

Source: Authors' field survey, 2014

In terms of trip length, 62.51% of respondents' across all rest stops had travelled in excess of 201 Km before stopping at the rest -areas, which meant that majority of the respondents' were well into their journey before making the stop. This underscores the need to develop rest stops at strategic locations, so as for travellers to have the advantage of resting and refreshing, two needs that are known to improve driver alertness, and as a result driver safety. Table 5.2 depicts respondents' trip length across all rest stop areas. It was also found that travellers from north-west moving towards Abuja prefer to transit at Barakat, while those heading towards north-west mostly transit at Dankande and Annur mainly due to trip length covered.

Table 5.2: Distance Covered by Respondents' before Stop at Rest Areas

Trip Length (km)	Barakat (%)	Dankande (%)	Annur (%)
Less than 100	23.42	24	15.15
100 to 200	11.7	15	24.2
201 to 299	45.2	37	45.4
>300	21.2	24	15.1
Total	**100**	**100**	**100**

Source: Authors' field survey, 2014

RESULTS AND DISCUSSIONS

Level of User Satisfaction with Rest- stops

Mainly six (6) different facilities were found to be available in the rest – stops, these are access roads, fuel filling station, religious facility (mosques), toilets and urinals and potable water sources. With regards to user satisfaction, the availability of religious facilities is one of the main reasons respondents" stop at Barakat rest stop, 70% of the patrons of Barakat rest – stop were either "satisfied" or "extremely satisfied" with the availability and quality of the mosque provided by Barakat rest stop. The same pattern is reflected in Dakande rest stop, where 72.5% of the respondents' were also either "satisfied" or "extremely satisfied" with the availability and quality of the religious facility provided by Dakande rest stop. In terms of overall level of influence on patronage, religious facilities ranked 1st for both Barakat and Dankande rest – stop areas with a mean value of 3.63 and 3.72 respectively. Only in the case of Annur rest-stop was religious facility the 3rd in terms of influence on patrons' decision to stop at the facility. Table 6.1 depicts actual values for patrons' level of satisfaction regarding religious facilities in all three rest –stops.

Table 6.1: User Satisfaction with Facilities in Rest- Stops

Utilities and Services	1= ED		2=D		3=UD		4=S		5=ES		(Q)M
	F	%	F	%	F	%	F	%	F	%	
Barakat Rest- Stop											
Potable Water	5	*11*	22	*50*	4	*9*	10	*23*	3	*7*	**2.63**
Toilet Facility	8	*18*	9	*21*	10	*23*	12	*27*	5	*11*	**2.93**
Electricity Supply	3	*7*	8	*19*	6	*14*	19	*44*	7	*16*	**3.40**
Access Roads	3	*7*	3	*7*	11	*25*	21	*48*	6	*13*	**3.40**
Religious Facilities	3	*7*	2	*5*	8	*18*	26	*59*	5	*11*	**3.63**
											n = 44

Dankande Rest – Stop											
Potable Water	8	*20*	18	*45*	1	*2*	11	*28*	2	*5*	**2.33**
Toilet Facility	7	*17.5*	13	*32*	7	*17.5*	9	*23*	4	*10*	**2.80**
Electricity Supply	4	*10*	7	*17.5*	0	-	24	*60*	5	*12.5*	**3.50**
Access Roads	2	*5*	4	*10*	8	*20*	17	*42*	9	*23*	**3.70**
Fuel Filling Stations	3	*7.5*	7	*17.5*	6	*15*	19	*45*	5	*13*	**3.40**
Religious Facilities	2	*5*	3	*7.5*	6	*15*	22	*55*	7	*17.5*	**3.72**
										n = 40	
Annur Rest – Stop											
Potable Water	1	*4*	5	*19*	2	*7*	17	*63*	2	*7*	**3.51**
Toilet Facility	7	*26*	9	*33*	2	*7.5*	7	*26*	2	*7.5*	**2.60**
Electricity Supply	4	*15*	5	*18.5*	2	*7.4*	13	*48.1*	3	*11*	**3.22**
Access Roads	2	*7.5*	3	*11*	6	*22*	14	*52*	2	*7.5*	**3.40**
Religious Facilities	3	*11*	6	*22*	3	*11*	12	*45*	3	*11*	**3.22**
										n = 27	

Source: Field survey, 2014

The state of the access road into the rest stops is another thing that tends to influence patrons of rest – stops. This is shown in the fact that 13% of respondents' were "extremely satisfied" with the access roads into Barakat, 14% for dankande and at Annur, 52% of the respondents' were satisfied with the state of the access road into Annur rest – stop, even though Annur rest – stop still had the highest proportion of "dissatisfied" patrons (11%) with the access road compared to the other two rest – stops. From Plate IX, it can be observed that the access road into Annur, along with the parking area is laden with pot holes, some of which are filled with water. This probably explains the level of "dissatisfaction" reported by the respondents. For Barakat, access road posted a mean value of 3.40, which shows that it has a positive influence on decision of respondents to stop at Barakat, and it is the second thing after religious facility. The same applies for Dankande and Annur where the mean values are 3.70 and 3.40 respectively, both representing the second position for each stop.

In terms of toilet facilities, 18% of respondents' in Barakat rest stop were "extremely dissatisfied" with the state of the toilets and urinals, another 21% were also "dissatisfied" making a total of 39%. Only 27% of respondents were satisfied with the state of toilets and urinals provided in Barakat rest stop, another 23% were "undecided". The outlook for Dankande is similar to Barakat, a total of 60% of the respondents' were "extremely dissatisfied", "dissatisfied" or "undecided". Only 10% of respondents were "satisfied" with the state of the toilets and urinals in Dankande rest stop. The case of Annur is such that 59% of the respondents" are "extremely dissatisfied" with the state of the toilet and urinals in Annur rest stop, with only 7.5% of respondents' attesting to their satisfaction with the toilets and urinary in the rest stop. The toilet facilities in all three rest stops had a mean of 2.93, 2.80 and 2.60 for Barakat, Dankande and Annur respectively, which meant that they fell below the cut – off point of positive satisfaction level, coming in at 4^{th}, 5^{th} and 5^{th} places for among facilities in Barakat, Dankande and Annur respectively. An explanation for this might be the pervasive attitude among travellers in Nigeria to relieve themselves by the roadsides and in nearby bushes, due to the bad state in which toilets and urinary in public places are usually in.

As for electricity supply 74% of respondents' were either "undecided", "satisfied" or "extremely satisfied" with electricity supply at Barakat rest stop. For Dankande rest stop, 60% of patrons were "satisfied", while 12.5% were "extremely satisfied" with electricity supply, meaning that 72.5% of respondents' were altogether "satisfied" with the state of electricity supply at the rest stop. Similarly, Annur rest – stop posted high "satisfaction" rates in terms of electricity availability, 66.5% of respondents' were okay with the state of electricity supply at the stop. Availability of electricity is important to travellers because it enable them recharge their portable gadgets, like mobile phones, flash lights and other hand held devices. It also guarantees availability of cold refreshing drinks and other provisions. It is therefore not surprising that respondents' ratings posted mean values of 3.40, 3.50 and 3.22 for Barakat, Dankande and Annur rest stop respectively. This meant that availability of electricity has a positive influence on the decision of patrons to stop at the rest areas, to the extent that it is second mostly considered thing for patrons of Barakat rest stop and the third for both Dankande and Annur rest areas.

Another thing that seems to bother patrons of the rest – stops is availability of potable water. As for water supply, only Annur rest – stop area was adjudged to be "satisfactory", to which 77% of patrons attested to. The availability of clean water for personal use from a public source is responsible for this. Barakat and Dankande rest areas had 70% and 65% of respondents "dissatisfied" with the state of water supply in the rest stop areas, mainly because they have to purchase water for personal use. The mean values turned out are 2.63, which is the fifth and least influencing factor for Barakat, 2.33 for Dankande, which also turned out to be the sixth and least influencing factor on patrons' decision. Only in the case of Annur was the figure above the 3.00 cut – off point, posting a figure of 3.51, which turned out to be first of the five facilities considered.

For the overall level of user satisfaction for the three (3) rest stops, Table 6.2 presents the weighted mean figures that show the level of influence of each facility found in the rest areas. It is apparent that religious facilities and good access roads/parking areas were the facilities with the most influence on patrons' decision to stop at the rest stops. The two facilities both posted mean values of 3.60 each, which are the highest. Availability of electricity followed with a weighted mean value of 3.40, thereby coming in as the third most important consideration by respondents'. It is surprising that water supply came below the cut – off of relevant needs of respondents, with a mean value of 2.81, only above, toilet facilities. This may be explained by the fact that some travellers carry their own supply of water or purchase water at the shops available at the rest – areas, which they do not consider as complimentary service. The general bad state of the toilets and urinary also explains its position as the fifth and least considered facility, with a mean of 2.70.

Table 6.2: Overall User Satisfaction with All Rest- Stops

Utilities and Services	1= ED		2=D		3=UD		4=S		5=ES		(Q)M
	F	%	F	%	F	%	F	%	F	%	
Portable Water	14	*13*	45	*41*	7	*6*	38	*34*	7	*6*	**2.81**
Toilet Facilities	22	*20*	31	*28*	19	*17*	28	*25*	11	*10*	**2.70**
Electricity Supply	10	*9*	20	*18*	8	*7*	56	*52*	15	*14*	**3.40**
Access Roads	7	*6*	10	*9*	25	*23*	52	*47*	17	*15*	**3.60**
Religious Facilities	8	*7*	11	*10*	17	*15*	60	*54*	15	*14*	**3.60**

Source: Field survey, 2014 **n = 111**

It is also worthy to note that only in the case of Dankande rest – stop is a fuel filling station within the precinct of the rest –stop, a phenomenon 45% of the respondents were "satisfied" with, and another 13% "extremely satisfied" with. Although, 7.5% of respondents' were "extremely dissatisfied" with this situation, the facility still turned up a mean of 3.40, putting it in the fourth position in terms of factors considered by respondents' in Dankande.

RECOMMENDATIONS

The study revealed that two (2) facilities of the five (5) found to be common in all rest stops were sources of unsatisfactory impulses. Only three (3), which include religious facility, access road/parking area and electricity supply were respondents' satisfied with. The relevance of this facilities to travelers is in the opportunity they provide them to refresh themselves and take intermittent rests, during journeys, and also the chance the rest – areas provide to fulfill religious obligations, hence, for user satisfaction of the studied rest stop areas to improve. It is recommended that access to clean and portable water, especially for other purposes order than drinking be improved. Also, since it was found that the state of access roads/parking areas is important to visitors, it becomes expedient that rest stop owners pay special attention to them, so as to improve patronage. Waste disposal practices need also improve as observation revealed that rest – stops appear cleaner when fitted with waste bins. Aside from Dankande rest – stop, where the minimal provision of waste bins is noticed. Other rest – areas lack this.

One very important inference from this whole exercise is that, even though the rest – stops have far less facilities than those of equal standing in the developed world. The stop – areas seem to provide the minimal needs of travelers in Nigeria. It then shows that, it is possible to come up with local standards that would help improve efficiency of these rest areas, without necessarily, benchmarking with international standards, which may require huge sums to implement. A local standard that would improve health and safety features of these organically developed rest – stops might be the first thing to start with. Lastly, the ministry of transport and its works and housing counterpart, need to start including rest – stop areas as part of supporting facilities, while rehabilitating or constructing new roads. This would serve to improve safety and general travel experience.

CONCLUSION

Overall, the study highlighted the importance of user satisfaction studies to the continued sustenance and improved management of rest – stops. It also identified the actual factors that are influencing the decision of patrons of the studied rest – stops. The need for proper design and planning of rest stops as complementary facility for highways is also apparent for Nigeria, so as to begin to take even more advantage of their significance. In terms of fostering driver alertness and general road safety, as attested to by several road safety standard monitoring agencies. Hence, the Nigerian system should also respond accordingly.

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EVALUATION OF HEALTH IMPLICATION OF OFF-CAMPUS RESIDENCE AS A SUSTAINABLE ALTERNATIVE IN TERTIARY INSTITUTIONS

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The importance of housing in any sphere of human endeavour cannot be over emphasised, and its use has evolved from being a mere means of sheltering human from environmental elements to being a setting for biological, social and psychological development. However, meeting this essential need of human has continued to be problematic in Nigerian Institutions of higher learning. This is because the yearly increase in the student's population is not met with corresponding increase in the number of student hostel which has created a severe housing deficit in tertiary institutions and this is being filled to a large extent by private hostel developers. This research paper is aimed at the evaluation of facilities and their maintenance provided by these off-campus residences, the physical design of buildings and facilities they provide on the basis of comfort, conformity to standard and health implication on students. The study area is the Akanu Ibiam Federal Polytechnic, Unwana and Ebonyi State University Abakiliki. Out of 100 questionnaires issued out to students, 80 usable questionnaires were collected back from respondents, and statistical techniques were then used to process the data using charts and tables. The study revealed that a lot need to be done in terms of design, maintenance and management of off-campus hostels, so that they do not become death traps for the occupants. Among other recommendations are: off-campus residents should be well designed to ensure adequate functionality and comfort, especially in the area of cross ventilation; security of properties and lives of people, and the state of facilities provided in the off-campus residences should be made a priority.

Keywords: Evaluation, Facilities, Health, Residences, Tertiary Institutions.

INTRODUCTION

Adequate housing is universally viewed as one of the most basic human needs (United Nations, 2007) and this holds true for students in tertiary institutions. According to Akingbohungbe and Ojo (2005), man's need for housing is a direct response to a legitimate and natural need for a safe and conducive environment for living, but for students in tertiary institutions, housing is more than just a place to shelter from harsh weather and social vices. To them housing plays a more psychological role than physical; it is an asylum for mental recuperation and articulation.

Student residence can be categorised into two types and these are: student on-campus residence and student off-campus residence (Owolabi, 2015). On-campus residence refers to student housing in the campus or school, while off-campus residence is student housing outside the campus of higher institution. Student residence is an important part of institutions of learning. Globally, students' enrolment in higher institutions has been increasing in recent times, and it is estimated that there has been about 160% increase in tertiary education (Sharma, 2012). However, in many countries of the world, the provision of accommodation for tertiary students continues to remain a challenge for the government (Centre for Global Education, 2002). As a result of this, one of the important issues of concern to the management of education is the issue of students' accommodation. To this end, for a typical low-income university student, the place that is been called home is often ends up being less than ideal.

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This is often as results of carelessness in the design, cleanliness, upkeep and maintenance of the structure and living environment by both the students and management/landlords. In many developed and developing countries, governments are not able to adequately provide accommodation for students in higher institutions. As a result of this, other educational stakeholders do support government efforts, either in partnership with government or by solely providing private accommodation facilities for tertiary students on or off-campus (Centre for Global Education, 2002). The situation of the participation of the private firms in the provision of affordable student accommodation has been a major concern to educational and marketing management as it possesses challenges to them in ensuring that the accommodations or facilities of students they provide meet the required standards and conditions and enhances the learning capacity of students.

In Nigeria, student residence was traditionally on-campus (Akingbohungbe and Akinluyi, 2012). However, with time student population explosion gave rise to development of commercial off-campus student residence in towns of universities and polytechnics across the country. The increasing rate of the development of off-campus student residence has been very significant and therefore, there is a need to evaluate their sustainable performance given the amount the charge compared to on-campus hostels. On-campus rents in government own tertiary institution range from 10,000 to 15, 000 naira per academic session. The table 1.0 shows that students living in off-campus hostels pay far higher than their on-campus counterpart.

Table 1.0: Annual Range Distribution of Off-Campus Residents.

S/N	Annual Rent	Frequency	Type Of Residence
1	20,000 – 30,000	20	Single room
2	30,000 – 40,000	10	Single room
3	40,000 – 50,000	12	Single room/self-contain
4	50,000 – 60,000	11	Self-contain apartment
5	60,000 and above	25	Self-contain apartment

Student residences in Nigeria have reached a crisis level. The main cause of this problem is the increasing number of students being admitted without a commensurate increase in the number of student residence (Owolabi, 2015). This situation has been aggravated by the absence of affordable and safe alternative residence in neighbourhoods surrounding universities (Agbola, Olatubara and Alabi, 2001).

For a building to be sustainable it must be conducive for the present occupants without causing any damage to their health, and it must also be conducive for future occupants too. Sustainable development can be defined as development that meets the needs and aspiration of the present without compromising the ability of future generation to meet their own needs (Butlin, 1989). Thus, if a building damages the health state of its occupants, it cannot be said to have met his/her need and therefore such building is not sustainable. Globally, housing is considered the most primary diseases and high mortality and morbidity rates causative agent (United Nations, 2007). For instance, exposures to damp indoor environments have adverse health effects on humans such severe allergic reactions, asthma and cough (Dales, Miller and McMullen, 2003; Kilpelainen, Terho, Helenius and Ksokenvuo, 2007); in 2004, the American Institute of Medicine of the National Academy of Sciences declared damp indoor environments "a public health problem" (Institute of Medicine, 2004). Therefore, this paper is aimed at examining the health, physical and psychological impact of off-campus residence on students as well as their facilities and maintenance as alternatives to on-campus hostels in Akanu Ibiam Federal Polytechnic, Unwana and Ebonyi State University Abakiliki. Sustainability in this research is not focused on the availability of these off-campus hostels but emphasis is laid on its ability to meet the required need of the students occupying them without leaving any harmful footprint on their health.

METHODOLOGY

Out of 100 questionnaires issued out to students, 80 usable questionnaires were collected back from respondents living in various off-campus hostels in the two institutions under study. This gave 80% return rate of the questionnaire. Most of the sample questions demanded YES or NO answers while a few were structured to measure the satisfaction level of responds on key issues. For the later, responses were measured on four-point Liker scales,

with responses ranging from “very dissatisfied” to “very satisfied”. Statistical techniques were then used to process the data using charts and tables. All data were collected between July and August, 2017.

FINDINGS AND DISCUSSION

Building Related Illness

The environment we live be it outdoor or indoor has direct impact on our health, comfort and productivity. One of the rising concerns in building is a phenomenon called the sick building syndrome. Building related illnesses (BRI), sick building syndrome (SBS) and allergy and environmental problems in buildings can have direct and indirect impact on health, work place comfort and productivity of the occupants (Singh,2015). BRI is defined as the illness caused directly as the result of being in and around the building environment. Building related illnesses and stresses can be caused by a number of factors individually or a combination of their synergetic effects. These factors could be Biological, Physical, chemical, organisational and management, Psychological and Psychosomatic factors.

However, the key among these factors is the quality of the indoor environment (Singh, 2015). The indoor environment is a conglomeration of a plethora of pollutants that can pollute the indoor air quality significantly, the effects of which may impinge on the health of occupant or the synergetic effect of these factors may be the cause of health related problems in buildings. However, if proper design consideration is given to cross ventilation, the indoor quality can be significantly improved. Cross ventilation in a room is achieved by ensuring that at least two opposite or adjacent walls in the room have adequate window opening for proper air circulation. Failure to do this can make the room to be stuffy, promote the growth of bacterial, cause thermal discomfort to occupants and can lead to the occupant feeling sick most often. Figure 1 shows an example of a cross ventilated building design.

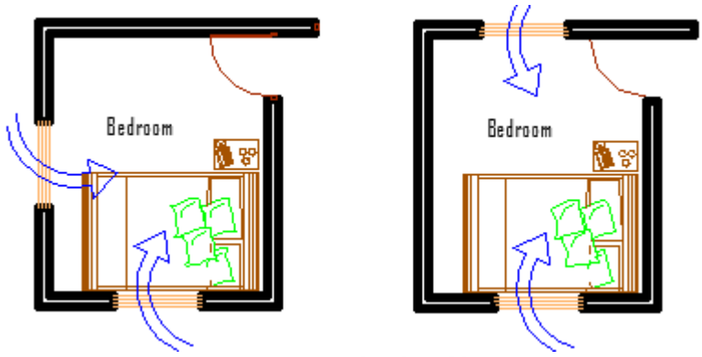

Fig. 1: Cross Ventilated Building Design

This present research investigation has revealed that most hostel design employ the impluvium form in their design. This involves a double array of rooms on both sides with a small court yard sandwiched in between them. Figure 2 shows a typical floor plan of Grace Villa Hostel in Unwana. It lacks cross ventilation and generator fumes from small portable generating set are also major cause of air and noise pollution.

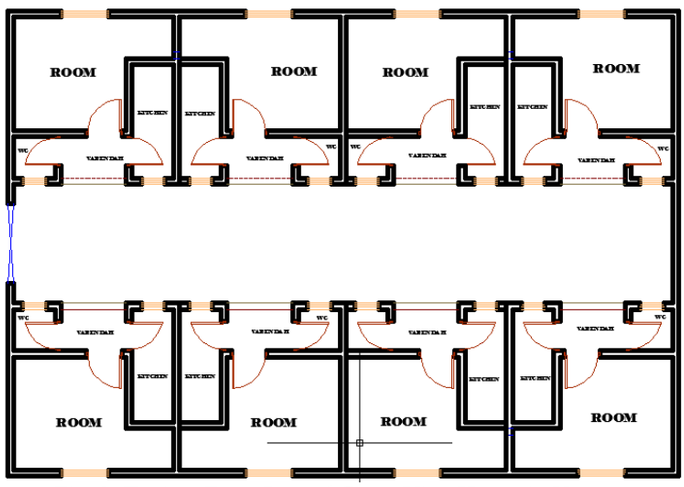

Fig. 2. Typical Floor Plan of Grace Villa Hostel in Unwana

Raising the indoor air temperature for comfort had led to an increase in skin diseases, such as atopic conditions, respiratory illnesses or allergies, indicating that human comfort levels may have a negative impact on health (Sundell, 2009). Furthermore, it was suggested that pollutants in the air have a 2–5 times greater negative impact on residents performing activity versus outdoor activity (Programme Needs for Indoor Environments Research (PNIER), 2005).

Beside cross ventilation there are many other factors that influence the indoor environment within buildings and these include the choice of building materials, infestation by insect, pests and other forms of biological organisms and the efficiency of service equipment.

The figure 3 shows a high level of insect and rodent infestation in the hostels. Apart from mosquitoes that are common in the tropical rainforest region, a high level of rodent such as rats as well as cockroaches was found. Rat is known to be a common carrier of dangerous diseases such as:

- Leptospirosis.
- Hantavirus pulmonary syndrome.
- Rat-bite fever.
- Salmonellosis.

Other diseases indirectly transmitted by rats include: Plague, Colorado tick fever and cutaneous Leishmaniasis.

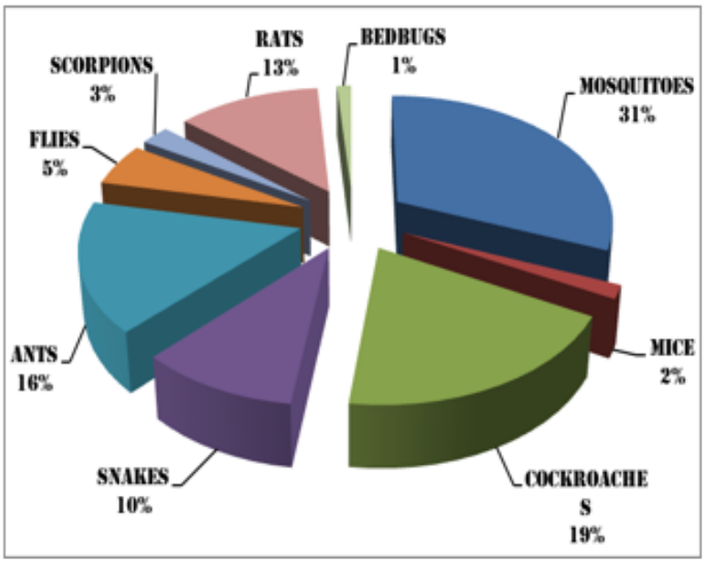

Fig3: percentage distribution of pest in hostels

Sanitary and Waste Disposal

Refuse dumps, open drainages, broken septic tank and inspection chambers are some of the major breeding grounds for rodents and cockroaches. Generally waste management in Nigeria is a major issue and the off-campus residences are no exception. This research showed that out of 100 off- campus hostels that were studied, only three hostels have a standard dumpster for waste disposal. This implies that 97% of the hostels studied do not have installed any standard dumpster for refuse disposal. This presents a serious environmental and health risk to the student as a result of air pollution. Figure 4 shows that 26% of respondents complained that they perceive the unhealthy odour from the nearby dumpster. This may also be responsible for the high rate of cough cholera and diarrhea diagnosed within the last academic session (see table 2.0). Poor waste disposal could also lead to blockages of drainages leading to stagnant collection of pools of water bodies, and these stagnant water bodies' acts as breeding ground for mosquitoes which may have led to high incidences of malaria.

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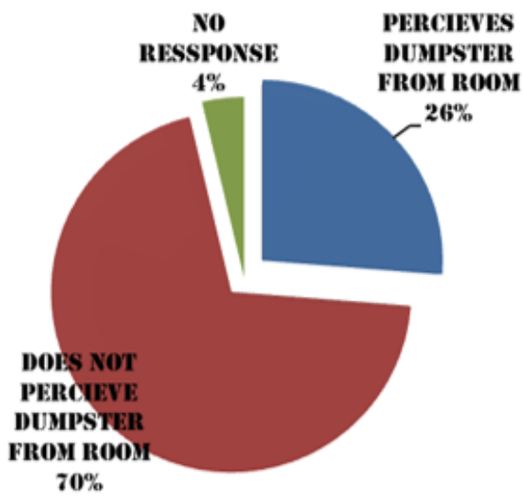

Fig 4: illustration of the people that perceive their dumpster from their rooms

Table 2.0: Commonly Diagnosed Diseases in the Past One Year.

S/N	Diagnosed diseases	Number of cases
1	Malaria	58
2	Cough	29
3	Diarrhea	1
4	Measles	3
5	Chicken pox	3

Maintenance in Off-Campus Residents

The maintenance of students' hostels whether on or off-campus has great influence on the hostel facility and in turn influences the user's satisfaction and performance (Noraza & Iftekha, 2015). Therefore, the maintenance of the hostel is an important factor in the sustainable performance of students' off-campus residents. According to Onyike and Uche (2010), hostel maintenance is the combination of all technical and associated administrative action intended to retain or return it to a more functional state. Maintenance could be planned or unplanned. Planned maintenance is a proactive action taken in accordance with predetermined schedule, while unplanned maintenance on the other hand is a reactive action taken when there is an unexpected breakdown or damage.

Common Maintenance Issues in Hostels`

Table 3.0 above illustrates some of the common defects observed in the hostels that were studied. Some of the defects such as broken pipes and septic tank can lead to serious outbreak of epidemic such as cholera and diarrhea. 30 and 21 respondents report the presence of molds and damp interior respectively. This is a very worry statistic because molds and damp interior are very dangerous to the health of occupants. From this defects analysis, it is therefore concluded that off-campus residences are not properly maintained. In 2004 the American Institute of Medicine of the National Academy of Sciences declared damp indoor environments "a public health problem (Institute of Medicine, 2004)." The challenge that was discovered is that students do not know the health danger they face by exposing themselves to molds and damp interior. Hence, they do not seek for repairs of such defects on time. From figure 5 above, 59% of the respondents did not even realise that they needed to request for repairs to be carried out by the Landlords. However, out of the 32% that requested for repairs only 9% were granted.

Table 3.0: Annual Range Distribution of Off-Campus Residents.

S/N	Defects	Frequency
1	Broken pipe	7
2	Broken septic tank/inspection chamber	5
3	Molds on wall	30
4	Broken windows	13
5	Broken stairs/ handrail	12
6	Faulty wires	38
7	Dampness inside room	21

8	Cracks on walls	25
9	Cracked floor finishes	17
10	Faulty ceilings	2

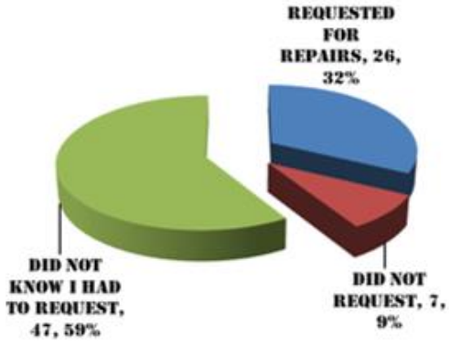

Fig 5: Maintenance Chart.

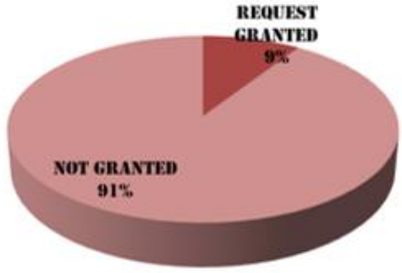

Fig 6: Percentage of Maintenance Request Granted.

Student Satisfaction on the Quality of Service

According to Sirgy (2007), the satisfaction of the student to the quality of their residence is a key factor in their educational success. He opined that residence satisfaction contributes to overall life satisfaction of the university students. Though, Stauss and Neuhaus (1997) noted that it is impossible for a person to be truly satisfied with his or her life based only on where he or she resides. Students with higher satisfaction levels enjoy higher retention and graduation rates, lower loan default rates and increased alumni donations (Billups 2008). Greater residence satisfaction can be attained through a homelike housing atmosphere rather than an institutionalised environment (Thomsen, 2007). The table 4 shows some of the key factors that contributes to the satisfaction level of students.

Table 4: Satisfaction Ranting of Occupants

S/N	Satisfaction Variable	Very Dissatisfied	Dissatisfied	Satisfied	Very Satisfied	Total
1	Satisfaction with waste management	34	31	8	9	80
2	Satisfaction with annual rent	3	10	20	47	80
3	Satisfaction with electricity supply	64	30	4	2	80
4	Satisfaction with water supply	44	30	4	2	80
5	Satisfaction with security at the hostel	43	27	7	3	80
7	Satisfaction with facilities provided	40	26	10	4	80

From table 4, it can be deduced that the only variable that has a satisfaction rate above 50% is the annual house rent, while security of properties and lives of people, and the state of facilities provided has the lowest rating. This implies that students are not satisfied with the security of properties and lives of people, and state of facilities provided.

CONCLUSION AND RECOMMENDATION

Adequate housing is universally viewed as one of the most basic human needs. However, Sustainable housing should not only be viewed on the basis of availability of houses, but it should also include the safety and affordability of such houses. Having studied off-campus residence as a sustainable alternative to student hostel in tertiary institutions, it was discovered that a lot need to be done in terms of design, maintenance and management of off-campus hostels, so that they do not become death traps for the occupants. The study revealed that the majority of the hostels that were studied do not have a standard dumpster for refuse disposal. This presents a serious environmental and health risk to students as a result of air pollution. Most of the off-campus residences lack cross ventilation, and generator fumes from small portable electric generating set are also major cause of air and noise pollution. A high level of insect and rodent such as cockroaches and rat infestation was found in the hostels. Off-campus residences are not properly maintained, Students do not know the health danger they face by exposing themselves to molds and damp interior. Hence, they do not seek for repairs of such defects on time. Most of the respondents did not even realize that they needed to request for repairs to be carried out by the Landlords. Students are not satisfied with the security of properties and lives of people and state of facilities provided in the off-campus residences.

It is therefore recommended that:

i. Every off-campus residence should be compelled by the relevant authorities to provide standard dumpsters that must be evacuated daily.

ii. Off-campus residents should be well designed to ensure adequate functionality and comfort, especially in the area of cross ventilation.

iii. The supply of public electric power should be improved in Nigeria to discourage the use of small portable electric generating set that are one of the major causes of air and noise pollution in the off-campus residences.

iv. The environment of the off-campus residences must be kept clean at all times to discourage a high level of rodent such as rats as well as cockroaches and to also discourage the high level of insect and rodent infestation in the hostels.

v. Off-campus residences should be properly maintained.

vi. Students should be educated about the health danger of exposing themselves to molds and damp interior and they should also be educated to know how to seek for repairs of defects on time.

vii. Security of properties and lives of people, and the state of facilities provided in off-campus residences should be made a priority.

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USER SATISFACTION WITH INFORMAL SPACE EFFICIENCY IN SELECTED OFFICE BUILDINGS IN LOKOJA KOGI STATE NIGERIA

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End users participation in the design of informal spaces in office building is not always included as most of the decisions are made by the professionals and the management. Suitability of users need is the main expectation of any spatial design. Office environment is evolving with changing nature of working condition and the growth in technology. Hence the use of informal spaces in office environment to strike a balance between work time and leisure becomes necessary. Despite this development, informal spaces have been observed to be relegated to the background in office building provision. The problem therefore is that users of these spaces are finding it increasingly difficult to perform their duties conveniently due to the degree of adaptation they could adjust to within the building. The aim of this research is to examine the user's satisfaction with the efficiency of informal spaces in office buildings. The research adopted the mixed method with the use of structured questionnaire and observations schedule. The data was analysed using descriptive satatistics tool on SPSS-21 software and the results transferred to tables and charts using Microsoft Excel-2010. The results show the dissatisfaction of the users of informal spaces in office building. It also revealed that informal space efficiency will improve user satisfaction with office buildings. The paper concluded that to achieve informal space efficiency in offices there is need to reorganize and increase the sizes of these spaces coupled with proper spatial differentiation.

Keyword: efficiency, informal space, office building, satisfaction, user

INTRODUCTION

Informal spaces link up the homogenous, staged, controlled, 'official' public spaces and private spaces of the office buildings. They are referred to in various discourses from the realms of architecture, planning, design and urban theory as 'terrain vagues' (De Sola Morales. 1995). However, they are overlooked, and are often relegated as no specific office function is attributed to it, (Doron 2000). These spaces lie outside the zones of official use and occupation, existing somewhere between the commercial, recreational and sometimes circulation zones of the office building. By definition, such spaces are non-prescriptive (Doron, 2000). The time spent in the office by gainfully employed person ranked second to home (Schweizer et al., 2007; Leech, Nelson, Burnet, Aaron, & Razenne, 2002). An average of eight hours is spent daily in office environment by workers. Adedeji and Fadamiro (2012) posited that workers comfort level (visual comfort, spatial arrangement, security and overall workstation comfort) is affected by both the internal and external work place setting. As such it can be tiring if there is no provision for spaces in office buildings that allows for some rest and cool off at some point during working hour and especially during break period.

The management of some establishment usually seeks to provide spaces within the office environment. Therefore ensuring the efficiency of these informal spaces provided for the users is of paramount importance. This can be achieved through a design process that allows for information regarding them be collated and used in the design parameters. The need for efficiency of informal office space is very important because its effectiveness on workers' productivity cannot be over emphasised.

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Audu & Eze (2018). **USER SATISFACTION WITH INFORMAL SPACE EFFICIENCY IN SELECTED OFFICE BUILDINGS IN LOKOJA KOGI STATE NIGERIA.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

Informal Office Space Provision

In line with the Property Framework (2014) individual establishments are responsible for their own accommodation arrangements. Therefore, it is important that the management (especially) the end users participate fully in the design process. If the management are not fully engaged but property officers delegated solely to handle the task, substantial innovation highly and efficient informal space is more difficult and less likely to occur. Figure 1adaptec from the UK Resource Management guide (2014) illustrates the responsibilities of respective sectors at each level of an organisation in the design process. Stakeholder engagement across the organisation is vital in delivering best-fit accommodation solutions that addresses user needs and ensure user buy-in to the cultural change process.

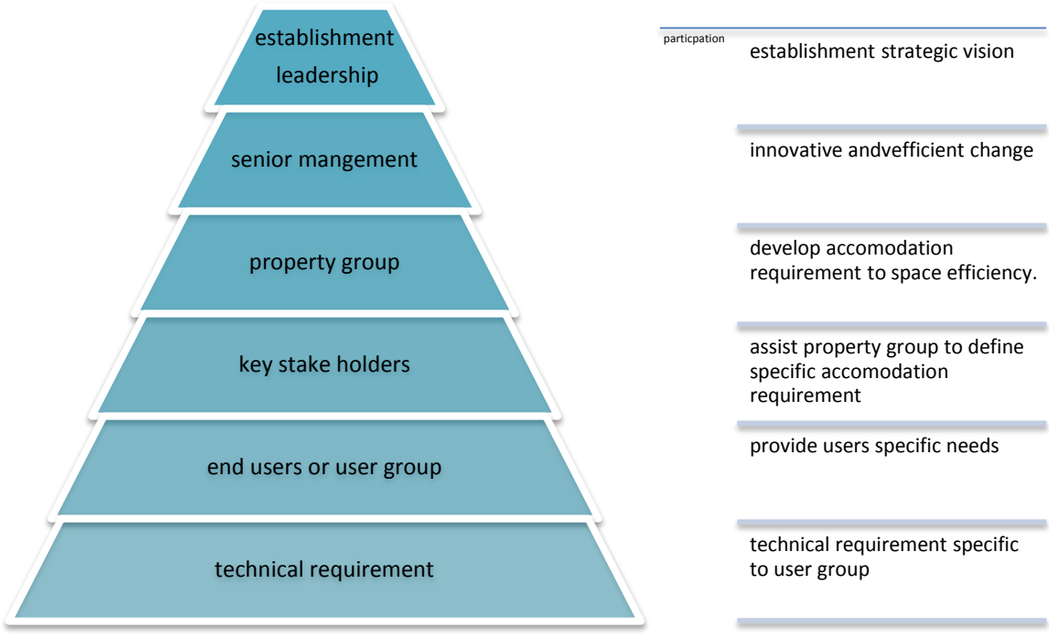

Figure 1: Responsibilities at each level of an organisation in informal space provision
Source: Resources Management Guide (2014)

It is worthy of note that this illustration is generic and does not represent any particular organisation structure. The stakeholder engagement process must give users the opportunity to participate in and have a real effect on decisions about the new workplace and its culture. Workplace design must take into account what, where and when work is undertaken. For the best design and management outcomes the design process should be interactive between the senior management of the agency, designers, project managers and the users. In addition, there must be ongoing mechanisms to track emerging user issues and usage patterns and to develop and maintain operating protocols.

Overview of Efficiency for Informal Space in Office Building

Informal spaces in office building need to be efficient and able to adapt to the growth, movement and changes in operations and technology. Efficient informal spaces also need to respond to both the needs of the individual and the employers, adjusting to when, where and how tasks are performed. Efficiency of informal space is needed in office environment to increase productivity thereby improving competitive advantage of an establishment (Naseem, Sheikh, & Malik, 2011 and Newsham, Brand, Donnelly, Veitch, J., Aries, & Charles, 2009).

Efficiency of informal spaces in office buildings depends largely on it level of flexibility Gilbert (1996), Nawawi & Khalil (2008}. Flexibility is not only facilitated by the physical space for example through setup of offices, fixtures and fittings but also where and how an individual may work on a task-by-task basis. Individual's physical location will depend on concentration/collaboration needs; what team members need to be consulted and in the wider sense, on work/life balance considerations.

In Nigeria, the type of informal spaces provided in office environment is largely dependent on the nature of the office building and the demand for office space. This is because even part of the informal spaces may be reorganised to create an office space when the need arise. This practice was found to be very common in public office buildings. Table 1 obtained from a preliminary study shows the nature of the type of office and the specific informal spaces

provided among them and Table 2 shows the population per square metre of each of this spaces.

Table 1: Nature of Offices and the Informal Spaces Provided in Them

Types of office	Number Informal spaces available									
	Café	lounge	Waiting area	Restaurant/dining	Outdoor spaces	forum	courtyard	Recreation centre	garden	total
Public	5	3	5	3	5	3	4	1	2	31
Private	4	3	5	2	3	0	0	0	2	19
total	9	6	10	5	8	3	4	1	4	50

Source: Author's field work, 2017

Table 2: Population per square metre of the Informal Spaces

Types of office	Population of the spaces									
	Café	lounge	Waiting area	Restaurant/dining	Outdoor spaces	forum	courtyard	Recreation centre	garden	total
Public	15	9	12	20	53	17	20	25	15	186
Private	10	6	10	18	23	0	0	0	8	75
total	25	15	22	38	76	17	20	25	23	261

Source: Author's field work, 2017

Space efficiency can be achieved through flexibility in design. Three important considerations in efficient space design according to Space Management Group (2006) are:

1. The quantity of space, generally calculated in terms of floor area though occasionally volume may also be relevant
2. The number of users, potential and actual
3. The amount of time the space is used.

There is no one-size fits all approach efficient informal office space installations as each application should be tailored to reflect the business model and activities of the establishment.

The many elements for consideration in delivering typical office solution can be classified under the following areas.

1. The physical solution – the fitout, furniture and configuration of the whole space.
2. The virtual solution – the technology supporting communication and mobility in the workplace.
3. The organisational and management solution and the workplace culture they underpin.

As the beneficiaries of an efficient informal space in office building, it is very important to seek the user's perception. The current level of informal spaces in office building cannot be said to be efficient due to the overall treatment of the space as mere extra space in the building. They are often treated with reckless abandonment. It would therefore be important to seek ways of ensuring that the current spaces are efficient enough to meet demand of the office users so that workers' productivity can be increased through its usage. This provides the base for evaluating the perception of efficiency in offices as this would assist in ensuring that key issues are tackled at the design stage by the people involved in office buildings in Nigeria in general and Lokoja, in particular.

METHODOLOGY

The method adopted for this research is post occupancy evaluation method (POE). Here, user's opinion is sought on the situation under study. POE has been adopted generally as a means of obtaining user's perception of built environment (Adedeji & Fadamiro 2012). According to Zimmerman and Martin (2001), with POE specific aspect of detailed planning and design has been tested. Their impact on building users was also investigated with respect to several parameters such as: health and safety, security, indoor environment quality and functions.

Lokoja in Kogi State in Nigeria was selected for the study on the basis of the wide spread of public and private office buildings in the area. The study was conducted on both private and

public office buildings (see table 3). This enabled the researcher to obtain data from both side and also to be able to establish comparative analysis on this trend in both public and private office setting. A questionnaire was developed and administered to the users of these informal spaces. The respondents were drawn from 10 office buildings (five each for both public and private office buildings) out of a population of 25 office complexes (15 for public and 10 for private) in lokoja, Kogi State. A total of 55 questionnaires were returned from the 100 copies administered. This gives a return rate of 55%. The breakdown of the return showed 20 returned questionnaires from the 50 administered to the private offices given a return rate of 40% and 35 returned from the 50 administered to the public offices giving a return rate of 70%. Selection of respondent was done based on the population of office buildings under study at the time of administering the questionnaire. This gives a true representation of the perceptions of the users of the informal space. Data was collated, sorted out based on the buildings studied. It was coded and analysed for descriptive satatistics using SPSS version (21) with the output further presented in tables and charts. Likert scale was used in the rating of user's perception with the view of establishing a finite decision upon which the recommendations of the research was based.

Table 3: Office buildings studied

Name of office buildings	
Public office buildings	**Private office buildings**
Kogi state secretariat complex	News agency of Nigeria (NAN) complex
Lokoja local government secretariat	Tec engineering office complex
Kogi state civil service commission	Equity plaza office complex
Industrial training fund office complex	Gtbank lokoja, kogi state.
Firs kogi state office complex	Salem university senate building

Source: author's field work, 2017.

RESULT AND DISCUSSION

From the result it is clear that users' perception of informal spaces in office building varies widely in terms of individual assessment. The combination of all the individual assessment gave an average perception of the measurement. The first part discusses the likert scale of measurement with the subsequent part offering discussions on the selected specific cases.

The Likert Scale of Measurement of Informal Spaces in Office Building

Choice of the perception of the user was measures on a weigthed scoring 1 – 4

The rating for this scoring are:

Very dissatisfied 1

Dissatisfied 2

Satisfied 3

Very satisfied 4

Table 4 shows that measurement scale of satisfied and dissatisfied have the highest number of respondents. The number of respondents in each section is multiplied by the weighted score allocated to it. The calculation for this is shown in Table 4 and the total score across the rows are added up and presented as the total at the end of the table.

Table 4: Respondents' Responses on Perception Efficiency of Informal Office Spaces Measured.

Variable measured	Very dissatisfied (X1)	Dissatisfied (X2)	Satisfied (X3)	Very satisfied (X4)	total	mean	interpretation
Sizes of the spaces	11	42	51	24	128	2.33	dissatisfied
Types of openings in spaces	8	54	39	8	109	2.18	dissatisfied
The geometry of the spaces	4	32	42	64	142	2.84	satisfied
Daylighting in the spaces	10	48	51	16	125	2.27	dissatisfied
Height of ceiling	9	48	63	4	124	2.25	dissatisfied
Furniture arrangement	8	46	69	4	127	2.31	dissatisfied
Furniture hierarchy	4	58	48	16	126	2.38	dissatisfied
Wall finishes	5	50	51	12	118	2.36	dissatisfied
Floor finishes	7	46	66	8	127	2.35	dissatisfied
Integration level	9	52	57	4	122	2.22	dissatisfied

Calculation of the result obtained based on Likert scale is interpreted thus:

1.0	-	1.49	Very Dissatisfied
1.5	-	2.49	Dissatisfied
2.5	-	3.49	Satisfied
>	3.5		Very Satisfied

The majority of the users were dissatisfied with all the variables of measurement for informal spaces provision except geometry of the spaces; variables like sizes of spaces; type of opening; daylighting in the spaces; wall and floor finishes; furniture arrangement and hierarchy did not meet with the users' satisfaction. Also of concern is the level of integration of the users which was found to be low based on the study. This is due to the fact that a well fitted and furnished informal space will always be efficient irrespective of the geometry of the space. Most informal spaces simply require a large space and convenience to maximise efficiency. On comparing both public and private office complexes, similar trend repeated itself. However while general dissatisfaction is felt on both public and private office complexes, the level of efficiency of informal spaces available generally differs. Therefore, there is need to examine the relationship in the efficiency of informal spaces in office buildings between selected variables in both the public and private office buildings.

Efficiency of Informal Space Rating Based in Office Building

Cost of infrastructural provision establishment is very exorbitant. Therefore, the tendency to maximise resources usually leads to informal spaces in office building being neglected when it comes to allocation of resources. Hence it is not uncommon to see the space allocation to informal spaces being either too small or not well equipped to maximise its use in most of the office complexes. Some level of disparity exists between the percentage of the users who are satisfied with the informal provision and those who are dissatisfied. Figure 2 shows high level of dissatisfaction with the users of the informal spaces in private office buildings was due to the small space available for them that ranged between 12 m^2 to 20 m^2 this affected the arrangement possibilities within the space.

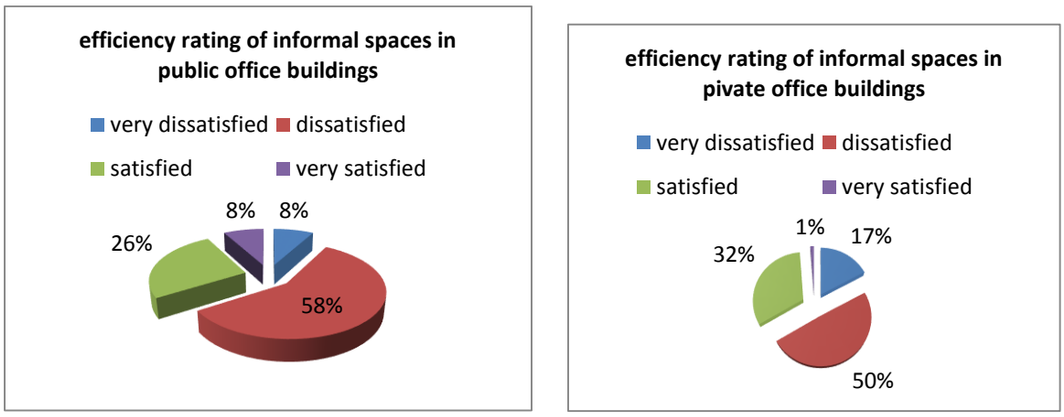

Figure 2: Users' satisfaction rating of informal spaces in office building
Source: Author's field work, 2017

There were cases where day lighting provisions to the spaces were insufficient for visibility let alone for maximum comfort. This accounted for some of the level of users' dissatisfaction on informal spaces in private office complexes. Figure 2 further revealed that efficiency is not just the requirement of those in public offices but also in private offices.

Efficiency of informal space rating based on the user group

There are two major user groups in informal spaces in office buildings. They are usually the staff (administrative staff and the program staff) of the office complexes. The difference between these user group lies in there office functions and task designation. The administrative staff that handles the management aspect of the whole office setup tends be more rigorous when compared to the programme staff. This also varies from establishment to establishment. In figure 3 it can be observed that the percentage of users that were dissatisfied with the informal office spaces is slightly higher in the administrative staff category. This can be understood because majority of the administrative staff interviewed found the available informal spaces to be inadequate. They also complained of inadequate space for relaxation and day lighting in the spaces. In the case of the program staff, their lack

of satisfaction has to do with the arrangement of furniture and the furniture hierarchy they are restricted to due to the lack of flexibility in the informal spaces provided. The administrative staff also complained level of integration of the informal spaces with the official working areas

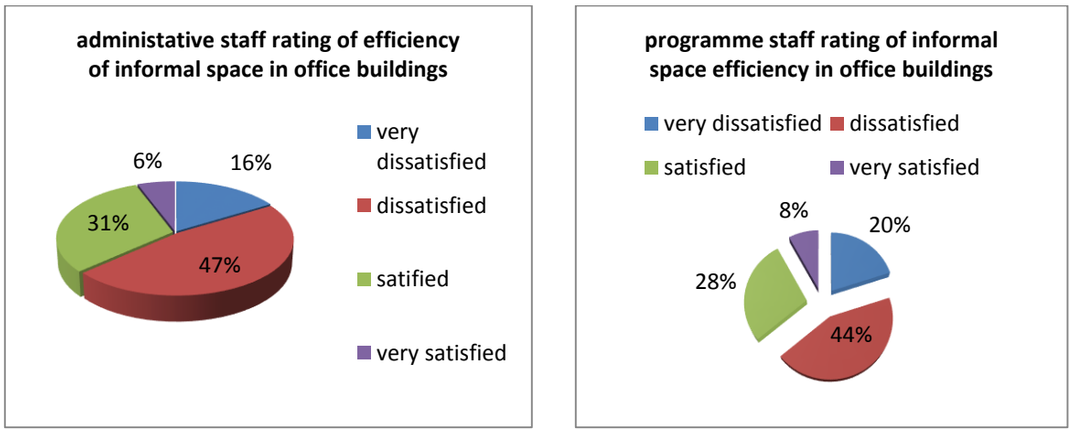

Figure 3: Users' satisfaction rating of informal spaces in office building based on user group
Source: Author's field work, 2017

Perception of level of integration rating of the informal spaces with official working area.

The major concern with most of the office complexes visited was the level of integration of the informal spaces provided with the official working areas (administrative and programme working areas). Many users complained that the informal spaces were not well lit to accommodate informal working condition. This is due to the sizes of the openings which inhibits the day lighting in the spaces. There is significant increase in the percentage of dissatisfaction among the users in the level of integration of the informal spaces in the office complexes as shown if figure 4. In the case of those that were dissatisfied in integration with the administrative working area, there major concern was the lack of flexibility in the special configuration. In an attempt towards achieving significant amount of integration, many users usually seek to reconfigure the spaces to suit their immediate need.

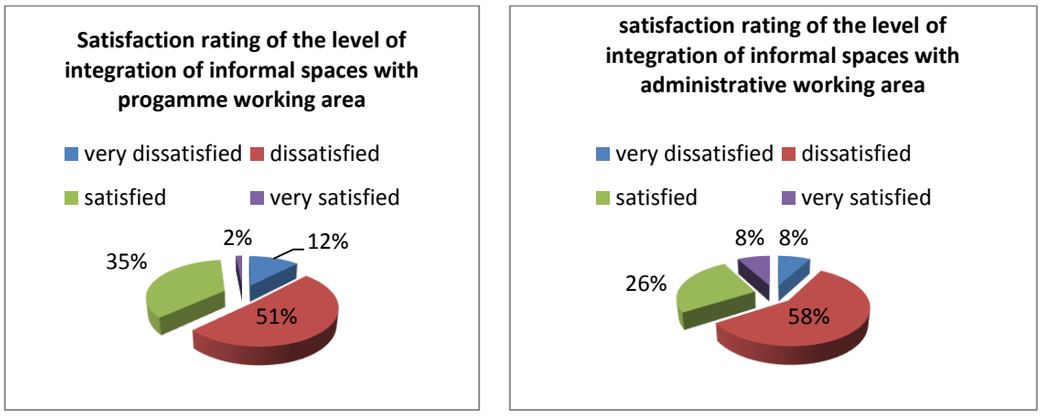

Figure 4: Users' satisfaction rating of level of integration of informal spaces in office building with official working spaces.
Source: Author's field work, 2017

CONCLUSION AND RECOMMENDATION

The management of these establishments should include user's perception in the provision of informal spaces in office buildings. It is also important that this spaces so provided are efficient. Requirements for informal space efficiency should form the core of the design process. The good option is for management to begin to examine how they could make the current available informal spaces efficient enough to allow for acceptance by the current occupiers such that they would be satisfied with the spaces hence reducing the demand for newer spaces on the account of dissatisfaction of the current one. Principles of informal space efficiency should be considered by property Architects so that such that this spaces scan can fit into the current trend of working environment. In conclusion, poor level of satisfaction of users leads to poor productivity. It is therefore recommended that users/occupants should be allowed to make inputs in design of office spaces and the arrangement of the existing offices.

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POST-OCCUPANCY EVALUATION OF STUDENTS HOSTEL FACILITIES IN FEDERAL UNIVERSITIES IN NORTH CENTRAL NIGERIA.

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The availability of adequate student facilities in Universities generally and hostels in particular is one of the key factors that have effects on the overall academic performance of students on campuses of institutions of higher learning. The social integration of students contributes to the overall satisfaction of students. The hostels in the Federal Universities of Nigeria and North Central in particular are not measuring up to the modern needs of students in the provision of students housing and it is not certain that Post-Occupancy Evaluation has been carried out as regard to hostel users' needs. The study assessed student's facilities in hostels of Federal Universities in North Central Nigeria with the aim of reviewing the present status of student hostels in order to improve on students living conditions. The data was gathered by the use of questionnaire and observation schedule and the SPSS software was used to analyze the results. The research concludes that overcrowding, inadequate spaces, non availability of recreational spaces and lack of internet services are challenges in hostels. The study recommends that there should be a periodic Post Occupancy Evaluation of the facilities in hostels of Federal Universities to determine the adequacy and state of the facilities for improvement where necessary.

Keywords: Facilities, Satisfaction, Students hostel, Universities.

INTRODUCTION

Student Hostel is an accommodation that is specifically designed to accommodate students, such as a 'live-in' residential college, boarding house or other purpose built development containing student units with other combined use ancillary facilities which includes; study areas, communal lounge, bathrooms and kitchens). These forms of development will be assessed as student accommodation or a boarding house (Adelaide City Council's Student Development Plan Policies (2007).

The hostels in the Federal Universities in Nigeria and North Central in particular are not measuring up to the modern needs of students in the design of hostels and it is not certain that Post-Occupancy Evaluation has been carried out as regard to hostel users' needs. The hostel might have been designed with standards that satisfied the demand of the earlier users but no longer supportive of today's students' needs due to the modern trend in the social facilities, educational facilities and increase in population in student hostels. The fact that a study-bedroom in the student hostel originally designed for 4 users is now occupied by at least 8 users makes it overcrowded. In the same vein there is need for change in spatial requirement and organization in the existing hostels and subsequent hostel designs to conform to the new trend of hostel design for comfort and satisfaction. There is need therefore to provide students hostels with modern day facilities for the general well being of occupants because students can perform well in their studies if they have good, comfortable living environments on their campuses (Amole, 2005; Hassanain, 2008).

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According to the National University Commission (NUC) 2003, the numbers of students who seek admission into Nigeria Universities are on tremendous increase yearly with no facilities in the Universities to accommodate the students.

The study aims at reviewing the present status of student's hostels with the following objectives; to determine user's level of satisfaction with hostel space and facilities, to determine the most preferred design for space and use in hostels and to eradicate/reduce the current accommodation problems suffered by students in the universities in order to improve on students living conditions.

Table 1.1: Hostel Accommodation Needs in Federal Universities in Nigeria.

Federal Universities	Total Student Enrolment (2002/2003)	Total Number of Available Bed Spaces	Percentage of Students Accommodated	Percentage of Accommodation Shortfall
University of Nigeria Nsukka	27901	11230	40	60
University of Lagos	32987	7500	23	77
Ahmadu Bello University, Zaria	28842	13645	70	30
University of Ibadan, Ibadan	21093	9415	45	55
Obafemi Awolowo Univ.	2217	9614	43	57
University of Benin, Benin City	25958	6880	27	73
University of Jos	12581	3248	30	70
Nnamdi Azikiwe University, Awka	17960	250	2	98
Bayero University, Kano	23607	6000	26	71
Univ., of Ilorin, Ilorin	18488	3820	21	79
University of Maiduguri	20272	8436	41	59
University of Calabar, Calabar	23252	4088	18	82
Usman Danfodio University, Sokoto	15509	3417	22	78
University of Port Harcourt, P.H.	26832	4734	18.2	81.8
University of Uyo, Uyo	18660	2944	16	84
Univ. of Abuja, Abuja	8000	2800	35	65
Univ. of Agric, Abeokuta	4504	824	18	82
University of Agriculture, Umudike	1752	228	39	61
FUT, Owerri	9374	3124	33	67
ATBU, Bauchi	6609	2240	33.89	66.11
NDA, Kaduna				
Univ. of Agric., Makurdi	4663	1248	27	73
FUT, Minna	8393	1540	18	82
FUT, Akure	5219	1296	25	75
FUT, Yola	8344	2864	34	66
TOTAL	393,077	111,355	28.33	71.67

Source: National Universities Commission, 2003.

The Concept of Student Housing Facilities

The conception of student housing draws upon the model of the conventional family house. For Six Smith (1986), home is not a single place for each person; rather, a number of places can fill this role simultaneously. Similarly, Klis van der and Karsten (2008) argue that home can be a dual-residence situation in which one dwelling is near the workplace and the other is the family residence (hometown). This concept as stated by Klis van der and Karsten (2008) are comparable to commuter residence. A student, for example, has both a university house close to the college and a home in his or her hometown. Students demand and acquire a second residence (i.e., university housing), where they stay during workdays and this

second residence is temporary in nature. Moore (2000) and Barnes *et al.* (2009) suggest that people attach a variety of connotations to their understanding of a house. Thus, Amina and Asir (2017), claim that old houses need to be renovated for living comfort confirmation, compromise innovative technologies and fulfilled inhabitant's needs.

Students Hostel Facilities

Facilities refer to house, plant or equipment that is built or installed to serve a specific purpose thereby providing convenience and service to users.

The facilities to be provided in the hostels for the convenience of the students includes the followings:recreationalarea,cybercafé,bathrooms,wardrobes,shelves,storagefacilities,waste disposal facilities, chutes, cafeteria, corner shops, water facility, common room, reading corner, electricity and security units(Amole, 2005; and Hassanain, 2008).

Other support facilities are; mini markets, parking lots, laundry spaces, relaxation areas.

Public Private Partnership in Provision of Hostel Facilities

A public-private partnership is a legally binding contract between government and business for the provision of assets and the delivery of services that allocates responsibilities and business risks among the various partners. Oladimeji and Adebiyi (2017), conceptualizes PPP as a model of public procurement based on long term relationships between government or other public bodies and the private sector for the delivery of services. In a similar account, Ogadinma (2013) reiterates that PPP relates to perceptions and practices affecting public-private sector relationship in ensuring national/global health, development and wellbeing, and the conceptual aspects of such relationships, including the role of the key players to make these partnerships successful or otherwise. All these concepts point to the fact that PPP involves a contract between public-sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project.

Benefits of Living on Campus

Living on campus while in the university does not only make students life more practical but gives the students a complete university experience as there are more things to be learnt from room and hostel mates that would not be taught by their various Lecturers in the classes. Living on campus makes it possible for the students to learn, worship and work together and the combination of living together, learning together and loving one another creates the foundation for the campus experience (retrieved from www.simpsonu.edu/visit).

Some of the benefits attached to campus life are:

▪ **Academic Success**: Living on campus positively influences a student's academic performance since it provides greater access and better relationships with faculty and staff by increased participation in campus life, and an overall higher feeling of satisfaction with the university experience generally.

▪ **Social Life**: A university student finds it easier to be involved, develop friendships, and locate study partners when he lives on campus because he mixes up with classmates easily.

▪ **Financial Advantage**: Living on campus can help students avoid various financial hassles, such as utility bills, travel costs, and unnecessary spending of money in supermarkets and social gatherings which does not have positive effects on their school lives. Also, the cost of living on campus can be offset by financial aid through contacts with other students who are more financially privileged.

▪ **Safety and Security**: Students living on campus benefit from dedicated campus safety officers

and are surrounded by supportive students, faculty, and staff. The security and protection of lives of students who live on campus are solely the responsibility of the authority of the school.

▪ **Gain Independence and Life Strategies**: Living on campus allows students to better prepare for life on their own, with the support of faculty and staff members, and makes it easier to take advantage of activities and organizations, including student government, intramural sports, and University sporting events.

▪ **Close to Resources**: Living on campus makes college life easier by giving students convenient access to classes, the library, recreational activities, and some basic needs like water and electricity (retrieved from www.simpsonu.edu/visit).

RESEARCH METHOD

The research design used was descriptive survey with the application of a questionnaire and a well structured observation schedule as instruments for the collection of data. The research is basically based on Post Occupancy Evaluation of the existing hostels. Post Occupancy Evaluation is defined as a systematic evaluation of opinions about buildings, facilities and space in use, from the perspective of users (Watson, 2003). Therefore, the research instrument is adequate. The instrument is to enable the students who are occupants of the hostels provide substantial information on their perception of the current facilities in their respective hostels and suggest their expectation on the design of hostels and facilities to be provided. Purposive sampling method was used in the selection of Federal Universities in North Central Nigeria while stratified random sampling was applied in the selection of one hostel each on the campuses. 250 questionnaires were distributed and 180 were returned from the respondents which provide a return rate of 72%. The percentage of the return rate is considered adequate for the study (Porter, 2004; Carley-Baxter, Hill, Roe, Twiddy, Baxter & Ruppenkamp, 2009). The analysis of the returned questionnaires were carried out by the use of descriptive statistics from SPSS, while the charts and tables generated in SPSS were further developed with the use of Microsoft Excel.

RESULTS AND DISCUSSIONS

Status of the Hostels

The hostels and facilities which students dwell and use affect their lives and academic performance both negatively and positively. When the hostels and facilities are conducive, the students perform better in their studies but reverse is the case when the hostels and facilities are not in good condition or worst still not provided at all. From the respondent's responses on the status of the hostels and what was seen physically during the field work, it is clear that the hostels are not in good condition as at the time of visit. 42.8% of the respondents which is the highest percentage described the hostels are been bad, 40.0% described it as been fair, 16.7% described it as been very bad while the least percentage is 6.0% who described the hostels as been very good.

Table 1.2 Status of the Hostels

Status of the hostel	Frequency	Percent (%)	Cumulative Percent (%)
very bad	30	16.7	16.7
bad	77	42.8	59.4
fair	72	40.0	99.4
very good	1	.6	100.0
Total	180	100.0	

Source: Author's fieldwork, 2017.

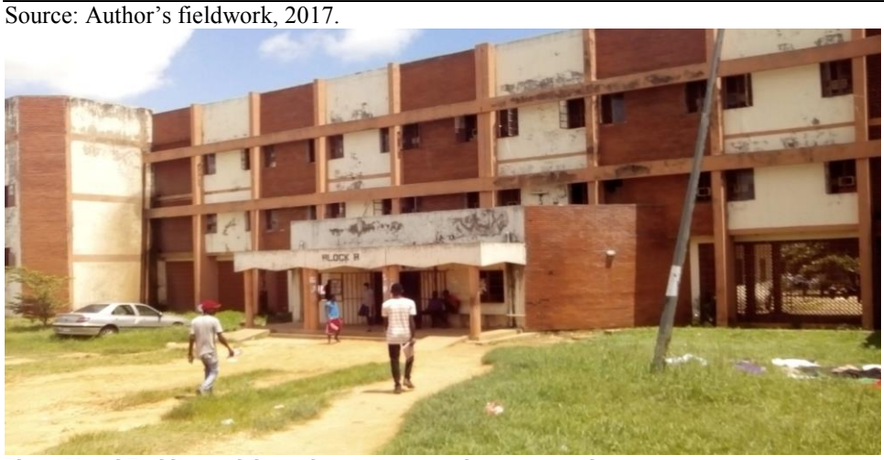

Plate 1Hostel Building with littered environment and not renovated
Sourc: Author's fieldwork, 2017.

Plate 2 Dilapidated bathrooms in Hostel Source: Author's fieldwork, 2017.

Students Satisfaction with the Hostels

Satisfaction evaluations are frequently required in order to determine the level students are satisfied with their hostels in terms of user expectations, needs and goals. User's satisfaction in the residence environment reflects people's responses to the environment they live in. The term environment is related not only to the physical components of residence environment consisting of housing, development of the housing area, and neighborhood, but also to social and economic conditions. From the responses gathered, 91.7% of the students are not satisfied with their hostel facilities while 8.3% of the respondents are satisfied with what they have as facilities in their hostels. The table is a clear indication that the required hostel facilities are not available in the hostels, therefore the need to proffer solution to the needed facilities.

Table 1.3 Students Satisfaction with Hostel Facilities

Satisfied with hostel facilities	Frequency	Percent (%)	Cumulative Percent (%)
Yes	15	8.3	8.3
No	165	91.7	100.0
Total	180	100.0	

Source: Author's fieldwork, 2017.

Plate 3 Unhealthy Hostel Environment.

Number of Students to Occupy a Study Room

There is a high increase in the number of students that are meant to occupy a study room in the hostels. On most of the campuses visited, a room that is designed to contain four (4) students is been occupied by eight (8) students. Students who were not originally allocated

such hostel space are referred to as “squatters” while the process of staying in such places that are not theirs is called ”squatting”. This increased number of students in a room has several health challenges as the indoor air quality of such a place will reduce. To mitigate the challenges that accompany squatting, 62.2% of the respondents suggested that a room in the hostel should contain 3-4 students maximum, 37.2% said they prefer 2 students per each hostel room, while 0.6% supported 5-6 students per room. None of the respondents indicated more than 7 students per hostel room.

Table 1.4 Number of Students to occupy a Study room in the Hostel

Number of students in room hostel	Frequency	Percent	Cumulative Percent
2 students per room	67	37.2	37.2
3-4 students per room	112	62.2	99.4
5-6 students per room	1	0.6	100.0
7-8 students per room	-	-	
More than 8 students per room	-	-	
Total	180	100.0	

Source: Author’s fieldwork, 2017.

To Maintain and Improve Hostel Facilities, Hostel users should pay Damages Fee upon their Exit from School

The need to improve hostel facilities cannot be overemphasized. Most of the existing hostels facilities are dilapidated and were they exist, the population of students designed to use them is at least twice that initial population. The big question is! How can the hostel facilities be maintained and improved? The school management of various institutions has failed over the years on the provision, maintenance and improvement of hostel facilities. From the instrument of the study, 45.0% of the respondents agree that damages fees be paid upon exit from the school, 34.4% disagreed, 18.3% were undecided on the hypothesis while 6.0% strongly agreed on the hypothesis. It therefore implies that the students want a better and conducive environment for their academic activities.

Table 1.5 To Maintain and Improve Hostel Facilities, Hostel users should pay Damages Fee upon their Exit from School

Perception	Frequency	Percent	Cumulative Percent
strongly disagree	3	1.7	1.7
Disagree	62	34.4	36.1
undecided	33	18.3	54.4
Agree	81	45.0	99.4
strongly agree	1	.6	100.0
Total	180	100.0	

Source: Author’s fieldwork, 2017.

Facilities Needed in the Hostels

For the comfort of hostel users (students), there are basic facilities that should be provided in the hostels. The availability of these facilities makes life easy and also brings the home feelings into the students on campus accommodation. Most hostels designs neglect the inclusion of facilities due to negligence on the part of the contractors and improper or no supervision at all by the Client and representatives. Some of the facilities that are expected to be in the hostel includes the followings: Wardrobe, Shelf, Reading corner, Internet Facilities, Parlour/Lounge, Waste Disposal Facilities, Air Conditioners, Recreational Facilities, Cafeteria, Corner Shops, Fitness Centres.

Table 1.6 Facilities Needed in the Hostels

Facilities need in the hostel	Responses		Percent of Cases
	Number of thick	Percent	
wardrobe	170	16.4%	99.4%
shelf	167	16.1%	97.7%
reading corner	16	1.5%	9.4%
internet facilities	166	16.0%	97.1%
palour/lounge/living room	15	1.4%	8.8%

waste disposal facilities	168	16.2%	98.2%
Air conditioners	168	16.2%	98.2%
recreational facilities	166	16.0%	97.1%
Total	1036	100.0%	605.8%

CONCLUSION

Hostels serves as home away from home for every student who lives on campus in the university and the university life is most often the first time some students will live independently. The facilities available in hostels and their conditions will affect the students positively when improved upon and adequate but the students will be uncomfortable when the hostel facilities are either not available, inadequate or in bad conditions. The study was able to show that the status of the existing hostels is bad and therefore need to be improved upon. It further reviewed that the occupants of the hostels are dissatisfied with the facilities in the hostels and want them improved. In addition, it was discovered from the study that more students occupy a particular hostel space as a result of inadequate spaces in the hostels.

RECOMMENDATIONS

1. Public private partnership should be embraced to allow developers to build hostels on campuses and manage them for agreed period of time before they are transferred to the school management.

2. A system should be provided where students pay caution fee on the facilities provided in the hostels upon their admission into the school. This caution fee will ensure that the students handle the hostel facilities with care as the money paid as caution fee will be used to maintain and fix the damaged or mishandled facilities.

3. Post occupancy evaluation of the hostels should be scheduled and carried out to ascertain the damages in the hostels and on the facilities in hostels for repairs, improvement and more provision as the situation demands.

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OPEN SPACES MAINTENANCE PRACTICES IN SHOPPING CENTRES IN KADUNA METROPOLIS KADUNA STATE

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Shopping centres play a very important role in every modern society as it acts as the economic reference point of the society. One of the key things open spaces offer is that it creates an avenue for social integration and interaction between people and the environment. The importance of maintenance in a building cannot be overemphasized. This research seeks to assess the maintenance practices of the open spaces in shopping centres in Kaduna metropolis by analyzing quality and adequacy of maintenance practice, factors affecting maintenance quality within the open spaces in shopping centre and the impact of the maintenance of the open space on the building, its user and its environment. Observation made and interaction with the users of the open spaces provided insight into open spaces maintenance practices in some shopping centres in Kaduna metropolis and the effects of such practice. Questionnaires were also used to gather data. It is evident that most of the shopping centres have almost the same maintenance practice and do not have a structured maintenance plan or model. From the data obtained, the user expressed their dissatisfaction on the execution of most of the task except sweeping and refuse disposal. 60 percent of the respondents were of the opinion that the open spaces are not adequately maintained considering the fact that the maintenance of open spaces in the shopping centres is as important as maintenance of the shopping centre. The occupant of the shopping centres are saddled with the responsibility of maintaining their personal spaces as well as the open spaces, lack of skilled personnel is the major factor affecting the maintenance of the open spaces coupled with indiscipline and ignorance then poor maintenance culture and practice on the part of the user. The out ward appearance of the shopping centre has its effect and impact on the users and the environment. The shopping centres should have a structured maintenance plan or model that is to be strictly adhered to, Maintenance practice needs to be adequate and effectively executed, Maintenance units should be provided coupled with the employment of skilled and un-skilled labor to execute the job effectively as at when due and necessary.

Keywords: Maintenance, Open space, Practice, Quality, Shopping Centre.

INTRODUCTION

One of the key things open spaces offer is that it creates an avenue for social integration and interaction between people and the environment. Open spaces refers to public or privately owned lands, assessable by members of the public and specifically designated for leisure, play or sport activities (Gehl and Gemzoe, 2000). It is any expanse of land with no building structure that is made available to the general public for use. They are areas for parks, green areas and other spaces, partially or completely covered by grasses, shrubs, trees and other landscape features (Balogh and Takacs, 2011). With the inclusion of open spaces in the built environment, the outward appearance of such environment will indeed be aesthetically pleasing as open spaces aid in ameliorating the built environment. A well-designed open space encourages outdoor activity and social communication and could potentially contribute to the health of local residents and social harmony of a community (Yang, 2015). Open spaces are of great benefit to the quality of life of people and the environment and are gradually being accepted and embraced as they also contribute to societal development as they create an avenue for social interaction and integration and also a means for sustainability because such spaces encourage conservation (Balogh and Daniel, 2011)). Open spaces in towns and cities are as old as cities themselves.

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They have ranged from the Hanging Gardens of Babylon to ancient London's marshes and to the lavish formal gardens of Paris and Vienna (Balogh and Daniel, 2011). Open spaces are believed to generate economic benefits and add value to a property and the environment. With the rate at which physical activity rate have decline in both children and adults, the availability of open spaces and recreation spaces can strongly influence an active life in people and in long run serves as an eye opener to what is available in the shopping centre. Open spaces are further classified into those having active use and those with passive uses. Active open spaces include spaces where active playgrounds such as courts, fields and pools (Ward 2013). Passive open spaces are those often used for the purpose of relaxation, such as spaces for strolling and sitting, plazas with open spaces, some portions of beach spaces, picnic grounds and strolling lanes can be classified as passive open spaces (Hwang et al, 2012).

Shopping centre refers to building or structures erected for profit making ventures, activities pertaining to the buying and selling of goods and rendering of services. Types of shopping centres include; retail stores-including convenience stores and shopping malls and supermarkets. Shopping centres are categorised using the scope of the centre. This ranges from high street centres to shopping centres to out of town retail parks. A shopping centre plays a very important role in every modern society as it acts as the economic reference point (Telcholz, 2001). Initially conceived as community centres where persons would converge for cultural activity, shopping and social interaction with one another (Gruen and Smith, 1960). They were brought into being as shopping centres in the early 1920's in California. Supermarkets were used as a magnet or anchor for other smaller stores (Cook, 2000). However, Faizi et al,(1980) was of the opinion that shopping centres began earlier in the year 1907 precisely, in a neighbourhood in Baltimore by a group of departmental stores that connected and went further to establish off-street parking. Shopping centres in recent times have greatly surpassed the earlier purpose for which they were conceived, with the great opportunity Nigeria has to offer, most shopping centres in Nigeria are set up considering some important factors. Such factor ranges from location, population, the presence of various types of business to the extent of development of infrastructure in various cities. Location being the major factor has brought about having most of the major shopping centre in the following cities; Lagos, Kano, Abuja, Port-Harcourt, Aba. These cities are known to be the major commercial hub in Nigeria (Bumdel, 2015).

Maintenance involves detailed works and activities carried out on a structure, its services, its immediate environment and its surroundings in order to restore and preserve it to retain and improve its condition, standard and performance (Highman 2013). The importance of maintenance of open spaces cannot be overemphasized as it ensures and assures the safety and health of occupants, functionality of building, Enhancement of building life Financial and Psychological satisfaction of users, Aesthetic. (Joaquim et al 2015).

Open space Maintenance involves detailed task, work and activities carried out on the open spaces, all facilities and structure that make up the space and its surroundings in order to preserve improve and maintain it condition, standard, quality and performance (Highman 2013).

This research seeks to assess the quality of maintenance practices carried out in the open spaces in shopping centres in Kaduna metropolis by analysing the quality and adequacy of maintenance practice, factors affecting maintenance quality within the open spaces in shopping centre and the impact of the maintenance of the open space on the building, its user and its environment. The research will focus on open space maintenance practice on single unit large scale multi-storey building that is two floor and above within Kaduna metropolis.

Open spaces in commercial buildings serve a lot of cultural and social purposes; they are usually located on the exterior, and in the interior parts of the buildings. These interior open spaces are used mostly for circulation within the buildings they include: courtyards, atriums, hallways, balconies and in some cases lobbies. They are usually in enclosed spaces, open, closed or semi-closed. Open spaces on the exterior part of the shopping centres include squares, scenic gardens and walkways, porches, rooftops to mention but a few (Holmes, 2017). Interestingly, most of these spaces can also be in the interior of the centres.

Routine maintenance ensures that all open spaces are clean safe, visually pleasing and contributory towards the quality of the environment. This also gives the space welcoming and secured feeling. There are many ways in which open spaces are maintained. These include sweeping, grass cutting, tree management, pruning of shrubs cleaning out of litter

and debris removal of dead shrubs to mention but a few which help improve the standard and quality of the open spaces , others include garden maintenance, bush land regeneration, tree maintenance and removal, weed control, turf maintenance and landscaping.Anon.(2017) www.bury.gov.uk

To sustain the quality of open spaces, high standards are maintained. Such maintenance standard and operations varies upon the circumstances of each location. Major factors that influence the quality of open space maintenance includes: availability of resources, (Capital, Labour, Material and Equipment), maintenance policies/culture and adequacy of maintenance (which outline the task to be performed, the frequency and time at which it is to be performed.

The impact of the quality of maintenance of the open spaces in a shopping centre cannot be overemphasised as such impact goes a long way in influencing the use, outward appearance and quality of the open space as well as the resulting effect on buildings within and around it and the environment. These impacts include: improved quality of space, improved utilization, enhances the aesthetic value of the environment and improved health and safety of users.

RESEARCH METHOD

A Comprehensive investigation was conducted in order to have an in-depth understanding of the open space maintenance in the commercial centres. The data for this research was obtained using structured questionnaire which inquired on the quality and adequacy of maintenance, factors affecting maintenance quality in the open spaces in shopping centre and the impact of the maintenance of the open space on the building, its user and its environment, Observation were made guided by an observation schedule which involved direct survey to check the existing condition of the open space and documentation of the physical state of maintenance of the open spaces of the shopping centres. Interview with the user of the open spaces and the relevant authorities was also carried out asking questions on areas that needed clarifications. Interview questions asked users of their personal opinion on the maintenance practice in open spaces in the shopping centres. More data were also obtained from relevant literature, journals, press report, online sources to mention but a few. Data obtained were further analyzed using Microsoft excel and SPSS, Likert scale measurement was also used to analyze the satisfaction level of the users of the open spaces in the shopping centres. Results were presented using tables and charts, while pictures were presented in plates and figures. The research covers shopping centres in Kaduna metropolis of Kaduna State. A simple selection of ten (10) shopping centres was done using random sampling method. A total of twenty (20) questionnaires were sent out to each of the selected shopping centre Thus, a total of 200 questionnaires were sent out to the ten selected shopping centre of which 186 questionnaires were retrieved.

RESULTS AND DISCUSSION

During the cause of the survey, it was observed that the maintenance practices employed in the shopping centres analysed were similar. Refuse is usually collected and gathered in bins which are later taken away by the waste management unit of Kaduna State Environmental Protection Agency (KEPA) for appropriate disposal. The causes of poor maintenance in the shopping centre were also similar.

Maintenance Schedule of Shopping Centres

A maintenance schedule was prepared by the researcher covering all the maintenance task carried out in the open spaces of the shopping centres after the interaction and interview conducted by the researcher with the user of the shopping centre was used as it is evident that the open spaces in the shopping centre have almost the same maintenance practice and do not have a structured maintenance plan or model. The maintenance schedule prepared by the researcher cover for all the usual and routinely maintenance task carried out in the open spaces in the various shopping centres. These tasks are carried out either daily, weekly, monthly or as required as the case may be. Routinely “cleaning” as they call it involves sweeping and refuse disposal which is usually done daily except Sundays in all the shopping centres, clearing of gutter is done weekly in almost all of them, then other tasks are done as

required The schedule was used in measuring their level of satisfaction with the various maintenance tasks as shown in

Table 2.0 it also shows the user's level of satisfaction with the various maintenance tasks and was analyzed using the Likert measurement scale. With the abbreviations stated below used to represent their satisfaction level.

VD Very Dissatisfied

D Dissatisfied

S Satisfied

VS Very Satisfied

The results are interpreted below using the following values:

1.0 – 1.49 Very Dissatisfied

1.5 – 2.49 Dissatisfied

2.5 – 3.49 Satisfied

3.5 And above very satisfied

Table 1.0 User's Level of Satisfaction of Maintenance Practice

S/NO	TASK	VD		D		S		VS		Total	Mean	Interpretation
		X	Xx 1	X	Xx2	X	Xx3	X	Xx4			
1	Grass cutting	42	42	120	240	22	66	2	8	356	1.9	Dissatisfied
2	Sweeping	4	4	66	132	96	288	20	80	504	2.7	Satisfied
3	Clearing of litter and debris	37	37	90	180	46	138	13	52	407	2.2	Dissatisfied
4	Clearing of cobweb	21	21	86	172	58	174	21	84	451	2.4	Dissatisfied
5	Weed clearing	30	30	74	148	78	234	4	16	428	2.3	Dissatisfied
6	Landscaping	10	10	102	204	68	204	6	24	442	2.4	Dissatisfied
7	Replanting	70	70	72	144	40	120	4	16	350	1.9	Dissatisfied
8	Watering of plant	16	16	89	178	70	210	11	44	448	2.4	Dissatisfied
9	Clearing of gutter	64	64	86	172	25	75	11	44	355	1.9	Dissatisfied
10	Refuse disposal	15	15	39	78	92	276	40	160	529	2.8	Satisfied
11	Tree and shrub management	74	74	77	154	22	66	13	52	346	1.9	Dissatisfied
12	Replacing and repair	40	40	64	128	67	201	15	60	429	2.3	Dissatisfied

Source: Author's Fieldwork, (2018)

The table analysed above conclude that sweeping and refuse disposal are the only task the users are satisfied with, the other tasks showed dissatisfaction

Adequacy of Maintenance

Maintenance practices are periodical which means they are meant to be carried out at intervals. It is necessary to ensure that the schedules are adhered to. All the practices should be carried out as required. Skipping scheduled task will lead to quicker deterioration of the facilities.Fig.1.0 below shows the respondent's opinion on the degree at which the maintenance practices are being carried out in the shopping centres observed.60 percent of the respondents are of the opinion that the open spaces are not adequately maintained.29 percent expressed satisfaction with the degree of the practices while 10 percent are of the opinion that the practices are very adequate. Consequently most of the open spaces are less interesting which in turn reduces utilization. Plate I below shows overgrown grasses in one of the shopping centres observed. This is as a result of inadequate grass cutting which is one of the maintenance practices poorly carried out in the open spaces of the shopping centres observed.

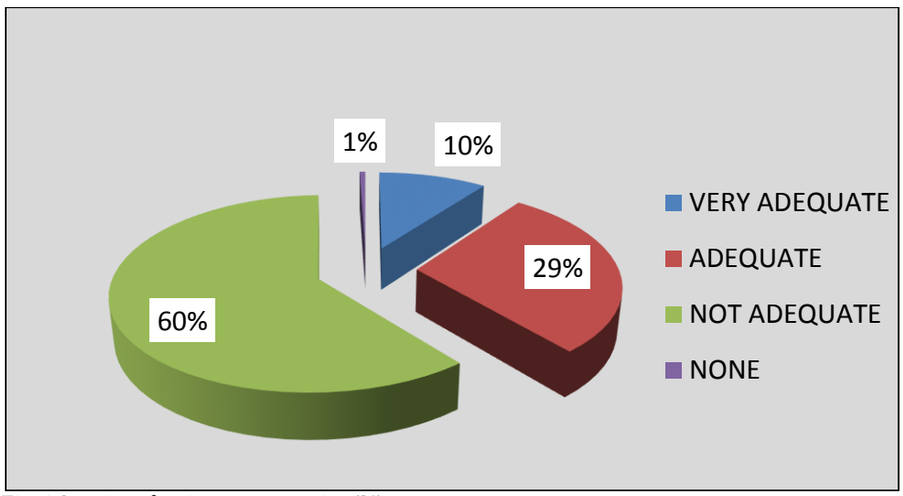

Fig. 1.0 rating of maintenance practice (%)
Source: Author's Fieldwork, (2018)

Plate I: Over grown shrubs in Sabir plaza.
Source: Author's Fieldwork, (2018)

Personnel in Charge of Maintenance

It is necessary to assign people to carry out specific maintenance task in shopping centres to ensure that this is task carried out efficiently. Fig 2.0 shows the percentage of people responsible for carrying out these practices in the shopping centres observed. 66 percent of persons responsible for the maintenance of open spaces in the shopping centres are the occupants. The government and the owners are responsible for 17 percent each. Consequently, the maintenance practices are usually neglected as the responsibility saddled on the occupant according to them is too much. They plead greater involvement in the part of the owners of the spaces. The users of the open spaces should also be involved. Reckless and improper use of the facilities should be discouraged. Indiscriminate littering of the environment by the users should also be discouraged.

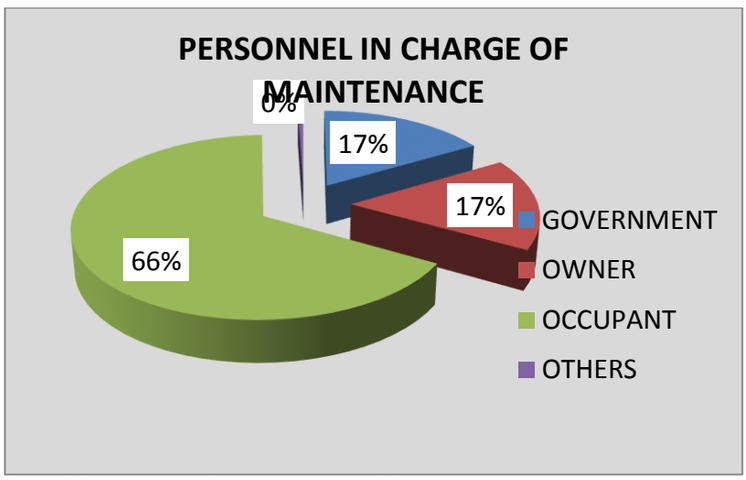

Fig. 2.0 Percentage of People in charge of Maintenance.
Source: Author's Fieldwork, (2018)

Factors Responsible for Inadequacy in Maintenance of Open Spaces

Everybody needs to be involved in the maintenance of open spaces. Users of the open space should adopt a maintenance culture. The occupant and the owners should also compliment the efforts of the occupants in ensuring that the spaces are adequately maintained. Fig 3.0 shows that lack of skilled personnel is the major cause of inadequate maintenance in the open spaces of the shopping centres observed. 31 percent of the respondents believed that the lack of skilled personnel to carry out maintenance practices in the open spaces is the major cause of inadequacy in the practice. Indiscipline and ignorance and lack of maintenance culture on the part of all stakeholders involved recorded 29 percent each as a cause of inadequate maintenance. Only 11 percent of the respondents are of the opinion that the lack of funds is the cause of inadequate maintenance practice in the open spaces.

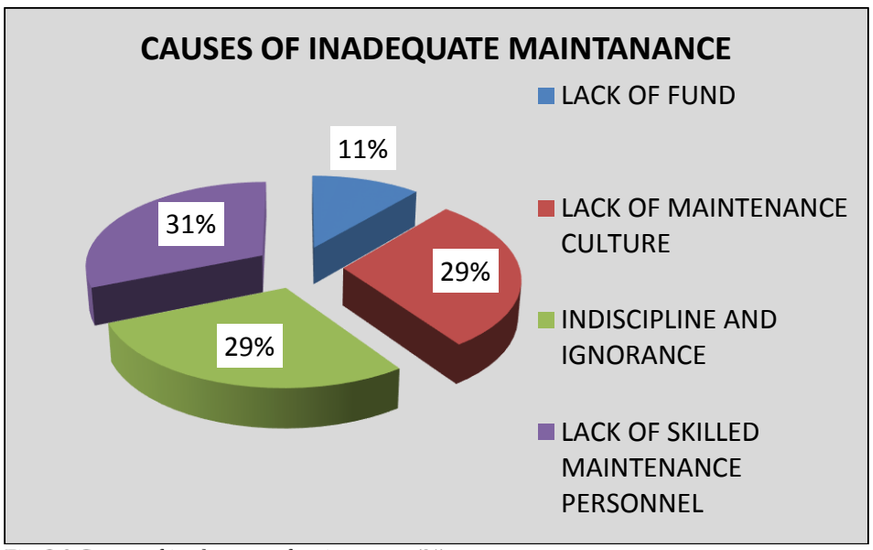

Fig. 3.0 Causes of inadequacy of maintenance (%).
Source: Author's Fieldwork, (2018)

CONCLUSION

Open spaces have a relevant integral component of building and environmental design and development. Maintaining these spaces is as important as their development. However, this maintenance practice is usually neglected as seen from analysing the data derived from the observation of selected open spaces of shopping centres in Kaduna metropolis. The government, building owners, occupants, and other users have a role to play in ensuring that this practice is imbibed. This is not the case in Kaduna metropolis where the bulk of maintenance activities are left to the occupants of the shopping centres who in most cases are unable to adequately carry out maintenance practices necessary.

In order to mitigate the impact of inadequacy and lack of proper maintenance of open spaces in shopping centres in Kaduna metropolis, stakeholders should be actively involved in maintaining the open spaces in shopping centres, skilled personnel should be employed to carry out these activities, indiscriminate dumping of refuse within the open spaces should be discouraged, Maintenance unit should be available to ensure maintenance practice is properly and duly done, Passive and active measures should be taken to ensure that spaces are put into proper use, Cleaning and clearing should be done both internally and externally (within and around the open spaces), Maintenance should not be restricted to sweeping alone as it is the common maintenance practice. Maintenance should be done when and where necessary. Cleaning of personal spaces alone leaving the open spaces unattended to should be discouraged.

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THE ROLE OF ARCHITECTURE IN WAYFINDING PERFORMANCE IN HOSPITAL BUILDINGS IN NIGERIA

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Tertiary hospitals are large scale, complicated healthcare facilities due to their purposeful organisations' complexity and architectural configuration. As such, these buildings are not able to support the psychological needs of first time patients and visitors who are unfamiliar with the hospital environment. In hospitals, people do not have time and energy to waste in looking for destinations. Accordingly, architectural design of the hospital environment should be efficient in wayfinding performance in order to ensure users' psychological satisfaction, comfort, and safety in order to improve staff productivity in the hospital. This research focuses on the roles of architectural features in providing information for spatial legibility in the hospital wayfinding process. The architectural features examined in the study are floor plan, pathways (circulation), landmark and signage. The case study was carried out at the University of Abuja Teaching Hospital (UATH), Gwagwalada, Abuja-FCT. The unit of analysis are buildings of General Outpatients Departments, Laboratory unit, Radiology and Pharmacy departments. The findings have shown the role of the architectural features in the legibility of the hospital environment as it affects wayfinding performance.

Keywords: Architectural features, wayfinding performance, users' perception, legibility

INTRODUCTION

Wayfinding is the ability to know where you are (origin), how to get to the place (path) and recognising the destination on getting there (Lin, *et. al*. 2014). In complex teaching hospital, wayfinding performance could be quite a challenging task in terms orientation for unfamiliar users of the environment that have to search for destinations (Samah, *et. al.*,2013). This impact negatively on the patients in form of disorientation, being lost and stress (Mustikawati *et al.*, 2017). In spite of these difficulties, wayfinding is a need of life as people must move from one place to another for a purpose, in the right direction and path, at the right time and target (Vilar, *et. al.*, 2014). Furthermore, wayfinding is significant in hospital design as a vital consideration in the quality of spatial disposition and the usability of the space that affect the quality of care in the hospitals (Samah *et al.*, 2013).

A lot of research has investigated the issues of wayfinding in unfamiliar environments, such as shopping malls, complex teaching hospitals, airports, urban environment and had been extensively discussed (Ullas &Aju, 2014). However, there is a paucity of research on the roles of architectural features has played in providing information for spatial legibility in the hospital wayfinding process. The architectural attributes are environmental features designed by the architects. Thus, architectural legibility is the extent to which the designed features of the environment help people in creating an effective mental image of the spatial relationships within a building, and the subsequent ease of wayfinding within the environment (Dehghan *et. al.*, 2012). Data was elicited from observational studies conducted in the hospital. The aim of the study is to describe the process of wayfinding by identifying the role of architectural features used to guide wayfinding performance. The objective is to gain understanding of the most important of the architectural attributes that influences the psychological needs and the social behaviour of the users in order to prioritise capital investment in wayfinding designs.

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The users' experience of the hospital environment is a functional relationship between the user and the environment (Hashim & Said, 2013). Thus, the success of wayfinding performance depends on the environmental cues which architectural attributes have a role in its identification and the spatial legibility.

LITERATURE REVIEW

Lynch (1960) first officially defined wayfinding as the consistent use and organisation of sensory cues from the external environment. This definition influenced the concept of spatial orientation and cognitive mapping being used to express wayfinding (Arthur & Passini, 1992). Pati, *et al.,* (2015) defined wayfinding as one's ability to find his way without getting lost. This definition has evolved over the years, depending on the perspective of the research field. Wayfinding is defined in the context of architecture as human response to the environmental cues that ease navigation to the desired destination in the built environment (Hashim & Said, 2013). This implies that it is an environmental learning process that includes perception, cognition and cognitive mapping by the use of the environmental information.

Basically, wayfinding is the process of recognising the current location and understanding how to get to the desired destination with ease (Farr, *et. al.,* 2012). In this process framework are decision making (plan of action), decision execution (putting the plan into appropriate behaviour correctly) and information processing (which involves the use of environmental perception, cognition and cognitive mapping) to accomplish the wayfinding task that flows in psychological pattern based on visual perception (Mustikawati *et al.,* 2017; Ullas & Aju, 2014). The focus of this study is on the role of architecture in the information processing in hospital wayfinding.

Development of Wayfinding

The foundation of human wayfinding started with the works of Kelvin Lynch (1960) the 'image of the city', where he divided the contents of the city into five elements used in environmental information to make cognitive map and make sense of the city. The elements identified were paths, edges, districts, nodes and landmarks which are connected with the perception of space and wayfinding in the urban environment (Karimi & Emami, 2015). Lynch's (1960) research findings are usually referred to as an architectural wayfinding approach.

Afterwards, Down and Stea (1973) studied human wayfinding problem from the cognitive science perspective and explained wayfinding on the basis of process – oriented approach. Their findings focused on environmental perception, cognition and individual decision-making process for successful wayfinding. Subsequently, Weisman (1982) identified four classes of environmental variables that influence the ease of wayfinding performance within the built environments, namely, (1) Visual access, (2) the degree of architectural differentiation, (3) plan configuration, and (4) the use of signs and room numbers to provide identification or directional information.

In addition, Arthur & Passini (1992) assessed the component of architecture and wayfinding in the circulation pattern with a view to construe environmental cues. Thus, this study is anchored on the theories of Lynch, (1960) which described environmental legibility as the ease to form a clear mental image that allows its users to find their way within it in the context of architecture.

Wayfinding in Hospitals Buildings

The first wayfinding research in hospital facilities was on the 'Design that Cares' by Carpman, Grant & Simmons (1986) in which it was contended that a harmonized wayfinding arrangement is required in healthcare facilities in order to ease wayfinding challenges that causes stress experienced by users (Mustikawati *et al*., 2017). In addition, the capabilities of manifest cues (such as the effectiveness of the signage posted in the environment) and environmental affordance (such as what the building communicates to the users) to communicate wayfinding were discussed in the studies.

Beyond this early healthcare research was the work of Baskaya *et. al.,* (2004) which identified some environmental attributes that influence navigation. The study showed that floor plan, building layout and environmental cues (such as visual configuration of space,

landmark, signage, architectural differentiation and symmetry) should be properly considered in the initial plan of hospitals. The findings reveal that plan configuration correlates with wayfinding performance. In addition, the study showed that symmetry and repetition of elements could pose a challenge to wayfinding in hospitals. Other studies confirmed these findings and identified the deficiencies in environmental attributes to affect wayfinding performance (Marquardt, 2011; Pati *et. al*., 2015).

Furthermore, studies have placed environmental affordance (such as corridor width and brightness) in straight rivalry with manifest cues (such as signage) as a result of the roles played by these factors in different circumstance, such as location tasks and emergency situations, (Vilar *et. al*., 2014). These disparities relating to the role of the floor plan and of manifest cues were demonstrated in the studies on people with dementia (Marquardt, 2011). The study indicated the architectural features that impede or aid wayfinding performance, such as long undifferentiated corridors, colour, lighting, repetitive elements, deviations of directional information within the circulation systems and information disorder negatively affects the spatial orientation in the design of environmental features.

In addition to these negative affordances, several studies underscore the importance of user's characteristics such as the aging population, the visually impaired and people with dementia and their limited abilities (Rousek & Hallbeck, 2011; Marquardt, 2011). Consequently, they identified some design attributes that produced wayfinding issues which include signage, path, lighting and flooring. As such, they argued that these issues impacted negatively on the participants, which involve tripping off to getting lost in the environment. As such, there is high awareness on the part of the contemporary hospital designers to implement multiple design strategies to improve wayfinding (Devlin, 2014).

However, there are limited researches that clarify which of the design strategies to prioritise and compromise due to project cost limit in terms of the way environmental cues are processed and used (Pati *et. el.,* 2015). This implies that it is significant to understand the different roles played by these environmental cues in terms of their importance and frequency of use. It is on this premise that this study is anchored in order to achieve project prioritisation and project cost budgeting in the design of wayfinding system. The identified architectural features and constructs for measurements are subsequently drawn.

Constructs for Measurement: The constructs used in the context of this study are spatial legibility, influences and usefulness of the attributes in wayfinding in the hospital studied. These were derived from literature.

Spatial Legibility: This is the extent to which the designed features of the environment is clear, simple, coherent, understandable and organisable that assist people in generating an effective picture-like perception of the spatial relationships within a building, and the subsequent ease of wayfinding within the environment (Koseoglu & Onder, 2011). However, these concepts used in describing spatial legibility are characteristics of space which are easier and faster to acquire spatial knowledge, but cannot be used to measure legibility (Dehghan, Moradi & Memariyan, 2012). In order to measure spatial legibility some parameters have been identified which can be used to measure the variables such as the extent of spatial layout complexity and the ability to recognise the variable as an important landmark (Pati *et. el.,* 2015).

Influences

The influence of a designed space in wayfinding is the extent to which the built environment inspires, stimulate, effect and encourage movement of hospital users to find with ease their destinations within the facility (Marquardt, 2011). The parameters that can used to measure these concepts are distinctiveness, complexity, affordance, accuracy and visibility of the environmental cues (Paul, 2013). However, for each of this dimension, specific design elements are measured with the factors that influence the ease of wayfinding in order to determine the quality of space in wayfinding (Marquardt, 2011).

Usefulness

The usefulness of any place legibility system is the extent to which patients and visitors see the information in the environmental cues, which may positively or negatively affect the ease of wayfinding (Ullas & Aju, 2014). For instance, architectural cues such as signs may be difficult to read if they are mounted too high, located behind another sign, and poor colour

combination (Paul, 2013). Moreover, finding a particular destination in a hospital can be difficult if the typeface, colour, letter, size, and terminology printed on the signs is poor.

However, it should be noted that no matter how good, legible or clearly worded the cue or sign is, if the information is not available where it is needed, the cue's or sign's usefulness is considerably reduced (Ullas & Aju, 2014).

Finally, for the effective usefulness of cues, signs and numbering, they should be made simple, consistent, flexible and visible (Pual, 2013). These are the constructs used in measuring the variables listed in the observation schedule for assessing the effectiveness of wayfinding performance design indicators.

METHODOLOGY

The study assessed the role of architecture in wayfinding performance at the University of Abuja Teaching Hospital, Abuja – Nigeria in the General Out-Patient Department (GOPD). Case study was done to understand this role in wayfinding processes undergone in the hospital. Consequently, wayfinding observation schedule on hospital design indicators was prepared based on previous studies to identify the various attributes as variables to be used for the assessment of the effectiveness of the wayfinding performance in the hospital. The study was based on researcher's participant observation of the physical setting and the social travel behaviour of the patients in the hospital. Also, constructs used for the measurement were identified from literature which was used in structuring the items in the schedule. The observations of the items in conjunction with the floor plan were analysed, inferences and conclusions were drawn.

Research Setting The case study was carried out at the University of Abuja Teaching Hospital, Gwagwalada-Abuja, Nigeria. The hospital was commissioned in 1992 by the Federal Capital Development Authority and in 1993 it was taken over by the Federal Government as a specialist hospital. In 2006, it was approved as a teaching hospital. The hospital has a bed capacity of 338. As a result of the evolution in development of the hospital in phases and the expansion of the hospital, circulation network was affected due to the addition of new buildings which consequently affects wayfinding in the hospital. The hospital layout is shown in figure 1 and the study area in figure 2.

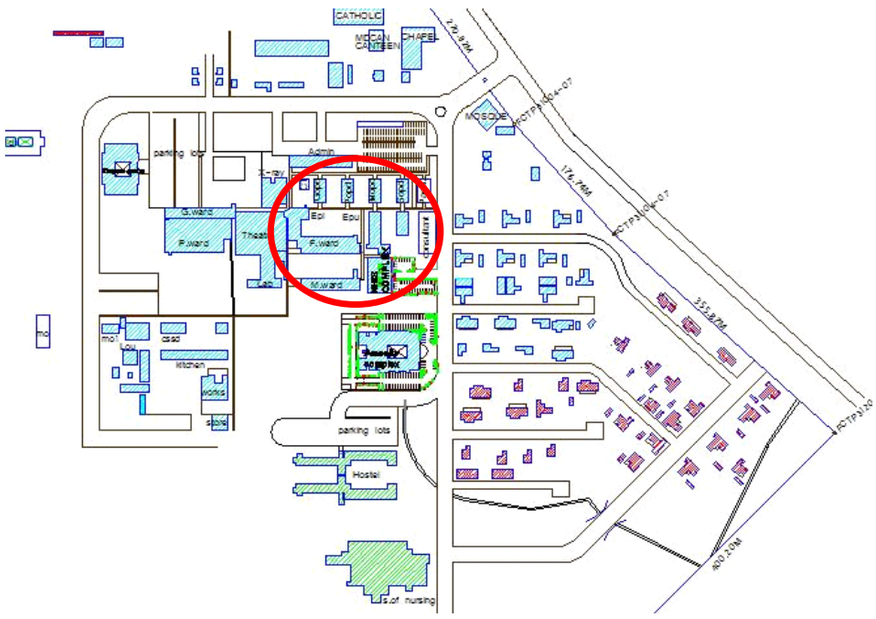

Figure 1: The layout of the hospital

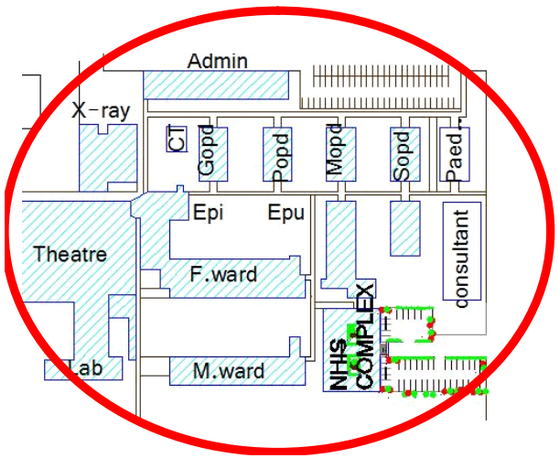

Figure 2: the study area within the hospital

Participants

Fifteen participants were observed, which includes 8 males and 7 females with an age range of between 20 and 55 years. The participants were assumed to be new patients who were unfamiliar with the hospital setting. This is because at the GOPD there was usually health talk to patients in which the researcher participated. It was mentioned by the senior nurse officer who delivered the health talk that the patients at the GOPD were new and was there to collect new record card at a cost which would expire after 7 days of collection.

Data collection procedure

Ethical approval was sought from the University Health Research Ethics Committee which enables the researcher to obtain permission for the study at the various units visited for the research. The study was carried out on 27th December, 2017 to 5th January, 2018. The hospital site plan, floor plan (GOPD) was obtained and photographs of selected departments were taken. An informed consent of all patients who entered the GOPD was taken by the principal investigator before the observation of the patients' behaviour in wayfinding situations. However, some patients declined participation because they were not emotionally stable to participate. Thus, the selection of the patients was purposive sampling. Each patient contacted was observed without instruction as he moves to the next destination after the consultation at the GOPD. The selected destinations for observation from GOPD were Accident and Emergency (A & E), Laboratory complex, Radiology and Pharmacy because they are all on the entry level of the hospital. The variables used for the spatial attributes of hospital users' route were number of directional change, distance from GOPD entrance, Signage on the wall and landmarks used by patients. In addition, patients travel behaviour was based on number of stops, number of looking around, number of asking for direction and the spatial legibility of destination from the GOPD entrance. Furthermore, 27 attributes of the architectural features considered as design indicators of the hospital units based on previous studies were prepared in the observation schedule and assessed on its legibility, influences and usefulness on the effectiveness of wayfinding performance.

Study Limitations

In this study some limitations were noted. They were as follows:

(i) In spite of the rich data obtained, the process of data collection in the participant observation was tedious and time consuming. Therefore, it is suggested that the method be applied to a small number of participants.

(ii) Besides, the interpretation of the patient's intention of stopping and looking around could be subjective since participants were not instructed to talk aloud for their intentions for actions. This was not possible for a sick patient that was in a hurry for medications. For future study, the use of camera and talking aloud by the participants should be applied.

Data Analysis

The research assesses the effectiveness of wayfinding performance in the hospital by exploring the role of architectural cues in the ease of wayfinding performance. In the

analysis, the observation of the physical setting, those of patients' route, the patients' behaviour and site plan analysis were done.

Observation of the physical setting

The site plan in conjunction with the physical observation of the buildings was done. The circulation spaces (pathways) in both the horizontal and vertical cues were legible. The GOPD has a central open core circulation system with stair case dividing the courtyard into two, which makes circulation legible. The floor plan configuration is symmetrical, the building plan shape and building layout were legible. However, the building entrance was not conspicuous which makes visual access not to be legible. Furthermore, most of the lighting points in the corridors (circulation space) were not working and consequently not legible. In addition, maps and display boards were not provided at the entrance which would have assisted patients in finding their directional routes.

Furthermore, the GOPD was a storey building adjacent to other out patients departments, such as the paediatric outpatients department (POPD), the medical out patients departments (MOPD), and surgical outpatients department (SOPD), that was bungalow buildings. Consequently, the architectural differentiation significantly influences the effectiveness and ease of wayfinding in the hospital. Besides, trees were used as visible landmarks, edges and different zones were clearly demarcated which influences wayfinding because they could be used as reference points. However, there were no directional cues such as signs at corridor intersections where patients take decisions as to which route to follow. Thus, could cause confusion on which route to take. In addition, rooms were clearly numbered and labelled. The cluster of functions, such as shops, ATMs, Banks and seating arrangements, as well as location signs were useful in the ease of wayfinding performance in the hospital.

Spatial attributes of a patients' route

The number of directional change from the entrance to the GOPD and other areas at entry level ranges between 1 and 2. Also, the signages on the walls were clear, consistent and legible. Trees and shrubs were used as landscape elements which constitutes the main landmark in the GOPD. However, there were no directional signs at the decision points.

Patients wayfinding behaviour

In this study, the participants were new patients that were not familiar with the spatial layout of the buildings visited. Besides, there were no instructions for the participants to talk aloud their actions. Thus, the observer just walks along and observes their movement pattern and wayfinding behaviour. This includes the number of stops, the number of looking around, the number of asking for directions and the spatial legibility of destinations from entry.

In addition, number of stops range between 1 and 2 amongst the participants. 5 out of the 7 female participants stopped 2 times while the male stopped 1 time before reaching their various destinations. Also, when the patients stopped, it was observed that they looked around to scrutinise the information by understanding the visual content of the cues that could potentially direct them to their destinations. Again, all the participants asked for direction to their destinations once. This implies that the spatial layout, signage, and architectural cues were legible and clear to the patients.

DISCUSSION

This research is about new patients in an unfamiliar hospital environment. The focus is on the user's perception of some architectural features that help to identify the buildings of their destinations as it affects the legibility of the hospital environment in wayfinding process. The concern of the studies is on the information obtained in the wayfinding process.

The wayfinding process consists of a sequence of steps of understanding where one is, realise the right route direction, follow the route and for one to recognise when the destination is reached (Mustikawati *et. al*., 2017). The information needs of the patients vary at each stage of the wayfinding process. This study examined the architectural information available in the physical setting, important landmarks, the spatial legibility of the architectural features, those that were useful and influences wayfinding performance. These constructs used in measuring spatial legibility and the findings corroborated previous study (Paul, 2013).

Besides, the findings on wayfinding behaviour revealed that the number of stops was to reassure the patient's orientation and to understand the information presented in the environment while the looking around was to ensure that the right route was followed. Thus, in this process, to avoid backtracking, patients ask for direction and to reinforce that the destination was reached which corroborated previous studies (Tzeng & Huang, 2009; Mustikawati *et. al*., 2017). The findings in this study of patients' behaviour conform to the concept of affordance in the visual quality of perception offered to users in the environment (Gibson, 2015; Marquardt, 2011).

CONCLUSION

The study showed that the spatial layout, circulation pattern,landmark and the design quality of the environment were significant cues in wayfinding process and that users depend more on visual perception than cognition. In addition, the findings of the research corroborated previous studies that gender and familiarity influences wayfinding performance in the hospital complex environment. Finally, the constructs of spatial legibility, influences and usefulness of architectural cues were used to assess the wayfinding performance in the unfamiliar hospital environment.

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ASSESSMENT OF FACILITIES CONDITION AND USERS' SATISFACTION IN PUBLIC HOUSING ESTATES IN MINNA, NIGERIA

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The failure of several housing projects across different parts of the world have been attributed partly to the lack of feedback from the end-users. This study conducts a post-occupancy evaluation of the condition of housing facilities and users' satisfaction in public housing estates in Minna. Two public housing developments (M. I. Wushishi and Talba Housing Estates) were selected for the study. Data for the study were collected through questionnaire administration, personal observation and interview. A total of 400 questionnaires were administered out of which 288 were retrieved and 256 were found to be useful for analysis, representing about 26% of the total housing stock in the two estates. Data were analysed using both descriptive and inferential statistics. Likert scale was used to analyse the level of users' satisfaction, while correlation analysis was used to test the relationship between the condition and the level of satisfaction. Results from the study revealed that residents were generally dissatisfied or felt indifferent with majority of the facilities with the exception of drainage in both estates and healthcare and educational facilities in M. I. Wushishi with which the residents were generally satisfied. The correlation coefficients (0.908 and 0.721 for M. I. Wushishi and Talba estate respectively) showed strong, positive relationships between facilities condition and users' satisfaction, implying that the better the condition of these facilities, the higher the level of users' satisfaction. To achieve higher level of satisfaction, a general improvement of the condition of facilities in public housing estates was recommended.

Keywords: *Users' satisfaction; housing facilities; public housing; post-occupancy evaluation; correlation analysis*

INTRODUCTION

The importance of housing to man's existence and wellbeing has been extensively discussed in the housing literature. Housing has been recognized by the United Nations as one of the basic human rights. This implies that every individual has a right to an adequate standard of living, including adequate housing (Habitat, 2009). The right to housing has equally being recognized in the Nigerian constitution. Housing can be viewed both as a consumption good and an investment good. As a consumption good, housing fulfils man's physical need, while as an investment good, housing offers its owner a means of storing and accumulating wealth. Housing is in fact, an indicator of a person's standard of living. Housing transcend just mere shelter. The Nigerian National Housing Policy (FRN, 2006) defined housing as "the process of providing functional shelter in a proper setting in a neighbourhood supported by sustainable maintenance of the built environment for the day to day living and activities of individuals and families within the communities." For a structure therefore to satisfy this definition of housing, such structure must be of good quality.

The Niger State government reported that there is a backlog of about 120,000 housing units in the state, which meant that the government must produce 5,000 units annually to meet such demand (NSG, 2008). Like in most parts of the world, the general approach in Nigeria is that housing provision is jointly undertaken by the public and private sectors.

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While a larger proportion of the total housing stock is produced by the private sector and targeted at the high and middle income earners, the few housing stocks produced by the public sector are usually targeted at low income earners and public servants (Agbola and Adegoke, 2007). Previously in Nigeria, the public housing units developed were owned and managed by the authorities. However, recent policies have transferred both ownership and management controls to the inhabitants (Isah, 2016). This is probably in response to the current privatization trend across the country. The situation is not different in Niger State. The Niger State Government embarked on mass public housing delivery through a Public Private Partnership (PPP) initiative during the period of 2007 to 2015. For instance, in Minna alone, a total of 1090 units of 2-3 bedroom bungalows have been completed during the period. 500 units each were completed at M. I. Wushishi and Talba Housing Estates, 50 units at the Minna Airport City Housing Estate and another 40 units at the Teachers Housing Estate. In other parts of Niger State, 250 housing units each were developed in Bida and Kontagora towns, also during the same period. Efforts of past governments in the state with respect to housing provision in Minna have also yielded results. Completed housing projects by successive governments include those at Bosso Low-cost, Tunga Low-cost, Old Airport Quarters, 123 Quarters and Type B Quarters among others.

Every building is expected to perform its function in such a way that it will satisfy its users (Khalil, Husin, Nawawi and Adnan, 2009). While this may be achievable in private housing developments, it is hardly the case with public housing. The failure of several public housing projects can be linked with the lack of input from the intended occupants during the development process. Thus, Isah (2016) pointed out the need to involve potential households in design delivery process between policy, planning, design and provision phases. In addition, Jiboye (2012) noted that housing projects have repeatedly failed because of lack of proper feedback mechanism from the property users or occupants. Accordingly, Khair, Ali, Sipan, Juhari and Dauda (2015) stated that in determining the quality of housing, assessing occupants' feedback on the services provided as well as the physical environment play vital roles. One of the techniques for getting feedback from the users is the Post Occupancy Evaluation (POE) technique.

The aim of this study therefore was to conduct a post occupancy evaluation of housing facilities in selected housing estates of Minna. The study had threefold objectives. The first objective was to assess the condition of the available facilities in the housing estates. The second objective was to ascertain the level of users' satisfaction with these facilities in their present conditions. The third objective was to assess the relationship between the condition of the facilities and the levels of satisfaction. It is believed that the findings from this research will add to the existing literature and also provide useful information for policymakers when they are making decisions to embark on similar housing developments in the future.

LITERATURE REVIEW

Post Occupancy Evaluation (POE) has been defined by Preiser, Rabinowitz and White (1988) as "the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time." Watson (2003) described POE as "a systematic evaluation of opinion about buildings in use, from the perspective of the people who use them." It principally focuses on the systematic study of the relationship that exists between people and the surrounding environment in which they live (Sanni-Anibire, Hassanain, and Al-Hammad, 2016).

Apart from POE, there are other techniques that are employed in building evaluation. Worthy of note however is that some of these techniques are more suitable in evaluating certain building types and not others. Some techniques and their applications have been summarized by Khair, et al. (2015). They include Building Quality Assessment (used for schools and office buildings), Serviceability Tools and Methods – STM (office buildings), Building Research Establishment's Environmental Assessment Method – BREEAM (residential), Quality Function Deployment –QFD (public housing), and Post Occupancy Evaluation – POE (student dormitories, hospitals, public housing and office buildings).

However, among all the building evaluation techniques, only POE fully takes into account feedback from the user during the building evaluation process (Flemming, 2004). Aside that, POE differs from the other techniques in that it considers all environmental aspects in the evaluation process rather than focusing on only one aspect of the housing project (Khair, et

al, 2015). POE is therefore a useful approach that provides a systematic assessment of an occupied building. It is an important tool for acquiring useful feedback on the current performance of a building as perceived by the occupants or users who have occupied the building for some reasonable time (Jaunzens, Grigg, Watson and Picton, 2003). There are several benefits of conducting POE. First, it gives room for improvement to be made over the building's lifecycle. Secondly, it helps in improving the knowledge base in the industry (Sanni-Anibire, Hassanain, and Al-Hammad, 2016). It also helps in identifying lapses in completed developments so that they can be corrected in future developments.

One of the key areas of concern in a POE is the assessment of users' satisfaction with the elements being evaluated as evident in most previous studies (see: Eyiah-Botwe, 2015; Khair, et al, 2015; Danquah, Attippoe and Ankrah, 2014; Ilesanmi, 2010). Findings from previous studies on residential satisfaction are inconsistent, suggesting that generalization cannot be made across different housing projects or locations. For instance, some studies revealed that residents are more satisfied with building design features - room height and material finishes **(**Eyiah-Botwe, 2015), dwelling unit features, housing conditions and location (Khair, et al, 2015), utility and infrastructural developments (Danquah, Attippoe and Ankrah, 2014), privacy and sizes of living and sleeping areas (Ibem, Opoko, Adeboye and Amole, 2013).

METHODOLOGY

Selection of the Study Areas

Having considered several public housing developments in Minna, two were selected for this study - M. I. Wushishi Housing Estate and Talba Housing Estate. A number of factors informed the selection of these two housing developments. These factors include the mode of development (PPP), target group, design and housing typology, period of development, age of the buildings, project sizes and pricing. These factors were found to be relatively consistent across the two housing developments. The projects were conceived by the state government to ease the accommodation problem of the citizens of Niger State, especially the civil servants.

M. I. Wushishi Housing Estate is a public housing development located along the eastern bye-pass of Minna, the Niger State capital. It comprises of 400 units of 2 bedroom semi-detached bungalows and 100 units of 3 bedroom fully detached bungalows. Construction of the estate started in 2007 and was completed in 2010. The houses in the estate are fully occupied either on owner-occupation or rental basis. Talba Housing Estate is another public housing estate in Minna situated along the Minna-Bida road in Minna, Niger State. The development also consists of 500 housing units - 300 units of 2-bedroom and 200 units of 3-bedroom bungalows all detached. Construction of this estate began in 2008 and was fully completed in 2012. About 70% of the houses are currently occupied.

Methods of data collection and analysis

This study adopts a qualitative data collection technique which is the survey method. Data for the study were collected through personal observation, interview and the use of structured questionnaires. A total of 1,000 housing units exist in the selected study areas, 500 in each estate. 400 questionnaires were administered (200 in each estate). Out of the 400 administered questionnaires, only 288 were returned. After careful screening of the returned questionnaires, 256 were found to be useful for analysis, 156 from M. I. Wushishi and 100 from Talba Estate. A personal evaluation of the general condition of the physical facilities in the estates was carried by the researcher. 10 facilities were assessed in the study. They are pipe borne water, electricity supply, road, healthcare facility, educational facilities, worship centers, recreational facilities, drainage system, security services and refuse disposal system all within the estates. The facilities were assessed on a 5 point scale which are: Very Bad (1); Poor (2); Fair (3); Good (4); and Very Good (5). A facility is adjudged to be in a very good condition when it is new and/ or performs its functions optimally. A facility is said to be in a good condition if it performs its functions to an acceptable standard, though not performing optimally. A fair condition is attributed to those facilities that are only partly functional. However, a facility is assessed to be in poor condition when it is available, but does not function meaningfully, that is, its performance is very minimal or insignificant. Lastly, a facility is said to be in a very bad condition when it does not perform its functions at all or non-existent.

Data were analysed using both descriptive and inferential statistics. In assessing users' satisfaction, users were asked to rank their level of satisfaction with the facilities on a scale of 5 which include: Strongly Unsatisfied (1); Unsatisfied (2); Indifferent (3); Satisfied (4); and Strongly Satisfied (5). The mean level of satisfaction was arrived at by calculating the weighted mean score. The following cut-off points were adopted. 1.00-1.49 for Strongly Unsatisfied; 1.50-2.49 for Unsatisfied; 2.50-3.49 for Indifferent; 3.50-4.49 for Satisfied; and 4.50-5.00 for Strongly Satisfied. Mean satisfaction score was used to analyse the average level of satisfaction with each facility by all the respondents. Further analysis was done by correlating the condition of the facilities against the mean satisfaction score to test if there is a relationship between the two variables. The two-tailed Pearson correlation was used.

RESULTS AND DISCUSSION

Condition of Facilities

The current conditions of the facilities as assessed in the two estates are presented in table 3. Generally, the condition of facilities were found to be relatively better at M. I. Wushishi when compared to what is obtainable at Talba estate. For instance, at M. I. Wushishi estate, three facilities were found to be in good condition. They are healthcare and educational facilities as well as the drainage system. Electricity, worship centers and refuse disposal system are in fair condition, while others (pipe borne water supply, road and security services) are in poor condition. At Talba Estate, water supply and recreational facilities were assessed as being in very bad condition. Healthcare facility and the drainage system were found to be good in this estate. However, electricity, road, worship centers and refuse disposal system were found to be in poor state, while the educational facilities and security were assessed as being fair.

Table 1: Condition of Facilities in the Housing Estates

	Condition	
Facilities	**M. I. Wushishi**	**Talba**
Pipe Borne Water	Poor	Very Bad
Electricity	Fair	Poor
Road	Poor	Poor
Healthcare Facility	Good	Good
Educational Facilities	Good	Fair
Worship Centers	Fair	Poor
Recreational Facilities	Very bad	Very Bad
Drainage System	Good	Good
Security Services	Poor	Fair
Refuse Disposal System	Fair	Poor

Analysis of Users' Satisfaction with Housing Facilities

Tables 4 and 5 provide an overview of users' level of satisfaction at M. I. Wushishi and Talba estates respectively. After analysing the responses, a mean level of satisfaction was arrived at and interpreted accordingly. Residents at M. I. Wushisi estate are generally satisfied with the healthcare facility, educational facilities and the drainage system and dissatisfied with the water supply, electricity, road, recreational facilities and security. They however felt indifferent with regards to worship centers and refuse disposal system. At Talba estate however, responses gotten indicate that users were only satisfied with the drainage system. They were not satisfied with water supply, road, educational facilities, worship centers, recreational facilities and security services. They were indifferent with regards to the electricity, healthcare facility and refuse disposal system.

Table 2: Users' Satisfaction with Facilities at M. I. Wushishi Housing Estate

	SS	S	I	U	SU	Mean	
Facilities	**5**	**4**	**3**	**2**	**1**	**Score**	**Remark**
Pipe Borne Water	0	0	32	63	61	1.81	Unsatisfied
Electricity	0	12	56	67	21	2.38	Unsatisfied
Road	0	0	7	52	97	1.42	Strongly Unsatisfied
Healthcare Facility	99	40	14	3	0	4.51	Strongly Satisfied
Educational Facilities	21	81	36	18	0	3.67	Satisfied
Worship Centers	14	54	25	55	8	3.07	Indifferent
Recreational Facilities	0	0	21	46	89	1.56	Unsatisfied
Drainage System	45	75	23	9	4	3.95	Satisfied
Security Services	0	0	29	62	65	1.77	Unsatisfied
Refuse Disposal System	20	71	35	23	7	3.47	Indifferent

SS – Strongly Satisfied; S – Satisfied; I – Indifferent; U – Unsatisfied; SU – Strongly Unsatisfied

Table 4 shows the level of satisfaction with the facilities at M. I. Wushishi housing estate. In all, the facility with the highest level of satisfaction is the healthcare facility at M. I. Wushishi with a mean score of 4.51. The healthcare facility at the estate was developed and equipped by the state government and serves not only the residents of the estate, but also other citizens of the state based on the availability of space. The level of satisfaction was then followed by drainage system and educational facilities with 3.95 and 3.67 respectively. From the bottom, recreational facilities at Talba estate recorded the lowest mean score of 1.36, indicating that residents in the estate were least satisfied with such facility among all others. It was observed during the field survey that though provision was made for such facility, it was yet to be developed as at the time of survey.

Table 3: Users' Satisfaction with Facilities at Talba Housing Estate

	SS	S	I	U	SU		
Facilities	**5**	**4**	**3**	**2**	**1**	**Mean**	**Remark**
Pipe Borne Water	0	0	14	61	25	1.89	Unsatisfied
Electricity	0	4	49	43	4	2.53	Indifferent
Road	0	0	17	41	42	1.75	Unsatisfied
Healthcare Facility	7	19	40	29	5	2.94	Indifferent
Educational Facilities	0	5	4	64	27	1.87	Unsatisfied
Worship Centers	0	11	26	45	18	2.30	Unsatisfied
Recreational Facilities	0	0	0	36	64	1.36	Strongly Unsatisfied
Drainage System	11	45	31	10	3	3.51	Satisfied
Security Services	0	2	35	48	15	2.24	Unsatisfied
Refuse Disposal System	0	27	46	20	7	2.93	Indifferent

Relationship between Condition of Facilities and Users' Satisfaction

The results of the correlation analyses for M. I. Wushishi and Talba estates are presented in tables 6 and 7 respectively. All the 10 facilities were used in the analysis in which the condition of each facility was correlated against the mean level of users' satisfaction for the facility. The result of M. I. Wushishi estate (table 6) indicates a strong, positive relationship between facilities condition and satisfaction, with a correlation index of 0.908. The relationship is significant at 99% confidence level. Likewise at Talba estate, the result shows that there is a strong positive correlation between the two variables measured, with an index of 0.721 (see table 7). It is significant at 95% confidence level.

Table 4: Correlation Result for M. I. Wushishi Housing Estate

		Condition of the Facilities	Level of Satisfaction
Condition of the Facilities	Pearson Correlation	1	0.908**
	Sig. (2-tailed)		0.000
	N	10	10
Level of Satisfaction	Pearson Correlation	0.908**	1
	Sig. (2-tailed)	0.000	
	N	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5: Correlation Result for Talba Housing Estate

		Condition of the Facilities	Level of Satisfaction
Condition of the Facilities	Pearson Correlation	1	0.721*
	Sig. (2-tailed)		0.019
	N	10	10
Level of Satisfaction	Pearson Correlation	.721*	1
	Sig. (2-tailed)	.019	
	N	10	10

*. Correlation is significant at the 0.05 level (2-tailed).

It can therefore be deduced from these results that there exist a very close linkage between the condition of facilities and the level of users' satisfaction with the facilities in the selected public housing estates in Minna. This implies that the better the condition of these facilities, the higher the level of users' satisfaction with the facilities. For instance, at M. I. Wushishi estate, a look at the condition of the facilities in relation to the level of satisfaction will exhibit a relationship. It can be seen that residents expressed higher level of satisfaction with facilities like healthcare, education and drainage system, which were observed to be in better condition compared to the other facilities assessed within the estate. On the other hand, the

residents expressed their dissatisfaction with those facilities that were observed to be in poor or very bad condition. A similar scenario could be established at Talba estate where residents equally expressed their dissatisfaction with facilities that were found to be in either poor or very bad condition.

CONCLUSION

Housing is more than just shelter as it encompasses the structure itself, the immediate environment as well as the facilities therein. It follows that for a house to be fully functional and satisfy its users, it must have adequate facilities within the surrounding in which it is located. This study therefore examined the relationship between the condition of facilities and level of users' satisfaction in recently developed public housing estates in Minna. Data were collected from the field and analysed using appropriate statistical techniques. While the author has assumed certain level of similarity between the two selected housing estates, findings from the study revealed dissimilarity in terms of condition of the assessed housing facilities, as well as in the level of users' satisfaction. Overall, the quality of existing facilities as assessed seem to be a bit better in M. I. Wushishi when compared to those of Talba estate. Again, residents of M. I. Wushishi tend to be more satisfied with their facilities than those of Talba estate.

While most of the previous studies of this nature have only looked at users' satisfaction with the building elements and in some cases the available facilities, this study adds to the body of literature by assessing the relationship between the condition of facilities and level of satisfaction. As expected, there exist strong, positive relationships between facilities condition and the level of satisfaction among residents of the study area, though at varying degree when compare between the two housing estates.

The study concludes that for residents of public housing estates to enjoy higher level of satisfaction, good housing facilities must be provided in the estates. The study recommends that efforts should be put in place to improve the condition of the facilities in the estates. Particular attention should be paid on such facilities as road, water supply, security and recreational services which had the least level of satisfaction among residents. In future public housing developments, the developers should take into account the facilities requirements of intended users right from the conception stage of the project, through the design stage up to the end of the entire development process.

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INTEGRATION OF BIM TECHNOLOGY INTO FACILITIES SPACE PLANNING AND MANAGEMENT AT A TERTIARY EDUCATIONAL INSTITUTION IN NIGERIA

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Over the past one decade, facilities management attention has focused on cost reduction, space efficiency, energy savings, and the development of sustainable management strategies for improved asset and infrastructure management, better business outcomes and a more proactive delivery of services from the facilities management organization to its stakeholders. A Strategic Facilities Plan (SFP) links facilities to core business strategies and it can also result in a more comprehensive approach to transforming facilities planning, delivery and reporting. The study aimed to present a demonstration of the procedure for integrating Building Information Modelling (BIM), the most recent advancement in Information and Telecommunication Technology in space planning and management. Objectives of the study include presenting a summary of past research on space and facilities asset management, identification of critical barriers to integration, review of international trends and a demonstration of how an organization can utilize BIM technology to improve asset management. Space management data on facilities located at the Federal University of Technology, Minna were used for the demonstration. It is recommended that other tertiary institutions integrate BIM technology in the management of their facilities for improved productivity, efficiency, and cost reduction. Among its benefits, BIM data can be used by contractor to automate quantity take-off, perform space management and analyses, perform clash detection studies to confirm that the design is buildable, and ultimately minimize errors and change orders during construction.

Keywords: Building Information Modelling, information and communication technology, Planning, Strategic facility management,

INTRODUCTION

Building Information Modelling (BIM) is the most recent advancement in Information and Telecommunication Technology (ICT) that has affected every discipline in built environment, and impacted the contemporary practice of facilities management in many countries including Nigeria (Aluwong, 2005). Lucy (1995) defined ICT as the acquisition, processing, storage and dissemination of vocal, pictorial, textual and numeric information by a micro-electronic based combination of computing and telecommunications. The British Institute of Facility Management (BIFM) stated that Facility Management (FM) is the integration of diverse disciplinary activities within the built environment and the management of their impact upon people and the workplace.

The scope of FM services is broad, and include a number of functions and roles played by professional practitioners (Chotipanich, 2004). IFMA (2003) described the work of a facility manager as potentially covering the following duties and functions: facility strategic and tactical planning; facility forecasting and budgeting; real estate procurement; leasing and disposal; procurement of furnishings; equipment and outside facility services; facility construction; renovation and relocation; health safety and security; environmental issues; development of corporate facility policies and procedures; quality management including bench marking and best practices;

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architecture and engineering planning and design; space planning and management; building operations; maintenance and engineering; supervision of business services such as reprographics; transportation and catering; telecommunication; and code compliance.

BIM software is an advancement of Computerized Maintenance and Management System (CMMS) and Computer-Assisted Facility Maintenance (CAFM) software applications that eliminates the tedious, time consuming, and duplicative data recollection effort that is often the initial step in developing these applications (Smith and Tardif, 2009). The advent of BIM has led to significant changes in the way construction projects are delivered in terms of the style of information sharing among the parties involved (Liu, van Nederveen and Hertogh, 2016). According to Wikipedia online encyclopedia, BIM offers improved visualization, improved productivity, increased coordination of construction documents, embedding and linking of vital information such as vendors floor specification materials, location of details, and quantities required for estimation and tendering, and increased speed of delivery and reduced costs. In the developed countries such as the United States of America, Building Information Modelling (BIM) technology is regarded as offering solutions that address existing problems confronting the Architectural, Engineering and Construction (AEC) professions. For example, BIM data can be used by contractors to make the process of estimation straightforward by automating quantity take off, perform clash detection studies to approve that the design is buildable and maintainable, and ultimately minimize errors and change orders (Weygant, 2011).

Building Information Modeling (BIM) is an inter-operable technology application that has the ability to manage and communicate electronic data among owners, clients, contractors, and suppliers, and across a project's design, engineering, operations, project management, construction, financial, and legal units. Norbert (2016) defined Interoperability as the ability to manage and communicate electronic product and project data among collaborating firms. Norbert (2016) also stated that interoperability eliminates manual re-entry of data because once information is created, it can be accessed over the life of the project and the same information can be used in different project phases, the same information can support different discipline processes, and be used by applicants from a number of vendors. Inter-operability is made possible by a range of information technology tools and applications including computer-aided design and drafting (CADD), three– and four–dimensional visualization and modeling programs, laser scanning, cost-estimating and scheduling tools, and materials tracking. All relevant building data is digitally maintained within a three-dimensional model, which is then used throughout all of the planning stages. As a result, the various CAD and structural analysis programs use the same model, which is directly transferred between the programs. The advantage of this concept is that all partners involved in a project are connected and share one single data source.

Facility management (FM) practice has been greatly impacted by Information and Communication Technology. For example, Halim (2010) stated that the use of mobile phones for communication by text messages and phone calls has helped to improve communication in the course of everyday tasks. Halim (2010) also claimed that staff on the field can make immediate contact with their office or a principal partner when problems arise while out in the field, such staff in the past would have had to return to base to deal with such problems. The use of computers and the internet has also enabled firms to control a number of branches separately from their Head offices with more ease than it was in the past. According to Halim (2010), the development of internet has facilitated the sourcing and sharing of information has well as email services. Scrutiny of professional reports may be done online and the exchange of documented information has been significantly improved.

The challenges facing facility managers, according to Halim (2010), include adaptation of new techniques such as building information modeling, space planning and management, complex scope of operation, cost management, time management, energy management, as well as an efficient and effective method of storing, retrieval and management of information for faster and more effective management decision. According to Ugwu (2011), the Facility managers in Nigeria do not seem to be operating at the same level with their professional colleagues in the developed countries in the application of latest ICT in facility management practices.

Despite the benefits of ICT in FM such as time saving, reducing waste, inspiring modest, ethical, transparent responsive and accountable conduct in the delivery of facility management services and ensuring easier, quicker and appropriate decision making in facility management practice, BIM technology is yet to be integrated into facilities management practices in Nigerian Tertiary Educational Institutions. The aim of this research was to demonstrate the integration of BIM technology for managing spaces within Higher Educational Institutions (HEI) in Nigerian. This study will significantly help to establish a proactive strategy that can be adopted to accomplish maximum efficiency in facility management practice in Nigeria, through the effective and efficient use of technology (computers, technology providers, telephone systems, e-mail, serves, software and networking).

There are four research questions addressed in this paper: (1.) What are the benefits of using BIM to model facilities at the Federal University of Technology, Minna? (2.) What procedure could be recommended for the implementation of BIM technology in facility management practice at the University? (3.) Who owns the Facilities Data compiled, and who is supposed to maintain the data? and (4.) What challenges would be involved in the integration of BIM with the current FM practice at the University, considering the strategic issues of migrating from the traditional to the contemporary practice of facilities management?

Scope of Facility Management Practice

Nutt (1999) defined the primary function of Facilities Management as resource management, at strategic and operational levels of support. Generic types of resource management central to the facilities management function are the management of financial resources, physical resources, human resources, and the management of information and knowledge resources.

Strategic facility management, one of the imperatives of refined facility management is a more comprehensive and proactive approach for transforming facilities planning, delivering of services and reporting from the facility management organization to its stakeholders for better business outcomes. Strategic Facilities Plan (SFP) links facilities to core business strategies. It is hoped that greater importance will be given to SFP in coming years as budgets continue to be squeezed, while employee experience, productivity, smart buildings and facilities resilience continue to dominate business planning. Chotipanich (2004) identified few of the factors that influence the practice of facility management such as organisational characteristics, business sector, culture, and facility features.

In advanced countries like United Kingdom, United State of America and Asia pacific region, there are several literature in respect to the practice of facility management. However, only few studies have been conducted in developing countries to examine the scope and the general constituent of FM and also determine its significance as it superside the traditional property management (Regterschot, 1990). Other studies carried out in the USA and UK that are concentrated on the strategic and specific role of FM in a business organisation includes, the works of Nutt (1999). However these studies have not discuss or examine the practice of FM in a developing country like Nigeria.

Types of Application Software Currently being used in FM practice

According to Serginson and Lockley (2012), there are several application software packages currently in use in FM practices. Building Information Modelling (BIM) is the fourth category of software packages and the latest ICT development in FM practices. BIM software is extreme ICT innovation that are currently popular in building life cycle. A BIM advantage is that data rich information from the previous process that can be transferred and re-use in FM stage in as-built model. BIM data can be used by contractor to simplify estimation by automating quantity take off, perform space management and analyses, perform clash detection studies to confirm that the design is buildable, and ultimately minimize errors and change orders (Weygant, 2011).

The third category of software packages are Computer Aided Facilities Management (CAFM) software. According to Smith and Tardif (2009), this consists of most interoperable set of application such as office suite which typically consist of some combination of word processing, spreadsheet, visual presentation, e-mail, relational database and desktop publishing applications.

The second category of software packages are Computerized Maintenance Management system (CMMS) software such as, C-work, TMA, EAM. CMMS software can be used to perform task such as project management plan development and scheduling, equipment/asset records creation and maintenance, equipment/asset bill of materials creation and maintenance, inventory control, invoices matching and accounts payable (Márquez et al., 2009). The first category of software packages is such as Building Energy Management (BEM) software which helps in the determination of the amount of energy consumed in the buildings, the comfort of the buildings occupants and operating times of active systems, i.e. heating, ventilation, and air-conditioning (HVAC) system (Marinakis, Karakosta, Doukas, Androulaki, and Psarras, 2013).

Benefits of using BIM to model Facilities at the Federal University of Technology, Minna

The University currently update its drawing and data information on separate formats: DWG floor plans which are purely 2D graphical representations; and an MS Excel database, both of which require being updated manually creating duplication of workload. Photographs and scanned elevations and sections from the original drawing sheets are also used to verify specific details. With regular changes in building utilization occurring year round, this is a lengthy task requiring the full time attention of a CAD technician. By modelling the campus in Revit, the creation of geometric information and inclusion of specific building information will allow automatic updating of required schedules, produces instant sections, elevations, 3d visuals/renders, as well as generating drawing sheets, all from one program. This provides instant efficiency gains as well as providing information that is not presently available to the FM team (see Figure 1).

There are several other secondary benefits that may potentially benefit an organization. The use of BIM for FM allows more accurate and consistent records, for example, certain areas of buildings on the campus required new surveys to verify the building layout as the DWG floor plans failed to stack up when used as a basis for a 3D model.

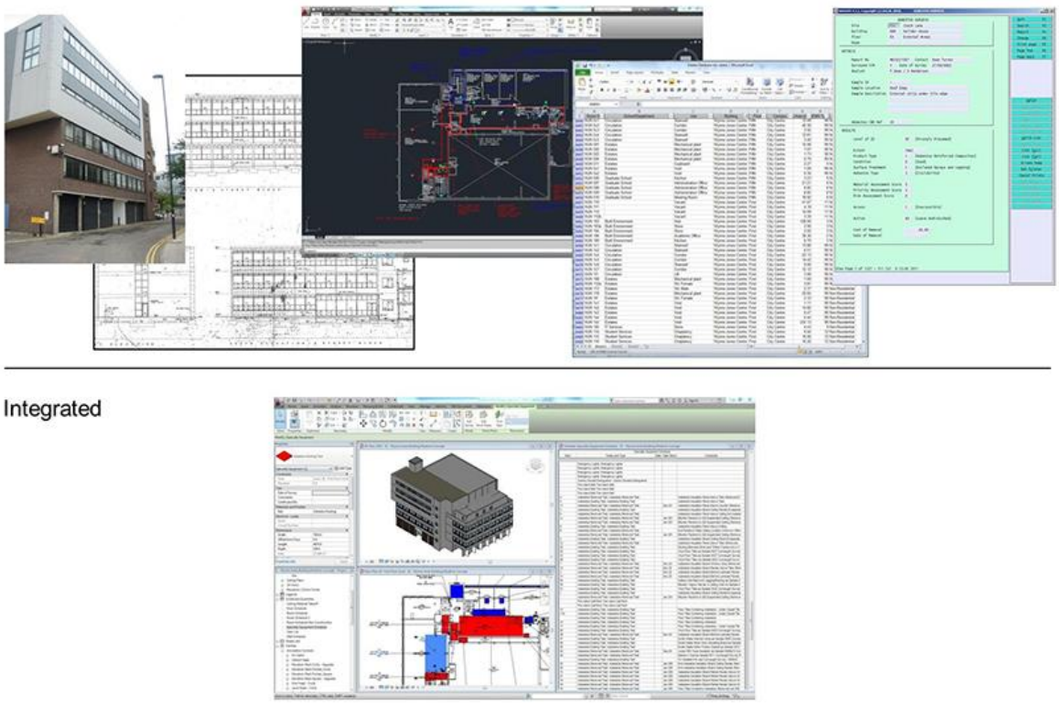

Figure 1: Comparison existing data maintenance procedure and potential BIM procedure
Source: Adapted from Serginson, M. and Lockley, S. (2012).

Facilities Data Ownership and Maintenance

According to Serginson and Lockley (2012), the BIM Academy research team recommended that the ownership and maintenance of the data incorporated in the building information models should be managed by the facility management team of the University. Serginson and Lockley (2012) also claimed that the facility management team must be willing to manage the migration from their current processes to BIM. To do this, they will need to have control of the data and be in a position to maintain it themselves. Staff in the organization

should work alongside the estates department to clearly communicate the deployment plan, so that the staff involved in FM understand the implementation process of BIM. The organization must also define and understand the business value of adopting BIM for FM, and take a long term view (minimum five year view) whilst integrating life-cycle costing into their strategy. A concise BIM specification should be developed to define the information required to suit the particular requirements of the business. A project template for all modelling of current and future buildings would provide consistency (information to be included, object styles, line styles, units, export settings, etc.).

Computerized drawing of most facilities on campus are not currently available with the Physical Planning Development Unit (PPDU) and Maintenance and Works departments. In the last three academic sessions (2014/2015, 2015/2016/ and 2016/2017), students in Dr. P. A. Bajere's BLD 324 (building maintenance), BLD 414 (facilities management), and ESM 619 (facilities management introduction) classes have been modeling several University's facilities using Revit, MS Excel and Word software.

Impact of ICT on Facility Management Practice

The technical capabilities of BIM in facilitating a collaborative environment has been promoted as a selling point for BIM methodology (Alreshidi, Mourshed and Rezgui, 2016; Liu, van Nederveen and Hertogh, 2016). The newly emerging area of ICT innovation include knowledge management (KM), eletronic document management (EDM) and e-business. The transfer of knowledge and information between project teams has been simplified by ICT reduction in project time and cost for document transfer. With the rapid rate of decrease in price of ICT hardware and software globally and the numerous benefit offered by ICT, embracing technological advancement by construction professional should not be too expensive in Nigeria and other developing countries of the world (Smith and Tardif, 2009).

The practice of facility management now encompasses the use of systems as electronic data processing (EDPs) management information system (MIS), decision support system (DSS and expert system (ES) as well as emerging business computing system such as group wares technologies (e.g. group decision support system, electronic mail video conferencing, computer supported cooperative work and organizational computing systems.

According to Serginson and Lockley (2013), the BIM Academy is currently involved in various research projects investigating the use of BIM in several areas relating to Facilities Management. This includes: Web-based 3D model viewer allowing BIM to be viewed through a free web-browser (xBIM Xplorer); Innovation of cloud-based BIM document management; Integration of COBie data; Research into integrating sensors into lecture theatres to monitor space utilization and digital lecture attendance; Estates information integration by using 3D models with 2D CAD underlay; Campus Online – Where am I? Room locator; 3D fault reporting using IOS and Android applications; Pedestrian movement simulation.

There are several information technologies or software applications available to support facility management practices. These applications can be grouped into the following categories (Sun and Howard, 2004). CAFM is a tools for organizing and managing the tasks within a facility such as: maintenance and operations, facility budgeting and accounting, construction and project management, space inventory and management, architectural and interior planning, space forecasting, telecommunications and cable management, lease and property management, and furniture and equipment management (Elmualim and Pelumi-Johnson, 2009).

Rowlatt and Vaze (2002) asserted that facility management practice of the twenty-first century is different from any other practice in the past and highlight three main aspects as follows: a) Infrastructure to assemble, analyze, communicate and manage information with computer mediated networks; b) Transactions to purchase goods and services carried out through Electronic Data Interchange (EDI) or over the internet; and c) Interactions transferring information between enterprises of individuals, which add to value.

Furthermore, Kakulu (2008) suggest that information and communication technology application in facility management provide the professional facility manager with an extremely powerful and flexible information management tool for facility management. ICT enable proper documentation of virtually everything about a facility, information about the owners' construction details; photographs, sketches, lease agreement including records of receipts and payments. Also, information about any facility can be called up at any time and

in variety of ways. According to her, computer can also be programmed with handy reminders, shortlists of which administrative actions are due or are pending at all times reducing the incident of failing to keep appointments or sending out delayed reminders. Also, apart from the database function, notices and reminders to client are made via the internet. In her words, ICT application is cost saving and the processes of negotiation with prospective client is properly documented and saved on the computer for future reference. The issue of distance is almost completely removed with ICT.

Facilities Management Practice in Nigeria

The practice of FM was unknown to Nigeria prior to 1993 Nigerian Institution of Estate Surveyors and Valuers' (NIESV) annual conference, when FM was introduced as the main subject of discussions. The consciousness of FM was stimulated in the mind of real estate professional, who was up till the conference were referred to as expert in property management. However, this consciousness raised question amongst the members of NIESV whether or not FM was exclusive discipline of the estate surveyors and valuers who are expert in managing real property and its facilities. Umezuruike (1998) argued that FM is a profession that has a broad scope of practice and requires both technical and management skills and is therefore a multi-disciplinary profession, to clarify the rift amongst members of the noble profession. However, in 1997 the Nigeria chapter of International Facilities Management Association (IFMA) was incorporated with only few members to the association. The association has grown rapidly in recent years to 700 with members having diverse professional background. The current trends in Cloud, Hybrid and Mobile Technologies for Asset & Infrastructure Management are at the forefront of conversations at recent conferences, articles, online forums and social media, in addition to emerging trends of IOT, Industry 4.0, Digitization and Big Data.

The decision to move from the current paper based tradition to embracing digital based method of analyzing and exchanging information has several benefits. Firms located on different street or in different town, cities, province, countries, or even continents have been able to exchange information actively, because more and more computer are connected through worldwide web, the advantage and impact of ICT on firms, industries and organization have indeed become universal. In addition, there is a remarkable change in organizational processes, technique of working and culture due to the impact of ICT on the traditional processes, reduction in data processing time, enhanced proper decision making and adequate coordination among construction practitioners as a result of improved communication system, to increase the productivity of the construction industry. This has been made possible because various internet-based tools provide medium of communication between distant users and enables them to exchange files, comment on new innovation, idea and changes as well as make request for information (De Lapp et al., 2004).

Although some ICT tools (precisely hardware) are generally required in engineering, architectural and quantity survey practice, others (commonly software) are specific to particular profession, these applications software are common in construction industry in areas such as administration, marketing, project management, desktop publishing, presentation and communication (Doherty, 1997; Arif and Karam, 2001).

In the construction industry the use of ICT can be fundamentally categorized into communication systems and technical decision support systems. The category of communication involves all the common means of communication which are now computerized (Doherty, 1997), while the technical decision support domain involves computer applications other than for communications.

In the field of communication, great potential for advance transferring and sharing of information and data accurately within a reasonable time frame is facilitated by computers and web-based technologies (Marosszeky, 2002). The need for closer collaboration among construction project partners has made the use of the Internet and computer-aided communication very essential.

According to Adebayo (2007) there are numerous ICT device used in construction industry ranging from the types of Computers (Desktops, Laptops, Notebooks, Cell phone and Mainframe Network), word processing and accounting software (MS Word, Word Perfect, MS Excel), presentation Software (MS Power Point, Adobe PageMaker, MS Outlook), architectural/engineering design and drawing software (CorelDraw, AutoCAD, ArchiCAD), quantity surveying measurement and estimating software (WinQs, CatoPro,

MasterBill, QS Elite, Snape Vector), project planning software (MS Project, Primavera, Job master, Power project, Icon), electronic communication systems (Internet Intranet, Voicemail Electronic data management (EDM) Videoconferencing). All these play a significant role in advancing every discipline in the construction industry including facility management.

Barriers to ICT Adoption FM in Nigeria

There are several barriers to the adoption of information and communication practices which has greatly impacted facility management practice. These factors may include limited level of ICT skills or competence within the firm, cost factor, lack of security and legal uncertainty (Vinit, Johan, Hakan and Pontus, 2010). Nevertheless, with the degree of technological advancement in the built environment, it is an inevitable task for facility management to perform it works without adopting and using ICT resources (Nutek 2004). With the level of FM practices, it can be inferred that the benefit embedded in FM practice has not yet been fully harnessed by Nigeria, due to the level of application of ICT in FM practices (Njathi, 2011).

Inadequate Power Supply

Lack of resources and appropriate infrastructure is one of the factors that affects the adequate implementation of ICT in developing country like Nigeria. The effective use of ICT would require the availability of adequate power supply for adequate running of ICT devices and accessories. In Nigeria, most of the rural areas do not have electricity and therefore one cannot even run a computer in the first place. On the other hand, electricity supply in most of the town and cities of Nigeria is not more than ten to eight hours in a day mostly due to low power allocation, planning deficiencies from the power authority, inadequate capacity of transformers, poor voltage regulation, cable undersize, and lack of maintenance of transformer substation due (Adeoye and Titiloye, 2012).

However, the development of the ICT infrastructure in a country is highly dependent on the availability of a reliable electricity supply (Shahadat, Mahbub and Che Kum, 2012). Resources such as computers, printers, multimedia projectors and scanners are power consuming device required in the implementation of ICT which are available in all facility management firms for the adequate execution of work. as a result of this many firms have developed an alternative power supply generator to run ICT device, not only that, there is constant requirement to carry out maintenance on the mechanical/electrical device besides purchasing petrol or diesel for their operation. This is a setback for facility manager because the amount to carry out the maintenance is uneconomical which could be invested on the socio – economic development (Adeoye and Titiloye, 2012).

Inadequate Technological Knowhow of Employee

Technological know-how refers to a person's ability to get the most out of their technology and for effective and efficient use of ICT (Bart, 2015), employee need to know how to use them effectively. For workers who have limited background knowledge technology they can find it difficult to adopt technology and relating to the vast and ever increase scope of ICT. However, inadequate technical know of employee can limit the level at which a firm adopts ICT in its practice.

Availability of Employment Opportunity

With the emergence of facility management in developing country like Nigeria, there seem to be a low level of patronage of the service of a professional facility manager due to lack of awareness of the general public on the scope of operation of facility management and The infringing on the services of a FM by other professional of the built environment. As a result of these, since the adoption of ICT facilities are capital intensive it has limited the level of adoption of ICT in the practice of facility management in Nigeria.

Fear of Virus Attacks

A virus is code that plants a version of itself in any program it can modify. The virus may append or otherwise attach itself such that the program executes after the virus code, making it appear as if the program were functioning as usual, or the virus may overwrite the program such that only the virus will function. A Trojan horse program could initiate the spread of a virus, as could a worm. The term "computer virus," has often been used imprecisely to refer to Trojan horses, worms, and logic bombs (NCSL Bulletin).

As a result of the awareness of the potential damage that a virus can cause to a computer, various user of computer system, including facility managers have developed certain level of fear of virus attack on their computer system which is a major barrier in sharing of file and information. Potential for harm from a computer virus is great because:

i. Viruses can spread from program to program within systems and from system to system without limit.

ii. It is extremely difficult, if not impossible to trace a virus back to its creator.

iii. A virus or worm or Trojan horse can contain virtually any type of harmful code, and such code can be extremely difficult to identify.

iv. The only full proof defense against viruses is to not use software with any function that is not thoroughly understood by the user. However, that is not practical; use of programs whose working is not thoroughly understood is the very cornerstone of computers' value.

Other barriers to adoption of information and communication technology in the practice of facility management include

i. High cost of hardware and software
ii. High rate of obsolescence of hardware/software
iii. Inadequate ICT content of construction education
iv. High cost of employing computer professionals
v. Lack of appreciation of ICT by firm's management
vi. Security/privacy fears
vii. Low return on investment
viii. Fear of mass job losses in the industry
ix. Fear of personnel abuse
x. Fear of ICT making professionals redundant

RESEARCH METHODOLOGY

The study takes a case study approach to evaluate and demonstrate the procedure for integrating BIM in Facilities Management practice, using the Federal University of Technology, Gidan-Kwano campus. The research stops at the review of the literature. After the literature review, the rest of the paper focuses on the discussion of the step by step procedure for integrating BIM technology.

PROCEDURE FOR INTEGRATION BIM IN FM

Preparation of floor plans in DWG format, scans of the original elevations and sections in JPEG and Excel room information database. It appears that limited numbers of related literature on FM practices in Nigeria is because FM is relatively new in Nigeria compared to other developed country. However, there were few studies that were conducted, to evaluate the scope of Nigerian facility management. For example, in a study by Umezuruike (1998), the findings suggest that the participation of facility manager in the areas of core competence in FM is a result of their training in FM and type of business of the organization they manage.

The first step is to develop model of the campus using Revit Architecture software, to creation geometric information and specific building information so as to allow automatic updating of required schedules, produces instant sections, elevations, 3d visuals/renders, as well as generating drawing sheets, all from one program. This provides instant efficiency gains as well as providing information that is not presently available to the FM team. The second step is to create floor plans in DWG format, scans of the original elevations and sections of existing facilities in JPEG and compilation of Microsoft Excel room information database. Photographs and scanned elevations and sections from the original drawings sheets are also used to verify specific details. With regular changes in building utilization occurring year round, this is a lengthy task requiring the full time attention of a CAD technician. The third step is to identify the key strategic issues through detailed discussion with the University's Physical Planning and Development Unit and the Works and Maintenance Departments such as the business value of the integration, the responsibility for the

ownership and maintenance of the system, change management, the technology platforms for operation, the content creation, and the deployment of the system.

In other to compile space database for each of the facilities, the following information must be available: a.) Dimension of each use group (class room spaces, laboratories, offices, circulation, etc); b.) Dimension on each space; c.) Gross floor area (GFA) of each space (in meters); d.) Net floor area (NFA) of each space (in meters); e.) Type of paint recommended for the University (Diamond brand, etc); f.) Recommended room finishes; f.) Type of furniture for each space; g.) Lighting types for each space, etc; and h.) Space colour coding.

Despite the benefits of using BIM to model the campus, one size does not fit all. BIM for FM is an emerging field and is yet to be proven compatible with CAFM (Computer-Aided Facilities Management) systems. Therefore multiple software platforms are essential and multiple data formats pre-requisite. The lifecycle of software is around 12 months, whereas the lifecycle of a building typically around 100 years, meaning data standards are critical. It is of vital importance that organizations do not fit their business to suit a technology, otherwise they will struggle to adapt to new software as technology develops.

Mitchell and Miller (2016) suggested that the requirements for computer integrated construction should include the following: a.) a widespread computer literacy (email, and digital documents), b.) industry wide standards for information exchange, c.) communication infrastructure (internet and external works), d.) discipline specific application software, and e.) work practice changes (re-engineering construction).

CONCLUSION

This study evaluated the integration of BIM in FM at the Nigerian Tertiary Educational Institution. From the findings of this study it can be safely concluded as follows:

(i) That information and communication technology (ICT) application has helped in expanding and facilitating the development of facility management practice in Nigeria. Business survival is becoming more closely tied to facility management firm's abilities to adapt to technological changes and to use technology to attract customers and improve their standard of practice. Through much debate and careful consideration, along with variety of successes and mistakes, facility management practice has been adapting itself to take advantage of the internet over the past years. With such explosive growth in electronic commerce, a number of discipline including facility management, are leveraging themselves to benefit from this new technology.

(ii) That there is a low level of adoption of information and communication technology within facility management in Nigeria. This low practice is caused by a combination of factors such as political, cultural, economic, financial and educational factors such as inadequate power supply, inadequate technological knowhow of employee, availability of employment opportunity, fear of virus attacks, high cost of hardware and software, high rate of obsolescence of hardware/software, inadequate ICT content of construction education, high cost of employing computer professionals, lack of appreciation of ICT by firm's management, security/privacy fears, low return on investment, fear of personnel abuse, fear of ICT making professionals redundant.

(iii) Professional reports may be vetted online and exchange of documented information has been greatly enhanced. Facility management professionals can now use internet to send up-to-date information to potential client at very low cost, accurately and quickly. The internet has also helped the practitioners to save time and provide a noticeably higher quality of services. As a profession that is relevant to all professionals in the in the built environment, there is an urgent need to remain at par with the rest industry by a gradual shift from overdependence on traditional filing cabinets and pocket calculators to the sophistication of computer technology.

(iv) The computerization process and the move towards automation at all levels of facility management practice is a cooperative responsibility of the International Facility Management Association(IFMA), Universities and other higher institutions as well as the individual facility manager as part of his/her personal continuous professional development efforts.

RECOMMENDATION

In the light of the foregoing summary of findings and conclusion, the following suggestions are proffered to ensure that facility manager practitioner embrace the use or application of information and communication technology in various facility management practice.

(i) The first call of recommendation should be the institutions of higher learning where the initial introduction to facility management is being made. Although presently in Nigeria, FM is not yet recognized by Nigeria University Commission as an independent area study at undergraduate level, however the study of facility management in being embedded in almost all course of study in the built environment. The curriculum should be revised to include extensive ICT training in terms of its theoretical and practical aspects, it will go a very long way in reducing the costs and burden of training staff by the facility management firms. It will also provide better job opportunities for the young professionals.

(ii) The International Facility Management Association (IFMA) should organize seminars, continuing professional development (C.P.D) and workshops including demonstration of the relevance of information and communication technology applications to facility management practice. This will not only help in educating the professionals who did not have a chance to learn but it will go a long way to update others who have the basic skills. Practicing facility management contractor should send their staff to these workshops and seminars to grasp the real life application.

(iii) Both International Facility Management Association (IFMA) and facility management firms should launch extensive research into the importance of information and communication technology application in facility management practice by approving funds for the research committee and individual to carry out such educational research. Data gathered from such research will serve as a fundamental base for learning and from where more facility managers may have insight into the benefits that abound in the use of ICT.

(iv) Acquisition of infrastructure: one of the major complaint of facility management firms who are not presently computerized is the cost of purchasing the equipment. They wonder if it cost-effective, if it will be as efficient as promised. However, ICT has proved to be cost effective in all discipline and facility management is no exemption. Practicing facility managers should, as a matter of necessity and absolute urgency undertake courses in computer science, to well-informed with what ICT can do and what it cannot do. .

(v) The Government should encourage the adoption of ICT in facility management practices by making regular power supply and make ICT equipment affordable by reducing duties on computer importation

(vi) Software developers should also work on the development of professional software and hardware packages in facility management practice that will accurately reflect the local practice method.

(vii) The Nigerian Chapter of the International Facility Management Association (IFMA) has been organizing training programs that is aimed at seeking more professional organizations to help in improving efficient facilities management services that will reduce operating cost, increase operational efficiency and improve bottom line performance. According to Aluwong (2005) the Nigerian government has been working on creating an enabling environment through the provision of adequate infrastructure, legislative backing and effective regulatory framework to enforce standards. The government, industry professionals, developers, financers and resident associations, have also been supporting and contributing to the programs that have been going on annually across the country to enhance the facilities management practices in Nigeria. The Federal Government of Nigeria sanctioned a national ICT policy and established a National Information Technology Development Agency (NITDA), to administer its enactment.

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ASSESSMENT OF SPACE PROVISION AND ADEQUACY IN PEADIATRIC HOSPITAL DESIGN: A CASE STUDY OF OFFA, KWARA STATE

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Globally, children are valuable asset to any society and her future. Therefore, it is important that child health care is prioritized. This awareness has led to the development of paediatric hospital in order to provide a comprehensive specialist health care services exclusively to children. In Kwara State there is an increase in child mortality rate in Offa General Hospital which serves as the major referral and has the highest patronage from the community and sub-communities. It is observed that little provision is made in terms of facilities for child health which underscores the need to propose a paediatric hospital in Offa. The aim of the study is to assess the adequacy and provision of spaces in paediatric hospital to promote healing. The methodology adopted for the collection of data for this research is through field survey, which involves the use of questionnaire and observation schedule as the research instruments. Data collected were analysed using descriptive statistics. The data was computed manually and tabulated in Microsoft Excel Spread Sheet Programme and statistical package for social sciences (SPSS).Findings indicate that the current trend in design of spaces in paediatric hospital is inclined to incorporating child- friendly space that includes family centered care and play areas into the design. It is concluded that planning and designing of paediatric hospital in Nigeria goes beyond the general requirement of hospital design. Therefore, there should be a redirection in the planning and designing for paediatric hospital. This should be based on children's literature of spaces, as this plays a major role in enhancing the healing process.

Keywords; Assessment, space adequacy, space provision, space therapy

INTRODUCTION

Health is not merely the absence of disease in human body, but the general condition of a person, which entail physiological, psychological and social well-being. It is of paramount importance to man and considered as wealth (Ahmad, 2011). Human beings can only function normally, be productive, and mentally alert when they are in good health condition. For these reasons, health care centres are important and provided as much as possible to restore sick people health condition. Hospital is a combination of science and coordination of human skills in enhancement of healing processes, hospital is described as a large organization built and staffed to provide a wide range of medical services such as diagnosis, rehabilitation, medical treatment of physical and mental patients, health educational programs, surgery, physician, as well as nursing training. It comprises of functional units that includes the emergency unit, the in-patient unit and outpatient care unit. It also provides hospitality functions such as food service and housekeeping (Kant and Gupta, 2004).

Children are valuable asset of any society and her future. Therefore, it is important that child health care are prioritized, this has led to the development of paediatric hospital in order to provide a comprehensive specialist health care services exclusively to children. It has the advantage over other hospitals in the sense that children are exclusively cared for and treated medically, as it offers a great deal of psychological and physiological sustenance to children and their families. It is usually staffed by professionals who provide health care service to this group of patient (Walker-Smith, 2011).

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The recent statistics in Nigeria shows that the infant mortality rate (IMR) and under-five mortality rate (U5MR) have steadily declined .The Federal Ministry of Health is of the view that, the rates of change have been slow.This is more evident,especially within communities due to lack of sustainable child health centres and infrastructure. According to Kwara State Government Strategic Health Development Plan (KWSSHDP, 2010), Recently Offa Local Government is noted for its records in increase child mortality rate; this is perceived to be due to, Offa specialist hospital serving as the major referral in the communities and sub communities and there is little provision made in terms of facilities for child health, hence the need for a paediatric hospital design that will use space as a therapy for healing (Roger, 2005). The aim of the study is to assess the adequacy and provision of spaces in paediatric hospital with a view to propose a design using space as a therapy to promote healing.

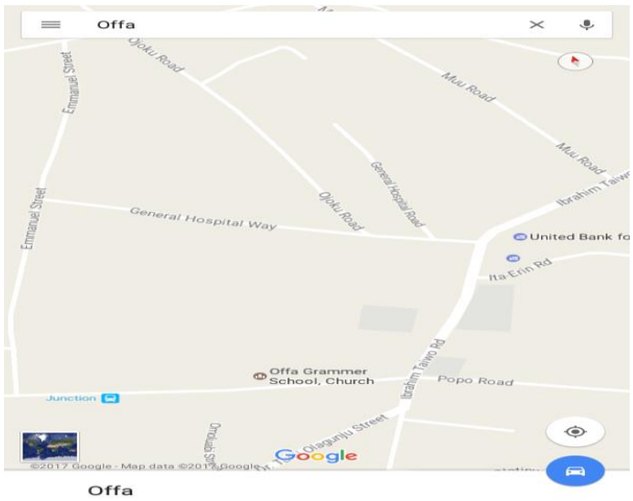
The Study Area

The study area selected for this research is Kwara state in Nigeria. The state lies between the Latitude of 8°- 10° N and the Longitude of 2° 45' - 6° 4' E. of the Greenwich meridian. Kwara state is situated in the middle belt area of the country Nigeria. Kwara state occupies a total land area of about 36,825 (km²) and is populated with about two million, five hundred and ninety one thousand, five hundred and fifty five (2,591,555) persons, according to the national population census carried out in year 2006 (Isah and Adeoye, 2011).

Kwara state of Nigeria constitutes a total number of sixteen (16) local government areas. These include Offa, Isin, Okeero, Baruten, Ekiti, Oyun, Pategi, Ifelodun, Irepodun, Asa, Kaiama, Ilorin South, Moro, Edu, Ilorin West and Ilorin East.

The vegetation of Kwara state is likened to that of the tropical forest which is characterised by thick and dense forest, combined with a vegetation of trees in the midst of dense shrubs and grasses. The climate of Kwara state is that of a typical tropical climate, experiencing dry seasons, harmattan and rainy seasons all through the year. Figure 1.2 is a map of Nigeria indicating where Kwara state is located within the country while figure 1.3 goes further to indicate the sixteen (16) local government areas mentioned above, which are all within the state borders.

Figure 1.2: Map of Nigeria showing Kwara State Source: www.ngex.com



Offa

Figure 1.3: The Map of Offa Local Government Area in Kwara state Source: www.ngex.com

RESEARCH METHODOLOGY

This research makes use of a descriptive research methods, descriptive research methods are designed to obtain pertient and percise information concerning a phenomenon (Lockesh 2007). However, the method of data collection adopted for this study is a combination of primary and secondary source. The primary data for this research was obtained from fieldwork conducted by the researcher, which were obtained by designing a well-structured questionnaire used to assess the knowledge, practice and perceptions of the caregivers, the parents and children in paediatric hospital, case studies and checklist to determine the effectiveness and efficiency of the various hospitals spaces and conformality with the minimum space required in an health facility. Secondary data were obtained from review of literature relating to how space enhances healing process in paediatric hospital. These constitute information gotten from journals, magazines, textbooks, project reports, seminar papers, and internet sources with adequate citation and references.

The sampling technique used in the course of this research is the purposive sampling technique and targeted mainly children, parents of these children and the health specialists .A sample size of six (6) hospitals that offers paediatric care were drawn, a total of twenty (20) questionnaires was administered to each of the six (6) selected hospitals making a total of hundred and twenty (120), Offa has no purposely built paediatric hospital but, has hospitals that provide health care service for both adult and children which includes; Offa specialist hospital, Lamadi hospital Offa, University of Ilorin teaching hospital Ilorin, children specialist hospital Ilorin, Garki general hospital Abuja and Angelic care hospital in Abuja

For the purpose of this study, descriptive statistics was employed. The data was computed manually and tabulated in Microsoft Excel Spread Sheet Programme and statistical packge for social scientist (SPSS).The following formats were employed to represent the frequency distribution and analysis of the data:

i. Figures help in presentation of sketches and illustrations
ii. Tables were used in presentation of data in analytic charts
iii. Plates were used for pictorial images presentation

RESULTS AND DISCUSSION

How adequate are the space provide in existing paediatric hospital?

Space standard is an important factor to be considered in design of any health care facility because; it helps to determine the amount of space required for a particular functional space. Spaces in the selected hospitals were measured in order to determine whether the spaces conformed to minimum standard space requirement in a health facility. From the result represented in Table 1- 4 which show the assessment of the spaces provided and its adequacy, it can be deduced that only 1 out of the 6 hospital has 60% of its space provided up to standard of the minimum space required for health facility. It is safe to conclude that 84% of the hospital fall short of the requirement of space based on the minimum space required for health facility which states that the unit floor area per person in the waiting area is 0.65 m^2; the unit area per person in the patient room is 9 m^2 and the circulation areas of 40% minimum should be provided in the ward (NHS Estates 2003).when all these are not meet it result to problem of circulation and congestion in most cases affect staff productivity and quality of service rendered.

Garki Hospital Abuja

Table 1 Checklist/Assessment of Space Provided and Adequacy

S/N	Control Measures	Minimum Standard	Measurement	Remarks
1	Unit floor area per person in the patient room	9 m^2	4.32 m^2	Below standard
2	Circulation area(width of lobby)	3 m^2	3 m^2	Standard
3	Waiting area(unit floor area per person = (0.65m^2))	18.5 m^2	17.5 m^2	Below standard
4	Accessibility (ramps & stairs)	Applicable	Applicable	Standard
5	Headroom	3 m^2	3 m^2	Standard

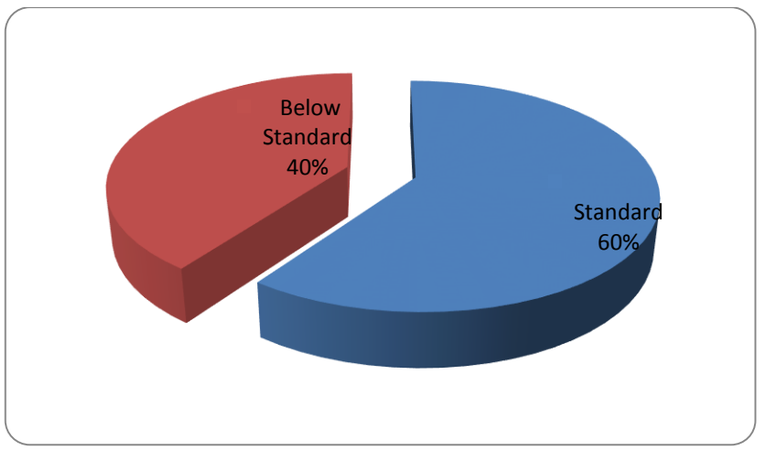


Figure 3: Space Adequacy in Garki Hospital

The result of the assessment of spaces reveals that 60% of the spaces are standard and 40% are below minimum standard requirement for health facility.

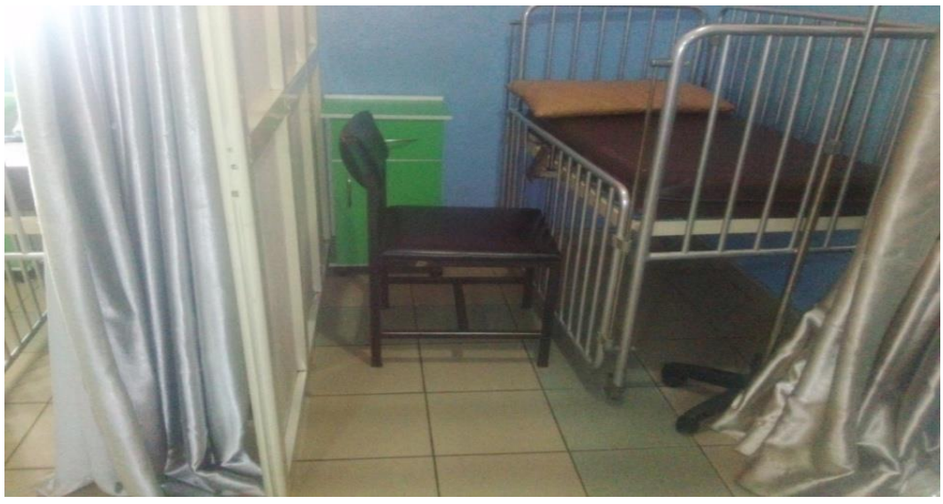


Plate II: Patients ward in Garki Hospital Abuja.

The deduction from table 1 above can be further explained with plate II, based on standard unit floor area per patient is 9.0 m^2 and the total floor area measured at Garki hospital pediatric ward from the plate II above, is 4.75$m^2$with the circulation area. Therefore, there is no provision for circulation area because, the typical floor area essential for 1 patient is greater than the prevailing floor area provided and this indicates, that the space assigned for patient wards were not adequate

Offa Specialist Hospital Offa, Kwara State

Table 2 Checklist/Assessment of Space provided and adequacy

S/N	Control Measures	Minimum Standard	Measurement	Remarks
1	Unit floor area per person in the patient room	9 m^2	3.50 m^2	Below standard
2	Circulation area(width of lobby)	3 m^2	3 m^2	Standard
3	Waiting area(unit floor area per person = (0.65m^2))	5.85 m^2	3.25 m^2	Below standard
4	Accessibility (ramps & stairs)	Applicable	Applicable	Below standard
5	Headroom	3 m	3 m	Standard

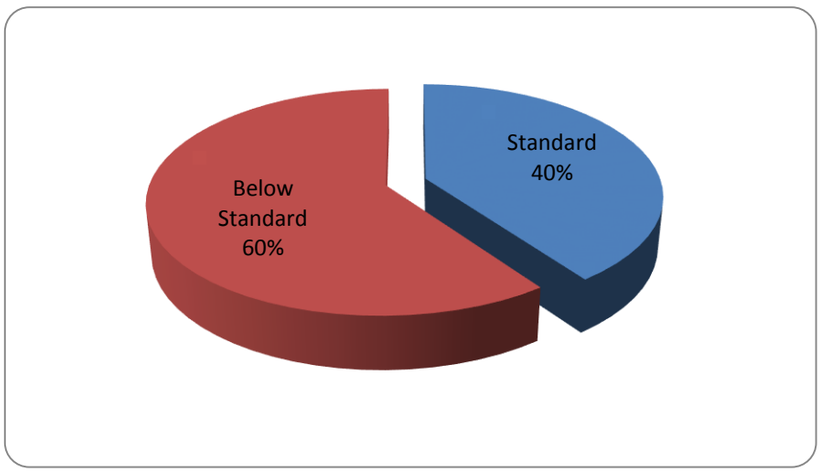


Figure 4: Space Adequacy in Offa Specialist Hospital

The result of the assessment of spaces reveals that 40% of the spaces are standard and 60% are below standard requirement. From the deduction above, it shows that the amount of space required for each functional space in order to take care of space demands is insufficient.

Children Specialist Hospital Ilorin, Kwara State

Table 3 checklist/ Assessment of space provide and Adequacy

S/N	Control Measures	Minimum Standard	Measurement	Remarks
1	Unit floor area per person in the patient room	9 m^2	4.50 m^2	Below standard
2	Circulation area(width of lobby)	3 m^2	2.75 m^2	Below Standard
3	Waiting area(unit floor area per person = (0.65m^2))	10.85 m^2	6.25 m^2	Below standard
4	Accessibility (ramps & stairs)	Applicable	Applicable	Below standard
5	Headroom	3 m	3 m	Standard

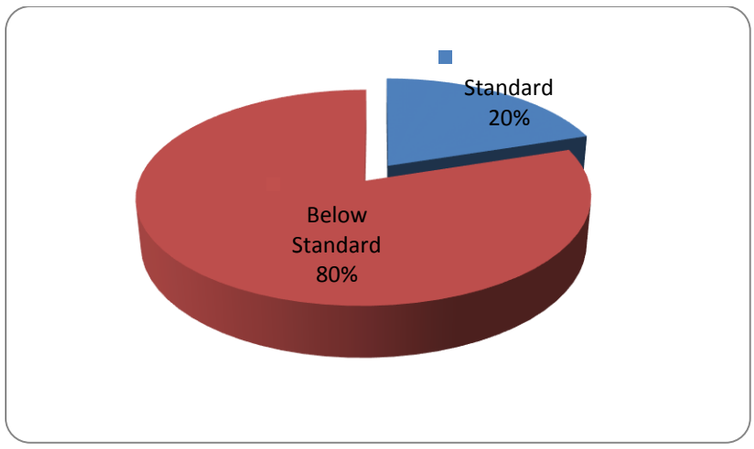


Figure 5: Space Adequacy in Children Specialist Hospital, Ilorin

The result of the assessment of spaces reveals that 20% of the spaces are standard and 80% are below standard requirement. The children specialist hospital in Ilorin is the only government owned paediatric hospital in Kwara state, from the deduction it shows that; the hospital does not meet with the minimum standard requirement of health facility, which result to over-utilization of space particularly in all the wards

Lamadi hospital Offa, Kwara State

Table 4: Checklist/Assessment of Space Provided and Adequacy

S/N	Control Measures	Minimum Standard	Measurement	Remarks
1	Unit floor area per person in the patient room	9m2	4.40m2	Below standard
2	Circulation area(width of lobby)	3m	1.8m	Below Standard
3	Waiting area(unit floor area per person = 0.65m2)	16.38m2	14.25m2	Below standard
4	Accessibility (ramps and stairs)	Applicable	Applicable	Below Standard
5	Headroom	3m	3m	Standard

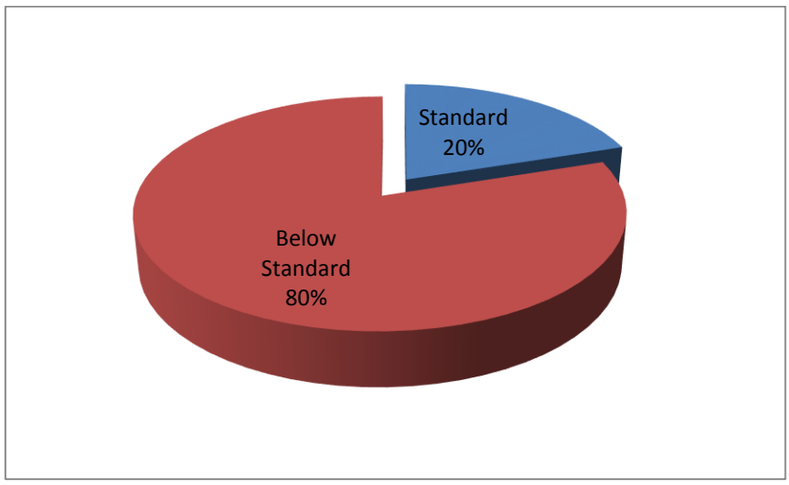


Figure 6: Space Adequacy in Lamadi Hospital, Offa

Deductions

The result of the assessment of spaces reveals that 20% of the spaces are standard and 80% are below standard requirement.The Lamadi hospital Offa, is the only paediatric hospital in Offa, kwara state, from the deduction it shows that; the hospital does not meet with the standard requirement, which means that the space are not adequate, This result to over-utilization of space.

User's perceptions on spaces provided in table 5, were analysis using linkert scale, using the formulae below to calculate the ranking.

a) Computation of the mean, using the weighted average formula

$$x = \frac{\Sigma fx}{\Sigma f}$$

Where x = mean

f = frequency of respondents choice of each point of scale

b) Computation of relative importance index (RII) for each item of intrest using the formular

$$RII = \frac{\Sigma fx}{\Sigma f} \cdot {}^{I}/_{k} = \frac{x}{k}$$

Where k= maximum points on the linkert scale (in this case k = 4 0r 5 as the case maybe)

c) Ranking of items under consideration based on RII values, the item with the highest RII value is ranked first (1) the next (2) and so on

d) Interpretations of RII values as fellows:

RII ≤0.60 is assessed to have low rating

RII ≥0.80, item assessed to have high rating

Table 5; Users Perception of Spaces provided in the hospitals visited

Users perception	Weighing frequency of response (f)					Σf	Σfx	$\overline{X}$	RII	Rank
	1	2	3	4	5					
Whenever a child needs to be admitted in a hospital, there is a need for provision for the parent to sleep over in the hospital	0	0	0	20	85	105	505	4.809	0.960	1st
I feel comfortable as a mother with the spaces provided, whenever there is need to sleep over	46	42	9	3	0	105	178	1.695	0.339	4th
My child is comfortable with the space provided, whenever there is need for admission in the hospital	53	21	0	7	19	105	228	2.171	0.434	3rd
I prefer to take my child to childern only based hospital (paediatric hospital) rather than general hospital for my child treatment	0	2	8	62	33	105	441	4.201	0.840	2nd

From the table 5; above shows respondent prefers to sleep over in the hospital with their children which ranked 1st, this shows that respondent prefers to have a family care centered incorporated in the design, Also the table shows that, respondents prefers to take their children to children only based hospital which ranked 2nd, which explains the need for a paediatric hospital in the study area

Current Trends in the Design of Spaces in Paediatric Hospitals

The current trend in design of spaces in paediatric hospital is the incorporating of child- friendly space that includes family centered care and play areas into the design; this helps in promoting the health and well-being of children. In all the hospital studied, none incorporates child friendly spaces as mentioned above in their design. To enrich the interventions of this research and to know the trends of paediatric care in the other parts of the world, from the internet research, the case, Taif children hospital, kingdom Saudi Arabia and Women and infant hospital providence Rhode Island USA, was as well studied. Plate II and plate III showchild- friendly space and play areas into the design.

Plate II: Patient Ward in Taif Children Hospital Kingdom of Saudi Arabia.

Plate III: Play Area in women and infant hospital providence Rhode Island USA.

Perception of Respondents on Incorporating Child-Friendly Spaces in Paediatric Hospital Designs.

Table 5 shows the perception of respondents on incorporating child-friendly spaces in paediatric hospital, it reveals that 81.6% of the respondents agree that it is extremely important to incorporate child -friendly spaces in paediatric hospital design, while 18.4% of the respondents said it is very important.

Table 5: Perception of respondents on incorporating child-friendly spaces in paediatric hospital

Important of Space	Frequency	Percentage
Very important	71	81.6
Extremely important	16	18.4
Total	87	100

CONCLUSION

From what has been discussed in all the chapters, it is concluded that planning and designing of pediatric hospital goes beyond the general requirement of hospital design. Therefore, the planning and designing for paediatric hospital should be based on children's literature of spaces, this is because, space in healthcare facility plays a major role in enhancing the healing process, particularly in pediatric patient as they response to some spatial elements such as size, shape, colour, and illumination. However, hospital spaces should be carefully designed considering the adequacy, adaptability, flexibility and the used of positive response from spatial elements to solve the problem of patient overcrowding and provide a healing environment that will enhance physical and mental restoration of the patients which was achieved also, through provision of space that gives a homely feel, adequate to play, with positive distractions to remove the anxiety and fear in pediatric patients.

RECOMMENDATIONS

From the findings obtained from the research and analysis of data, it is important to infer that space is an effective element use in "wholesome healing" of paediatric patients. Therefore, the following recommendations are made in other to enhance patient's recovery in the proposed paediatric hospital design:

The quality of spaces (both outdoor and indoor) in a health-care facility has a direct impact on the recovery of children.

• The higher the quality of space, the more likely the specialists will be sensitive and friendly in their approach towards the patients to encourage them in their critical conditions and to make them feel they could get well soon, vice versa.

• Because Children dislike dull, dirty, disordered and crowded spaces in a hospital but rather like clean, tidy, colourful, bright, comfortable, well-maintained spaces, the walls should not just be plain but decorated with different colours and with very colourful wall hangings, pictures, paintings or drawings. Such spaces, take their minds of the clinical procedures and traumas that they go through and make a visit to the doctor a much more pleasant experience.

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GREEN CONSTRUCTION AND EFFICIENCY

PROMOTION OF GREEN INFRASTRUCTURES IN NIGERIAN URBAN SETTLEMENTS FOR SUSTAINABLE DEVELOPMENT: AN ADVOCACY

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Advancing the course of green infrastructures to preserve the various developments in our cities has become imperative at the instance of climate change and global warming. Environmental ills such as deforestation, erosion, poor waste management, burning of fossil fuel and lack of commitment to international treaties on environment had all culminated into impure volume of air to be inhaled, gully erosion sites, and refuse laden communities, poverty and unhealthy cities to live in. City being a future investment of the society needs to be preserved in the context of sustainability for the future generation. Nigerian cities need to start looking in this direction as they had been plagued by environmental degradation for several years. The study took a comprehensive look at all these through the instrumentality of literature review and advocates for the need to create green cities in the country. Finally, case studies of three cities, which are already declared 'green cities' were carried out and recommendations made based on deductions from them.

Keywords: Sustainability, Going Green, Emission, Energy and Open space

INTRODUCTION

Green infrastructures entail every natural elements of vegetation which over the years were known to support human lives and beautified the various settings in which they are found. Their appearance, presence and quality can be controlled to achieve a desirable end. Nigeria is a country which attained independence in 1960 and since then government at various levels has embarked on physical development of the nation's 924 square kilometers of its national land area. This has resulted in the growth of several areas which hitherto use to be hamlets and farm settlements. In addition, the nation has witnessed massive urbanization of yesteryears towns. This growth and urbanization came with its attendant consequence of depletion of ecosystem of its greenery in order to pave way for construction activities. Urban settlements are also nucleated with population of rural dwellers who from year to year throng the cities in search of better life. Nigerians attitudes towards tree felling which the government has been advocating against has not help the situation either.

To create a development which can be trendy and sustainable. A panoramic view of what it offers in the present as well as our ability to retain it before handling it over to the future generation must be examined. This explained the concept of sustainability_ the ability of the present generation to meet their needs without compromising on the capacity of the future generation from meeting their own needs (Dokun, 2008). As our cities grow in population and expand on constant basis intruding into places which used to be forest and farmlands, trees; grasses; shrubs and flowers are made to give way for houses, roads, monuments and metallic entities on the city landscape. These reduces the quality and quantity of air in the atmosphere which are hitherto being purified by plants. More so, in the twenty first century Nigeria cities, with more houses comes more generating sets, air conditioners and refrigerators which all emit poisonous gases like chlorofloride, carbon- monoxide, methane, nitrate, carbon-dioxide and Sulphur. The presence of these gases raises cities' temperature and constitute threat to human lives.

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Olufemi & Nuhu (2018). **PROMOTION OF GREEN INFRASTRUCTURES IN NIGERIAN URBAN SETTLEMENTS FOR SUSTAINABLE DEVELOPMENT: AN ADVOCACY.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

From the savannah in the north, where desert is fast encroaching on the land to the rain forest in the south where the cities are struggling with environmental issues of waste management, gas flaring and deforestation, the menace of inadequate green infrastructure is evident across the nation. If this trend is left unchecked, Nigeria will not be able to meet the sustainable development goal number six which talked about environmental security for global cities by the year 2030.

The focus of this paper will be in the area of advocacy for creation of artificial forests in the nation's urban settlements, cleaner source of energy, reduction of carbon emission, and reclamation of cities open spaces which had been occupied by illegal and permanent structures and finally the attitudes of Nigerians towards landscaping of their immediate environment. The study will looked at what the city landscape is in the present with view to correcting the ills of the citizens' poor attitudes toward green infrastructures.

Concept Clarification

Promotion: advancing the course of pollutants free urban settlement. Going green: becoming cleaner, controlling effluents discharge, effectively managing wastes at source, combatting desertification, erosion, gas flaring, burning of fossil fuel, showing serious commitment to the various environmental laws and international treaties signed to address the several ills threatening the world habitat.

Emission: discharge of the various ultraviolent gases like Carbon dioxide, methane, nitrogen oxide, chlouroflouride and Sulphur into the environment which are responsible for global warning. Sustainable: advancements or development or happenings that can be repeated in the future by the generation or group of people that will live then because of the conscious efforts being made now not to compromise their ability to meet their needs.

Open space: a track of land in the city or town usually containing shade trees, benches, water body and so on. Open spaces are used to achieve aesthetics, break monotony of building on urban lands and provides a serene environment for people to meet.

Aim

The aim of this paper is to promote the adoption of the concept of going green in Nigerian cities in order to experience the benefits of green infrastructures in these cities which had hitherto being exposed to excessive heat, hazardous gases, menace associated with improper waste disposal and desertification.

Objectives

1. To established a relationship between urbanization and the depletion of flora elements from the city landscape
2. Creation of awareness among the various stakeholders participating in municipal development activities the need to plant trees and other flora elements destroyed to pave way for construction activities.
3. To advocate for development of new open spaces and recovery of existing ones which had been hitherto occupied by illegal structures.
4. To make the various development authorities to see the need to realize the environmentally sustainable development.

Statement of Research Problem

In the wake of the several injuries inflicted on the various environments that made up our cities, the need to address the issues of environmental challenges using green infrastructures is becoming imperative. This calls for inquiry into how we live, how we build, how we service our systems and how we power our cities on daily basis. Correct answers to these questions will sensitize the need for cleaner energy, cleaner environment and improved waste management solutions. Therefore the research want to mitigate by way of planning and provision of organic elements of flora features on the cities' landscape the harshness imposed on our cities by the absence of green infrastructures.

METHODOLOGY

The methodology adopted for this study is basically reviewing of relevant literature and case studies of some selected green cities around the world to know the strategic plans employed to attain the green city status and bring to the fore the various advantages of installation of

green infrastructures in terms of aesthetics, functionality and climatic modification of their immediate environment.

The Green Agenda

The green agenda for cities around the world is being advocated for by the phrase "going green" which according to Alitheia (2010) refers to corporate and individual actions consciously taken to curb the harmful effects on the environment through consumer habits and life styles. This include reduction of carbon emission, proper disposal of waste, tree planting and adoption of clean energy system. A recent report on the green agenda of African countries shows that South Africa, Kenya and Ghana top the table in terms of promoting projects with an environmental sustainability in focus. The greenhouse gas emission is one of the ills that the green agenda aimed to eliminate to have a cleaner environment. A large quantity of this is being contributed by building sector, with commercial buildings contributing about 40% of this emission annually. The green agenda appear unattainable by the Nigeria energy commission- a body saddled with the responsibility of guarantee adequate, sustainable and optimal supply of energy at appropriate cost and in an environmentally responsible manner to the various sectors of the economy. This body appears incapable of championing initiatives in alternative clean energy. Dick, Charles, Steve and Sandy (2003), explained what it mean to globalized environmental changes which in their words mean 'unnatural changes resulting from human activities. Though human have been altering environments for generations, one of the unique things about the modern world is the spatial scale of alteration'. i.e the consequences of someone's action in one part of the globe affecting others in a faraway place(s). Moreover, going by the report on energy supply of Nigeria that shows that an average of 40 million litres of petrol/ diesel are burn every day for the private generation of electricity, shows that a lot need to be done to clean the environment (Alitheia, 2010). The exhausts of 60million generating sets in the country keep the environment polluted from day to day. IBM (2015), described planning for a smarter city as building and carrying out ways for a city to realize its full potentials for while maintaining efficient day to day operations. This will be the future cities free of pollutants and clean for all to dwell in.

Importance of Trees in City Building

BGCI (2016) stated the importance of trees to life generally and by extension to city setting in the light of green agenda. The following were highlighted as the importance of trees

1. Food: everything we eat comes directly or indirectly from plants. Throughout human history, approximately 7,000 different plant species have been used as food by people.
2. Air: Oxygen is brought to us by plants, as a byproduct of photosynthesis
3. Water: Plants regulate the water cycle: they help distribute and purify the planet's water. They also help move water from the soil to the atmosphere through a process called transpiration.
4. Habitat: Besides human myriad uses, plants make up the backbone of all habitats. Other species of fishes and wildlife also depend on plants for food and shelter
5. Medicine: one-quarter of all prescribed drugs comes directly from or are derivatives of plants. Additionally, four out of five people around the world today rely on plants for primary health care. The extinction of plants will be a threat to the discovery of new medicine.
6. Climate: plants store carbon and have helped keep much of the carbon dioxide produced from the burning of fossil fuels out of the atmosphere.

Vegetal features in the ecosystem is so important that without them or without the right quantity of these soft elements in the system, it will not be balanced. The plants need carbon dioxide released by animals during respiration in exchange for the oxygen dispensed into the environment by plants as byproduct of photosynthesis. In this way the environment is kept cool, purified and the system attained balance from excessive heat and presence of hazardous gases which are diffused and absorbed in the process. This very much explained the importance of trees in an environment. And where they are lacking in quantity or not available at all, the environment suffers excessive heat, pollution and insufficient volume of oxygen needed to support animal lives.

The Concept of Sustainability and Green Infrastructures

Ifeoluwa (2016), asserted that sustainable development required sustainable infrastructures that can impact the economy, society and the environment. Infrastructural development is a goal that has very high multiplier effects on every aspect of the economy and human life as well as very huge return on investments for the investors. In light of this and couple with the fact that cities are society's investment in their future, developmental strides of every agency of government must be executed in a way that can be retained and handed over to the succeeding generation. It must be recognized that the issue of unsustainable development showing in negative human activities that are affecting the environment is big and complex in its manifestations.it is political because it involves the making of policy decisions about the best way to achieve certain objectives that affect the present citizenry and future generations (Dokun, 2008). The sustainable development goal of the United Nation for environment is goal number fifteen which state that

"Sustainably manage forests, combat desertification, halt and reserve land degradation and halt biodiversity loss". (Dokun, 2008)

Ifeoluwa (2016) went further to state that these entail fighting soil/ habitat degradation and preserving biodiversity. The benefits of this goal are linked to preserving endangered species, combating climate change, and enhancing productivity. Several experts had proposed introduction of green infrastructures inform of parks, gardens, urban forests, green walls, green roofs, golf courses, water fronts, tree lined streets and a host of others as a strategy to bolster diversity and land conservation. Green infrastructures will provide grazing and perching spots for animals, which will keep them from extinction. Hence, cities that are fast becoming slums in the country can be rejuvenated, beautified and remodeled through the promotion of green infrastructures on their landscapes. Space earmarked as green areas in the various cities across the country can be reclaimed if they are already occupied by illegal structures for the benefit of all. Besides this goal, Dokun (2008) also revealed the four international major instruments of legalities from United Nations organized conferences that can be used for combating environmental degradation. These are;

1. Stockholm Conference, 1972: A conference that discuss treaty to effectively curb the menace of international environmental degradation.
2. Rio Conference, 1992: a conference on solutions to the problem of poverty, the growing gap between industrialized and developing countries and introduction of the paradigm of sustainable development.
3. Kyoto Protocol Conference, 1997: the conference for the framework convention on climate change
4. The United Nations Earth Summit II, 2002: a call for broad measures to alleviate poverty and protect the environment.

To understand the relevance of these legal instruments and treaties in particular, there is need to examined the ways in which laws and constitutions can give effect to collectively held values on the environment and differentiate them from genuinely held individual preferences.

Urban Open Spaces Earmarked For Green Infrastructures

Encyclopedia Britannica (2016) define open space as undeveloped land that is protected from development by legislation. In addition, Emman and Obialor (2012) described open space as a track of land in the city or town usually containing shade trees, beaches, water body and so on. They went on to say 'besides designated open spaces, there are always undevelopable areas, abandoned railway lands and others within the city that are regarded as open spaces'. These are spaces left undeveloped but covered with trees, shrubs, flowers, grasses and greenery to achieve municipal landscape aesthetics, relaxation spots and sightseeing avenues. These has been occupied by illegal structures, lunatics' abodes, refuse, mechanic workshops and erosion in Nigerian cities and towns to the detriment of the various master plans. Hence Linus and Ugochi (2008) observed that most Nigerian cities show inadequate consideration or even total neglect and even destruction of the open spaces, green belts and reserves. Pressure on urban land has forced land administrators to indiscriminately encroach on public parks, gardens and open spaces. Finally, they conclude by revealing that our open spaces have grossly disappeared from our city scenario due to encroachment with permanent and temporary structures. Emman and Obialor (2012) agreed to the fact that open spaces sustainability requires some level of maintaining the conditions necessary for its

survival. It involves the ability of a community to adapt to changing internal and external conditions, to exercise some measure of control over its own destiny, to promote democratic values and to create a just society.

Case Studies of Green Cities around the World

The present industrial civilization became possible when the huge supply of energy store in the fossil fuels was first tapped by the mining of coal about 900 years ago and oil about 150 years ago. With improvements in technology for discovery, recovery and utilization of these fuels, their use grew on a scale hitherto unimaginable (Rao, 2007). More so, as the world population soar, more than half of the world populace now reside in cities. And as the effects of climate change worsen, the need for our cities to adapt through accelerated transition to cleaner, healthier and economically viable setting is becoming apparent than ever before. This can be realized through heavy investment in renewable energy, improvement in energy efficiency and regulation reforms.

The following three green cities has been appraised and adjudged to be an environmentally concerned urban settlements and worth copying in the area of utilization of renewable energy, promotion and support of green lifestyle, endorsement of green laws for the protection of the environment and their use of innovative strategies to accomplish their goals of greener communities.

Case Study I: Oslo, Norway

The city of Oslo started its journey to becoming green earlier than several other cities in the world. It was a conscious effort on the part of its government and cooperation of the local residents to achieve this feat. In the year 2007, Oslo was declared the second world greenest city. This long history regarding worldwide environmental concern has seen Oslo government giving incentive for each new building developed in order to cut down greenhouse gas and achieved energy efficiency. In addition, the transportation system in Oslo was used to facilitate the going green objective of government as lanes were incorporated into the city's road network to accommodate bickers. Oslo is a city in which 85% of school children ride on bikes to and from schools while local commuters used hydroelectric powered public transportation. The future objective of achieving a more greener Oslo by its government include the on- going plan to inject 140 city buses that will run using biofuel processed from collected food waste into the transportation sector by the year 2020.

Case Study II: Vancouver, Canada

Vancouver is the greenest city in Canada presently and its government hope to make it the greenest in the world by 2020. Vancouver achieved the status of being the 5th greenest city in the world in 2015 through clean-technology innovation like solar-powered garbage compactors that can be found within the city. Besides its clean-technology used to achieve fewer emissions of carbon and increase generation of renewable resources for up to 90 percent, Vancouver has over two hundred open clean parks. This makes it possible for tourists to really enjoy the fresh Canada air, thereby promoting their visitation from year to year.

Case Study III: San Francisco, California (U.S.A)

San Francisco was adjudged the 4th cleanest city after Reykjavik in Iceland, Bristol in south west England and Portland in Oregon in 2015. The city achieved this status through effective legislation that banned the use of plastic bag, launching of mandatory recycling programme in 2009 which enables it to keep 77% discarded waste materials safely away from landfills and education of its residents and business owners on the importance of its zero-waste city agenda. And despite its growing population and vast land mass, San Francisco remain a high popular tourist destination because it is one of the greenest cities in the world.

Deduction

The going green initiatives has five focal points of operation to achieve its main goal of creating a clean world. These include: reduction of greenhouse emission, waste management and control, retaining/ creating/ reclamation of open spaces in urban areas for city aeration and landscape features (fauna and flora), clean transportation system and energy sources to power the various city operations and commitment to the various environmental laws and treaties to attain a greener world.

The Norwegian government use a long time commitment to be environmentally concern and effective city planning to achieve a green Oslo while Canadian authority used the available local technology to clean the city of Vancouver. San Francisco city in California attained the status of a green city using effective legislation and campaign for zero-waste city. A combination of these strategies can be adopted to clean Nigeria cities. Again Pandey (2007) suggested two approaches as solution for environmental management which include:

Management based on standards and management based on best practical means

Pandey went on to expatiate the first approach as setting a limit for each pollutant (air, water, noise and landfill) in the city and the second to mean allowing industry to adopt any suitable method which is technically feasible as well as economically viable.

CONCLUSION

Achieving result when going green may obviously not be an easy task but it is achievable with serious commitment and well planned strategies. Our city planners and municipal authorities across the country will need to emulate cities outside our shores who had been adjudged to be green after setting out to clean their environment. The source of energy that is cleaner and renewable will have to be considered and our observation of the various environmental laws and commitment to international treaties to address the issue of climate change are the right ways to go in achieving result. Addressing these issues that define a green city will culminate in developments that are sustainable and promotion of tourism.

The followings are solutions derived from the foregoing discussion as revealed by the study:

- Both our city planners and residents need a re-orientation on how to be environmentally responsible and use our city's facilities in anticipation of the future generations that will take over from where we stop.
- Creating green cities is a journey that has to be embarked upon and achieving results may take time but it is beneficial for sustainability, healthy living and tourism promotion
- Effective campaign and legislation will help to achieve result in our strive to go green
- Available technology or the one transferred can help in waste management and the various recycling programmes.
- Finally, government at various levels must be committed to the various international treaties on climate change and environmental protection laws and regulations.

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PERCEIVED BENEFITS AND POTENTIAL CHALLENGES OF IMPLEMENTING GREEN BUILDING PRACTICES IN LAGOS, NIGERIA.

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Buildings provide countless benefits to the society. They however contribute adversely to the society through high energy consumption which invariably leads to resource depletion, air pollution and creation of wastes that are not easily assimilated by the environment. To address these problems, green buildings, which offer a lower level of environmental risk, have been advocated in developed countries. The paper evaluates the perception of stakeholders towards economic, environmental and social benefits of green building and potential barriers towards its implementation in Lagos. The literature reviewed and results of a survey among the stakeholders formed the basis of the study. Questionnaires were distributed to 92 selected property developers and 150 Estate Surveyors and Valuers in Lagos, selected using the simple random sampling technique. The study adopted the descriptive method of analysis of frequency count, mean, median and standard deviation. The result revealed that prominent perceived benefits adduced to green building are better market distinction, reduction of operating cost, user satisfaction and optimization of life cycle economic performance of a building. Major obstacles to its implementation include slow market penetration, lack of good example of green building and green technology in the country. The paper concluded that awareness campaigns should be instituted to enable the populace gain an appreciation of the benefits of green *building as against the negative impacts of buildings as currently constructed.*

Keywords: Environmental preservation, Green Building, Perceived benefits, Stakeholders,

INTRODUCTION

The built environment is designed to serve human needs, such as protecting people from outdoor environments. However, the built environment has significant negative impacts on the natural environment and on human health and performance. For instance, the recent hurricane Harvey in the United State, flooding in Karachi, Pakistan, heavy flooding in Bihar, Indian and the devastated heavy flooding across Nigeria have all been attributed to effects of climate change on the environment. In the U.S. alone, buildings are responsible for: 38% of carbon dioxide emissions; 71% of electricity consumption; 39% of energy use; 12% of water consumption; and 40% of non-industrial waste. (United State Green Building Council [USGBC], 2007; UCL Energy Institute, 2015). This alone has a negative impact on the sustainability of built environment. Green building practices which have been described as dynamic, rapidly growing and evolving field, driven by a confluence of rising public concerns about global climate change and the impact of the built environment on human health and performance has accordingly emerged as an innovative building concept to lessen the environmental impact of conventional buildings, reduce resources use, and at the same time optimize users and occupant's comfort (Olaleye, Ayodele , & Komolafe, 2015; USGBC, 2007). Green building refers to both structure and the use of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from sitting to design, construction, operation, maintenance, renovation, and demolition (United State Environmental Protection Agency [USEPA], 2009).

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Green building practices largely draw their existence on studies conducted in the developed world (Kalua, 2015). Green buildings are becoming more prominent in developed countries with the obstacles and barriers to its implementation being overcame gradually owing to increase awareness about its numerous benefits as against the conventional buildings. Market studies, extensive research and industrial reports in the area of green building practices around the developed world indicated general consensus that green building are more energy efficient; have lower operating and maintenance costs; provides better comfort and well-being for occupants; are more marketable than conventional buildings; have lower risk potential; and reduced negative impact on the environment. (Green Building Council of Australia, [GBCA], 2008; Kats, 2003; RICS, 2005; Srinivas, 2009).

A study on world green building trends conducted by McGraw-Hill Construction among various stakeholders in the construction industry around the world indicated an increasing rate of adoption of green building practices (McGraw Hill Construction, 2013). But the practices are yet to be embraced in developing countries like Nigeria owing to wide range barriers and relatively newness of the concept (Dairu, Dania & Adejoh, 2014; Nduka & Ogunsanmi, 2015). In Nigeria, green building practices are hardly put into consideration when new buildings are being designed or when old one are being renovated. These according to Otegbulu, (2011), results in a shortfall in user satisfaction, functional space planning and service type.

As a result of the foregoing, this study was conducted to access perceived benefits and potential challenges of implementing green building practices in Lagos, Nigeria with a view to making recommendation that will enhance its implementation toward environmental preservation and sustainability. The objectives of the study are; To examine perceived benefits of green building practices by stakeholders in the study area, to examine challenges of implementing green building practices by stakeholders in the built environment and to make recommendation that will enhance green development, management and implementation by all stakeholders including government.

LITERATURE REVIEW

Many studies on the green building have adopted various vocabularies to connote green building concept. It is instructive to note that the definition of green building is constantly evolving. Green building is an outcome of a design philosophy which focuses on increasing the efficiency of resource use, including energy, water and materials, while reducing building impacts on human health and the environment during the building's life cycle, through better sitting, design, construction, operation, maintenance and removal (Royal Institute of Chartered Surveyors [RICS], 2010). Green building involves finding the balance between home building and sustainable environment. It is a practice of creating healthy facilities designed and built in a resource efficient manner. Green building is therefore not a matter of choice but a necessity for the environmentally conscious industry professionals. Green building practices expands and complements the conventional building design concerns of economy, utility, durability, and comfort (USEPA, 2009). It brings together a vast array of practices, techniques and skills to reduce and ultimately eliminate the impact of buildings on the environment and human health.

Benefits of Green Buildings practices

The World Green Building Council's [WGBC], (2013), report pointed out a number of green building benefits to include low operating cost due to reduced energy costs, better environment, high staff retention rate and reduction in workplace illness and absenteeism. This was also in agreement with the finding of the examination of market drivers of green building conducted by McGraw Hill Construction (2014). They found that green building increased worker's productivity, reduced absenteeism, reduced healthcare cost and improved employee satisfaction. A study done by Boyd and Kimmet (2006), looked at the Triple Bottom Line [TBL] approach to the financial performance of investment properties, focusing specifically on environmental and social characteristics of green buildings. The outcome of the study shows greater environmental efficiency, i.e. improved working environment, reduced building operating costs, reduced Facilities Maintenance (FM) costs and increased capital costs. All characteristics, with exception to the latter had positive impacts on the capital value of property.

Challenges of green building practices

While green building practices promises lofty benefits, potential challenges to its implementation have equally been documented in the literature. Bowers and Cohen (2009) argues that though many risks of green building are similar to the risk of conventional buildings, the addition of sustainability/efficiency benchmarks and the need to attain a certain level of certification was recognized to be a greater challenge. The authors emphasize risk facing design professionals such as Leadership in Energy and Environmental Design [LEED] to include; expectation to show higher standard of care from the designers, acceptance of the fact that design failures may result in non-compliance with the LEED certification of the project, and more importantly, liability may arise from the failure of system or component to perform adequately over the building's life cycle.

Currently, nearly every country in Europe, Unites state of America, Canada, Australia, Japan Hong Kong and South Africa has their green building rating tool. The World Green Building Council has three levels of membership (established, emerging and prospective), having about 100 Green Building Councils (GBCs) at various membership around the world 27 being fully established with South Africa having only one established Green Building Council (GBC) in Africa (Olaleye et al, 2015). Non-establishment of green building council have been identified as potential barrier to implementation of green building practices in the developing and least developed countries (Kalua, 2015).

There is also a perception that green buildings are more expensive than conventional building (Kats, 2003; Srinivas, 2007) but Morris & Matthiesen, (2007) are of the opinion that there is no significant difference in average costs of green buildings as compared to conventional buildings.

A few authors on this topical issue from Nigeria have equally lent their voices. Findings from the study of perceptual analysis of the benefits and implementation difficulties of green building conducted by Oladokun, Gbadegesin, & Ogunba, (2011) shows that improved wellbeing, reduced turnover and increased ability to attract high quality workers, increased work process efficiency in ranked order were benefits of green building. The findings from the authors further reveals that lack of political will and strong leadership at the top levels of government, the benefits of green certification are not clearly understood by many of the country's decision makers and lack of conceptual understanding among leaders about sustainability and its long-term, systematic benefits to the residents and the economic vitality of the country also in ranked order were recognized as perceived implementation difficulties. The authors advocated a strong political will for the development of legal framework for the implementation of green buildings in the country. Otegbulu, (2011) examined occupiers' preferences with respect to existing building components and services to ascertain the level of their appreciation of green elements in its economics of green design and environmental sustainability. The results of the survey revealed that incidences of flooding, loss of property, and poor electricity were traced to unsustainable building design. The author advocated for a holistic adoption of green design in Lagos metropolis. Dahiru, Dania, and Adejoh, (2014) inquired into the expectations of stakeholders on the potential benefits of green building in Nigeria. The authors discovered that reduced capital costs, reduced operating costs, market benefits, health and productivity gains, reduced liability risk, attraction and retention of employee, preserving natural resources were the perceived benefits from implementing green building practices. The results from the authors further revealed that lack of awareness, developer and builders tends to keep as simple as possible, market expectation and no enabling environment as factors hindering the practice of green building. Olaleye et al, (2015) explored the relevance of green building practice in emerging market. The outcome of the perceptual analysis indicated that reduced resource utilization, improved quality of work life, increase ability to sell to pro-environmental customers, enhanced occupant comfort and health were potentials advantages of green features. Some of the operational challenges faced on existing building features according to the authors are cumbersome maintenance of lightening process, inefficient power supply system, and high cost of water. With the apparent benefits derivable from green building buildings, it is anticipated that if building users and occupants, especially in developing country like Nigeria and most importantly across Metropolitan Lagos, are adequately informed and sensitized, their demand for green building might be better enhanced.

METHODOLOGY

The research is descriptive in nature. Literature review was first undertaken to determine issues around green building concept. A questionnaire survey was adopted because it can be used to gather information from large samples and the result can be used for further statistical analysis. Data were obtained through a self-administered close-ended questionnaire. Questions were asked on the perceived benefits of green building which was categorized under four different headings such as higher building value, cost savings, productivity gain and the environment based on the literature. Questions were equally asked on the potential barriers to green building practices under three different categories such as education/awareness, and lack of incentive, support, regulation from leadership and government as was identified in the literature. This is similar to methods used in related studies (David & Olabode, 2015; Ahn, et al, 2013). The study took place in Lagos State, Nigeria being the nation's commercial capital with over 80% of businesses having their head offices or at least a branch office in the city.

Population of the study comprises Real Estate Development of Nigeria (REDAN) whose members include (Architects, Builders, Civil Engineer Town Planners and Quantity Surveyors) and Estate Surveyor and Valuers. The study adopted random sampling techniques where questionnaires were delivered directly to respondents and filled questionnaires were retrieved after the administration. A total of 242 questionnaires were administered to the respondents out of which 190 were retrieved. During the central editing, a total of 15 questionnaires were diagnosed with error of omission and partial completion. This renders affected questionnaires invalid for this study. In all, a total of 175 questionnaires were valid for this study, making a response rate of 72.3% which formed the basis of data analysis and the subsequent conclusion. According to Moser and Kalton (1974, p.45) the result of a survey could be considered as biased and of little value if the response was lower than 30-40%, the response rate for the research is 72.3% which indicate an unbiased and higher value of survey.

Cronbach's alpha is a measure of internal reliability. This is bound by 0 and 1, with measure closer to 1 representing strong reliability for the items in the research instrument. The sustainability instrument in this study recorded a Cronbach's alpha value of 0.797 which justifies the reliability of the instrument to adequately measure the data obtained. The data was analyzed using the Statistical Package for Social Sciences (SPSS). Techniques applied for data analysis were mean scores and ranking as most of the variables were measured on nominal scale while few of the variables were measured on the ordinal scale. The averaging statistical analysis was also used to calculate straightforward totals, percentages and averages.

Responses were evaluated on a perceived level of agreement with statement based on a 5-point likert scale where 1= hardly beneficial, = fairly beneficial, 3= not beneficial, 4= beneficial and 5=very beneficial. The perceived benefits were then ranked based on their mean values.

Furthermore, in examining potential barriers to green building practices, responses were equally evaluated based on a 5-point likert scale where 1= strongly disagree, 2=disagree, 3=undecided, 4= agree and 5=strongly agree. The potential barriers were subsequently ranked based on their mean values.

RESULTS AND DISCUSSION

For ease of presentation, the results are analyzed and discussed in line with the three focal areas of the study. The first aspect focused on the perceived benefits of green building practices by stakeholders in the built environment the second focused on implementation challenges of green building practices while policies to be implemented towards the improvement of green building practices by stakeholder formed the third focal area.

Qualifications and experiences

Most of the respondents hold a first degree i.e HND (37.7%) and B.sc (48.6%), and a master's degree (13.7%). Moreover, 70.3% of the respondents are Estate surveyor and valuers while 29.7% of the respondents are members of REDAN with various qualifications and affiliated with other professional members. From the demographic survey coupled with the years of experience and professional qualifications of the respondents it is believed that

they are suitably qualified to make informed opinion on green building practices. They are thus assumed to be knowledgeable enough to give informed opinion on set of variables presented in the questionnaire.

Table 1: Perceived Benefits of Green Building practices

1. *Productivity Gain*

VARIABLES	N	Mean	Std. Deviation	Variance	ranking
User satisfaction.	175	3.5886	1.14565	1.313	1
Users have more control over their environment.	175	3.5257	1.21209	1.469	2
Reduce absenteeism.	175	3.2514	1.19129	1.419	3
Boost creativity.	175	3.2457	1.14077	1.301	4
Better comfort for the occupant.	175	3.1143	1.38073	1.906	5
Fewer claims made on health cost. e.g medical cost.	175	3.0343	1.21720	1.482	6
Higher morale.	175	2.9829	1.31514	1.730	7
Reduce health and safety risk.	175	2.9657	1.28160	1.642	8
Improved indoor air quality for staff welfare.	175	2.9543	1.21209	1.469	9
Productivity benefits.	175	2.8057	1.23035	1.514	10
Valid N (listwise)	175				

2. Higher Building Values

VARIABLES	N	Mean	Std. Deviation	Variance	ranking
Higher prestige	175	3.1771	1.21179	1.468	1
Better market distinction	175	3.1657	1.25989	1.587	2
Enhancement of building value	175	3.0857	1.22642	1.504	3
High demand	175	3.0000	1.25488	1.575	4
Readily leased	175	2.9257	1.24114	1.540	5
Secure higher rent	175	2.9029	1.14307	1.307	6
Higher tenant retention	175	2.8400	1.29881	1.687	7

3. *Cost Savings*

VARIABLES	N	Mean	Std. Deviation	Variance	ranking
Reduce operating cost	175	3.7429	1.27177	1.617	1
Water conservation	175	3.4343	1.17198	1.374	2
Energy efficiency	175	3.1886	1.26577	1.602	3

4. ***Environment***

VARIABLES	N	Mean	Std. Deviation	Variance	ranking
Optimize life cycle economic performance of building	175	3.3829	1.19228	1.422	1
Improvement of air and water quality.	175	3.2457	1.27404	1.623	2
Fight global warming.	175	3.2286	1.21499	1.476	3
Sustainability (not to jeopardize future generations need.	175	3.2171	1.17871	1.389	4
Conservation of natural resources.	175	3.2114	1.20625	1.455	5
Reduce waste pollution and environmental degradation.	175	3.1657	1.30911	1.714	6
Improvement of air, thermal and acoustic environment of building.	175	3.1429	1.24436	1.548	7
Waste minimization	175	3.1257	1.29374	1.674	8
Enhance and protect ecosystem and biodiversity.	175	3.1200	1.22352	1.497	9
Less pollution	175	3.0400	1.24273	1.544	10

Table1 indicates overall probable benefits of implementing green building practices under four categories: higher building value, cost savings, productivity gain and the environment from the perspective of stakeholders in built environment. Most of the identified perceived benefits indicated preparedness to embrace green building as most mean values were above the average of 2.5. The highest ranked perceived benefits under the category productivity gain was user satisfaction with mean value of 3.5886 followed by user have more control

over their environment with mean value 3.525 while reduce absenteeism and boost creativity with mean values 3.2515 and 3,2457 were ranked third and fourth respectively. The least ranked perceived benefits under the same heading were reduced health and safety risk, improve indoor air quality and productivity benefit with mean values of 2.9657, 2.9543 and 2.8057 respectively.

The highest ranked perceived benefits under the second category was higher prestige (3.1771), followed by better market distinction (3.1657), while enhancement of building value and higher demand with mean values of 3.0857 and 3.000 respectively were ranked third and fourth. The least ranked perceived benefits under this category were readily leased, secured higher rent, high tenant retention, with the mean values of 2.9526, 2.9029 and 2.8400.

The highest ranked perceive benefit under the category of cost savings was reduction in operating cost (3.7429), followed by conservation of water (3.434) and energy efficiency with mean value 3.1886. This result is in accordance with the findings of Dahiru, Dania & Adejoh (2014), Oladokun, et al (2010), which established a reduction in energy cost to be a major benefit of green building.

For the category of environment, the highest ranked perceived benefit was optimization of life cycle economic performance of building with mean score of 3.3829, this was followed by improvement of air and water quality with mean score 3.2457 and fight global warming was ranked third with mean score of 3.2289. the least ranked perceived benefit of green building under this heading were waste minimization, with mean score of 3.1257, followed by enhance and protect ecosystem and biodiversity with mean score of 3.1200 and less pollution with mean score 3.0400. The result was in agreement with UNEP report of 2011 that green building practices are a collection of environmentally sustainable friendly measure which aim to inform environmentally sustainably path for the built environment.

Table 2: Potential barriers to adoption of green building practices

Education/awareness

VARIABLES	N	Mean	Std. Deviation	Variance	Ranking
Unwillingness to change	175	3.4629	1.21653	1.480	1
Slow market penetration	175	3.4114	1.27391	1.623	2
Lack of awareness about the amount of greenhouse gases released by conventional building	175	3.3600	1.21371	1.473	3
Lack of awareness of the benefits of green building	175	3.2400	1.16934	1.367	4
Lack of faith in effectiveness of green features	175	3.1886	1.25207	1.568	5
Inadequate knowledge about investment in innovative building	175	3.1486	1.21801	1.484	6
Lack of awareness about the amount of energy & resources average building consume	175	3.1429	1.23509	1.525	7
Lack of knowledge of the wide raging environmental problems caused by conventional building	175	3.0400	1.22409	1.498	8

Lack of incentive, support, regulation and concept from leadership and government.

VARIABLES	N	Mean	Std. Deviation	Variance	Ranking
Lack of good examples of green buildings and green technologies in the Country	175	3.6686	1.20530	1.453	1
Absence of authority responsible for implementing the adoption of green buildings	175	3.4457	1.24853	1.559	2
Insufficient support and leadership by various level of government.	175	3.3829	1.17285	1.376	3
Uncertainty about new and emerging green technologies.	175	3.3771	1.31985	1.742	4
Value in green building is often intangible	175	3.3657	1.28339	1.647	5
Insufficient government incentives	175	3.3200	1.18922	1.414	6
Reliability of using renewable energy sources	175	3.3086	1.19707	1.433	7

Inconsistency/uncoordinated Regulation	175	3.2857	1.17863	1.389	8
Lack of conceptual understanding among leaders about sustainability and its long-term benefit.	175	3.2800	1.23008	1.513	9
Value in green building is typically excluded from developer's own cost-benefit analysis.	175	3.2400	1.19366	1.425	10

Table 2 shows some probable barriers of implementing green building practice. They were categorized under two headings: Education/Awareness and Lack of incentive, support, regulation and concept from leadership and government. It is instructive to note that most of the identified variables under different categories are significant barriers as most of them are above the average mean value of 2.5.

The result from the first category of barrier which is education/awareness revealed that unwillingness to change with mean value of 3.4629 was ranked first and this was closely followed by slow market penetration with mean value of 3.4114 while lack of awareness about the amount of greenhouse gases released by conventional building and lack of awareness of the benefits of green building with mean values of 3.3600 and 3.2400 were ranked third and fourth respectively. The least ranked factors under this category were inadequate knowledge about investment in innovative building with mean value of 3.1486 which was ranked 6th while lack of awareness about the amount of energy & resources average building consume and lack of knowledge of the wide raging environmental problems caused by conventional building with mean values of 3.1429 and 3.0400 were ranked 7th and 8th respectively. Findings from the second category which was grouped under lack of incentive, support, regulation and concept from leadership and government revealed that lack of good examples of green buildings and green technologies in the country with mean value of 3.6686 was ranked first followed by absence of authority responsible for implementing the adoption of green buildings with mean value of 3.4457, and Insufficient support and leadership by various level of government with mean value of 3.3829 was ranked third while uncertainty about new and emerging green technologies, value in green building is often intangible with mean values 3.3771 and 3.3657 were ranked fourth and fifth respectively. The least ranked factors among the variable are Inconsistency/uncoordinated regulation with mean value of 3.2857 lack of conceptual understanding among leaders about sustainability and its long-term systemic benefits to the residents and the economic vitality of the country with mean value of 3.2800 and value in green building is typically excluded from developer's own cost-benefit analysis with mean value of 3.2400 were ranked eighth, ninth and tenth respectively in the series. The outcome of this research was in accordance to the view expressed by Tse & Ganesan, (1997) as cited in kalua, (2015) that government macroeconomic policy influences construction activity. Therefore, a certain amount of political goodwill for green building practices would go a long way in enhancing their economic sustainability.

Table 3 contains responses of stakeholders on the probable policies to be implemented towards the improvement of green building in commercial properties in Lagos metropolis, Nigeria. Results of analysis from the table show that in rank order, identification of green building practice that are not yet incorporated was ranked first with mean value of 3.7257, this was followed by the development of legal framework for the establishment and implementation of green building in Nigeria with mean value 3.4686, and intensive enlightenment and publicity about the benefits of green building with mean value of 3.4457 was ranked third while ensuring that these priorities are addressed when establishing green building requirement with mean value 3.0400 was ranked fourth and awareness through research and publication was ranked fifth with mean score value 1.338962. This result was in agreement with the view expressed by Adegbile, (2013) who suggested that for implementation of green building in Nigeria, Government at federal, state and local levels should not only support but also legislates a national/state/local green building policy and regulation on sustainability issues, implement same in the building acts, building regulations, building bye-laws and building codes.

Table 3: policies to be implemented toward the improvement of green building

VARIABLES	N	Mean	Std. Deviation	Variance	RANKING
Identify green building practice that are not yet incorporated.	175	3.7257	1.16667	1.361	1st
Development of legal framework for the establishment and implementation of green building in Nigeria.	175	3.4686	1.28111	1.641	2nd
intensive enlightenment and publicity about the benefits of green building	175	3.4457	1.28482	1.651	3rd
Ensure that these priorities are addressed when establishing green building requirement	175	3.0400	1.25652	1.579	4th
Awareness through research and publication	175	3.0000	1.38962	1.931	5th
Consider the extent to which building requirement already establish green building measure	175	2.6514	1.32122	1.746	6th

CONCLUSION AND RECOMMENDATION

The implication of the result is that though no building has been certified in Nigeria, given the various benefits that stakeholders tends to derive from going green, there is high potential for its implementation, growth and practices among built environment practitioners and environmentally conscious person. Based on the findings of this study, Green building practices therefore is not a matter of choice but of necessity for the environmentally consciously professionals, developer and even government taking into consideration devastating effects of climate change across the world today. To propagate this lofty practice therefore, perceived implementation challenges such as absence of authority responsible for implementing the adoption of green buildings, insufficient support and leadership by various level of government should be surmounted. This can be done by development of legal framework for the establishment and implementation of green building practices in Nigeria and carrying out intensive enlightenment and publicity about the benefits of green building practices.

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STRATEGIES FOR MATERIAL WASTAGE MNIMIZATION ON BUILDING CONSTRUCTION SITES IN KADUNA STATE – NIGERIA

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A major feature of average construction sites in Nigeria is the presence of material wastage in various forms and in large quantities. Construction materials often account for more than 50% of the total cost of buildings in Nigeria and a greater part of it is wasted during construction process. To this extent, the study evaluated the cost of wastage of some selected materials and waste minimization techniques adopted on construction sites. Mean Score, Ranking and T-Test were employed for data analysis. Findings revealed that the major factors that contribute to material wastage were poor supervision, improper material handling and faulty workmanship. In addition, the study indicated that there is no significant relationship between estimated and actual material waste on construction sites based on the P-value of 0.296 which was greater than 0.05. It was concluded that material wastage has an effect on contractor's profit margin and overall project cost which accounted for over 50%. Cement, blocks and formworks had the highest wastage indices of 6.01, 10.67 and 10.09 respectively. The study recommended that materials with high negative wastage indices should be given greater attention.

Keywords: Materials, Strategies, Waste, Construction Sites

INTRODUCTION

The construction industry is one of the vital constituent of any country's economy. The growth in construction activities increases the amount of construction waste generated (Babatunde, 2012). Dennis (2001) established that the construction industry has been found to be one of the major generators of waste in the built environment. Building materials account for 60 – 70% of the project cost (Mahesh, Chetna, Bhavsar and Rakesh, 2011). Up to 15 – 30% of purchased materials at construction sites end up as waste in landfill sites in many countries (McDonald and Smithers, 1996). Generally, construction activities which produce waste can be grouped into off-site and on-site operational activities. Off-site activities include prefabrication, project design (architectural, structural, mechanical and electrical design), manufacturing and transporting of materials and components. On-site construction activities relate to construction of a physical facility which consists of the substructure and superstructure of a building. Some degrees of waste materials are inevitable in the construction process. All estimators allow wastage factors in the pricing of BOQs. Over the years, experience has shown, however, that unless site management control is tight, wastage can frequently exceed, often by a large margin than the figure allowed in the tender document (Wahab and Lawal, 2011). This assertion is in line with Babatunde (2012), his study concluded that construction material wastage accounted for an average of 15.32% in construction sites which was higher than the allowable waste in the BOQ. Dennis (2001) asserted that many building materials that are wasted on construction sites, result in two cost factors (materials procurement cost and the waste disposal cost). Although the waste disposal cost of construction site waste form as little as 0.5% of the total budget of a typical building project, contractors realize that this cost can significantly affect their profit since contractors generally operate within a tight 5% profit margin.

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Okosun, et al., (2018). **LIVELIHOOD OPPORTUNITIES IN SOLID WASTE RECYCLING IN KADUNA METROPOLIS, NIGERIA.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

Most construction managers and building professionals are majorly concerned on how to control cost without any emphasis on waste control measures. Therefore it is crucial that materials be adequately controlled and a proper site management layout (Wahab and Lawal, 2011). Waste recovery for reuse and recycling can tremendously reduce the amount of waste that is destined for disposal by landfill. It is therefore important for the contractor to adopt waste management methods that will provide a sustainable built environment and give the contractor an edge in winning contracts. Hence the need to study construction wastage minimization techniques on construction sites in Nigeria.

LITERATURE REVIEW

The construction industry has been characterized as one that produces the highest amount of solid waste amongst all industries (Olatunji and John, 2013). Waste incurs additional cost either through it being carted away or that which results from the actual work. Waste arises from different activities carried out by the contractor during construction, maintenance and demolition which include wood, cement, glass, tiles, plastic, concrete, pipes and paint (Ekanayake and Ofori, 2000).

Ekanayake and Ofori (2000) categorized construction waste into four major categories as; design, operational, material handling and procurement (see Table 1). However design and operational factors are of major concern because little detail is paid to material waste minimization at these stages of a project. Babatunde (2012) quantitatively classified construction material waste as cutting waste, application waste, transit waste and theft and vandalism waste.

The critical point at which contractors and subcontractors can influence material waste is when buying materials for a project. This activity determines the materials that are to be considered in-expensive when compared to labour. A "waste allowance" is generally included within the order to account for design waste and construction process waste. These waste allowances are often generic and not inaccurate (Dennis, 2001). This can lead to either the order of a surplus of materials (usually entering the waste stream) or a materials shortfall (resulting in additional costs to purchase more materials). Little evidence exists on the practice of reconciliation between materials ordered and materials used (Jannatun and Zulhabri, 2014). Material wastage results in increasing the total project cost and reduces profit for contractors and subcontractors. If contractors can demonstrate willingness to support and engage in waste reduction measures and demonstrate that these have an effect on their waste, then they improve their chances of being identified as preferred bidders as they could help in meeting their waste targets (Dennis, 2001). According to Al-Hajj and Hamani (2011), there are several waste techniques which contractors or project managers can apply at every stages of a building project in order to reduce waste and increase contractor's profit margin. Some of these techniques according to Dennis (2001); Jannatun and Zulhabri (2014); Sawant, Hedaoo and Kumthekar (2016) include the 3 "R"s of construction waste minimization which are based on three (3) concepts namely recycling, reuse and reduction. Some other waste minimization practices also include Lean construction, material requisition, just-in-time principle, disposal method, waste management plan amongst others (Greenwood *et al*., 2003, Parija*et al*., 2010 and Ayarkwa, 2012).

According to Akinkurolere and Francis (2005) the economic interest in re-using or recycling building materials is governed by some factors which are; the availability and thus the cost of natural or new building materials, the availability of disposal space, the tipping charges and the taxes for dumping, and the transportation cost. Effective waste management is of growing significance for the construction industry. Adding the cost of storing and transporting construction waste, along with the loss of revenue from not reclaiming waste materials, it makes financial sense for construction companies to take action to minimize waste.

Table 1: Sources of Material Wastage

Design	Operational	Material Handling	Procurement
Lack of attention paid to dimensional coordination of products.	Errors by tradesmen or operatives.	Damages during transportation.	Ordering errors (eg., ordering significantly more or less).
Changes made to the design while construction is in progress.	Accidents due to negligence	Inappropriate storage leading to damage or deterioration.	Lack of possibilities to order small quantities
Designers inexperience in method and sequence of construction.	Damage to work done caused by subsequent trades	Materials supplied in loose form	Purchased products that do not comply with specification
Lack of attention paid to standard sizes available on the market	Use of incorrect material, thus requiring replacement	Use of whatever material close to working place	
Designers unfamiliarity with alternative products	Required quantity unclear due to improper planning	Unfriendly attitudes of project team and operatives	
Complexity of detailing in the drawings	Delays in passing information to the contractor on types and sizes of products to be used		
Errors in contract documents	Equipment malfunctioning		
Incomplete contract documents at commencement of project	Inclement weather		
Selection of low quality products			

(Source: Ekanayake and Ofori, 2000)

Material Wastivity

Material wastivity concept was developed as an indicator of the wastage rate of a material and the contribution of the material wastage to construction cost overrun. Therefore, it is a proposed strategy in material management for disbursing the available resources and control of those materials such that greater attention would be devoted to these high wastage indices (Oladiran, 2008 and Mahesh *et al*., 2011).

$$\text{Wastage level (\%)} = \frac{Mp - Mu}{Mp} \times 100\%$$

Where Mp = Purchased material

Mu = Used material

$$\text{Wastivity} = \frac{\text{Wastage}}{\text{Estimated consumption}} \times 100\%$$

Where;Estimated = what was originally proposed for the work.

Actual = what was used after the supply for the work.

RESEARCH METHODOLOGY

In order to examine the factors responsible for material wastage on the Nigerian construction sites and to assess the cost implication of material waste on the profit margin of contractors two sets of data were gathered. The first part involves a visit to five construction project sites in Kaduna in different locations and projects that were at different stages of construction were observed to stocktaking the level of material waste management on construction sites

and to investigate from site supervisors about the strategies being used in minimising construction waste. The second part of the study involves administration of well-structured questionnaire to professionals involved on some identified on-going construction projects within the study area to obtain information on the factors responsible for material wastages on construction sites. A combination of purposive and snowballing sampling techniques were employed in administering a total of 100 questionnaires to the construction professionals. A snowball sample is a non-probability sampling technique that is often being used in research when the elements of a population are difficult to locate. This was employed to assists the researcher to obtain data from the few construction sites which the researcher can locate, then make a request from those identified to provide information needed to locate other construction sites that they know are presently undertaking construction works. The selected sites for visit and observation were purposively selected. Of 100 questionnaires that were self-administered, 90 were retrieved and met the condition for the analysis presented in this paper. The study also obtains archival data from the selected construction sites and as well carried out document analysis. The results obtained from the first phase as well as the quantitative data were analysed, combined and discussed in line with the literature findings. Descriptive analysis (mean score, relative important index, charts) and Inferential analysis (T-Test and Wastitivity analysis) were employed for this study.

RESULTS AND DISCUSSION OF FINDINGS

Table 2: Ranking individual factors contributing to material wastage on constructions sites

Individual Factors	Contractor Mean Score	Contractor Rank	Consultant Mean Score	Consultant Rank	Overall Mean Score	Overall Rank
Design Variables						
Poor supervision	4.62	1	4.62	1		
Incorrect specifications	4.40	3	4.44	3	4.28	3
Undue interference with the execution with the project	3.60	5	4.33	4		
Late changes/ alteration	4.54	2	4.60	2		
Detailing errors	4.40	4	3.23	5		
Supply, Material handling and storage						
Improper Material Handling	4.65	1	4.59	2		
Negligence/ Carelessness	4.62	2	4.44	3		
Poor storage/ poor site layout	4.33	4	4.63	1	4.38	1
Manufacturing Defect	3.97	5	4.31	4		
Mode of Delivery	4.58	3	3.77	5		
Operational						
Faulty workmanship	4.71	1	4.71	1		
Over Estimating the Required Quantity	4.52	3	4.43	4	4.31	2
Misinterpretation of Drawing	3.87	4	4.50	3		
Poor Material Management Practices	4.68	2	4.63	2		
Excess Material Input especially due to over Excavation	3.53	5	3.52	5		
Phenomenal						
Delay of Passing Information to the Contractor	4.4	2	2.89	4		
Required Quantity Unclear due to improper planning	3.45	4	3.55	3	4.11	5
Damage by inclement condition	4.41	1	4.58	1		
Site accident/ acts of God/ Natural disasters	4.41	1	4.58	1		

Damages while transporting	4.33	3	4.53	2		
Client related						
Undue Pressure to deliver, resulting in crash Programme	4.50	1	4.46	1	4.20	4
Expectation of too High Standard	4.47	2	3.42	3		
Undue Interference with the Execution of the Project	4.38	3	3.97	2		

The findings in Table 2 above showed the contractor and consultant ranks of category of factors contributing to material wastage on construction sites. The study revealed that Supply, Material handling and storage factors mostly contribute to material waste, followed by operational factors, design variables client related factors and lastly phenomenal factors with mean scores of 4.38, 4.31, 4.28, 4.20 and 4.11 respectively. The table also showed from the contractor's ranking that, supply Material handling and storage factors were majorly due to improper material handling, and negligence/carelessness; while from the consultant's ranking, poor storage and improper material handling contributed mostly to supply factors. Poor supervision was the most contributory to design factors, followed by late changes and incorrect specifications. From the contractor and consultant's mean scores, faulty workmanship (4.71) was the most contributory to operational factors while excess material wastage input especially due to over excavation was the least contributory with an average mean score of 3.52. Client related factors were mostly as a result of undue pressure to deliver resulting in crash programme with mean scores of 4.50 and 4.46 from contractor and consultant rank respectively. Both contractors and consultant respondents agreed that phenomenal factors were due to damage by inclement weather and site accident / act of God that contribute to material wastage on construction sites.

Table 3: Ranking of contributory effects of material waste on construction projects.

S/N	Contributory Effect	Contractor Mean Score	Contractor Rank	Consultant Mean Score	Consultant Rank
1	Increases material shortage on site	4.70	1	4.38	2
2	Delay in completion time	4.50	6	4.17	4
3	Increase project cost	4.63	2	4.42	3
4	Increases use of man power	3.97	9	3.54	9
5	Increases cost of operating & maintaining landfill sites	4.48	7	4.00	7
6	Reduce clients value for his money	4.52	4	4.79	1
7	Increase environmental pollution	4.50	5	4.00	6
8	Reduce contractors profit margin	4.61	3	3.96	8
9	Reduce production productivity	4.30	8	3.38	10
10	Increase in disposal cost	3.42	10	4.04	5

Table 3 above showed contractor and consultant ranking of contributory effects of material wastage on construction projects. From the contractor's point of view, the major effect of material waste are, increases material shortage on site, increase project cost and reduces contractor's profit margin with mean scores of 4.70, 4.63 and 4.61 respectively. Increases use of man power and increase in disposal cost ranked the least with mean scores of 3.9 and 3.42. Consultant ranking showed that, reduces clients value for his money ranked first followed by increases material shortage on site and increases project cost, with mean scores of 4.79, 4.38 and 4.42 respectively. Consultant ranking of least contributory effect of material wastage on construction projects was in line with contractors results.

Table 4: Percentage cost of materials to the total cost of construction.

S/N	Percentage cost (%)	Frequency	Percentage (%)
1	Below 20%	0	0
2	20-30%	0	0
3	31-40%	0	0
4	41-51%	6	6.67
5	Above 50%	84	93.33
	Total	90	100

Table 4 shows the percentage cost of materials to the total cost of construction. It can be deduced that, above 50% ranked highest which accounted for 93.33% of respondent population while 41-51% came second which accounted for 6.67%. 40% below were null.

Table5: Level of usage of material waste management techniques

S/N	Level of usage of Material waste management techniques	Frequency	Percentage
1.	**Lean construction**		
	Very much in use	0	0
	Slightly in use	14	21.21
	Not in use	52	78.79
	Total	66	100
2.	**Just-in-time principle**		
	Very much in use	3	4.55
	Slightly in use	6	9.09
	Not in use	57	86.36
	Total	66	100
3.	**Waste management plan**		
	Very much in use	0	0
	Slightly in use	7	10.61
	Not in use	59	89.39
	Total	66	100

The analysis in Table 5 above showed the Level of usage of material waste management techniques. It can be deduced from the table above that, although very few of the respondents slightly use some of the above techniques, majority of the contracting respondents do not use lean construction, just-in-time principle and waste management plan which accounted for 78.79%, 86.36% and 89.39% respectively.

Table 6: Effect of Material Waste on Contractor's Profit Margin and Overall Project Cost

Effect	Mean Score
Very High Effect	4.00
High Effect	3.38
Low Effect	3.33
No Effect	2.71

As seen from Table 6 above, there is a very high effect of material waste on contractor's profit margin and overall project cost with a mean score of 4.00, followed by high effect (3.38), Low effect (3.33) and lastly no effect (2.71).

Table 7: Material wastage control strategies on construction sites.

Material wastage control strategies on construction site	Contractor Mean Score	Contractor Rank	Consultant Mean Score	Consultant Rank
Building information modelling	4.87	1	4.75	1
Use of Quality Materials	4.67	2	4.63	1
Proper storage, handling and usage of materials	4.78	1	4.60	3
Improved site security	4.62	4	4.60	4
Effective material planning and control policy	4.57	5	4.50	8
Record keeping	4.52	7	4.52	7
Preparation of material element schedule	4.63	3	4.57	5
vigilance of supervision	4.53	6	4.53	6
Adherence to standardized dimensions	3.83	13	4.11	11
Reuse of Materials	4.48	8	3.95	10
Effective waste Accounting System	3.92	11	3.82	12
Correct and comprehensive design details/specification	4.33	9	4.62	2
Avoidance of late changes at critical stages	4.21	10	4.47	9
Education and training of site personnel	3.87	12	3.80	13

Table 7 showed material wastage control strategies on construction sites. Contractors ranked proper storage, handling and usage of materials, use of quality materials and preparation of material element schedule (4.78, 4.67 and 4.63 respectively) as the major material waste control strategies on construction sites. Avoidance of late changes at critical stages;education and training of site personnel, effective waste accounting system and adherence to standardized dimensions were the least considered strategies by the contractors and consultants. The consultants ranked use of quality materials (4.63), Correct and comprehensive design details/specification (4.62) and proper storage,

handling and usage of materials (4.60) as the major material waste control strategies on construction sites.

Graphical Presentation of Data

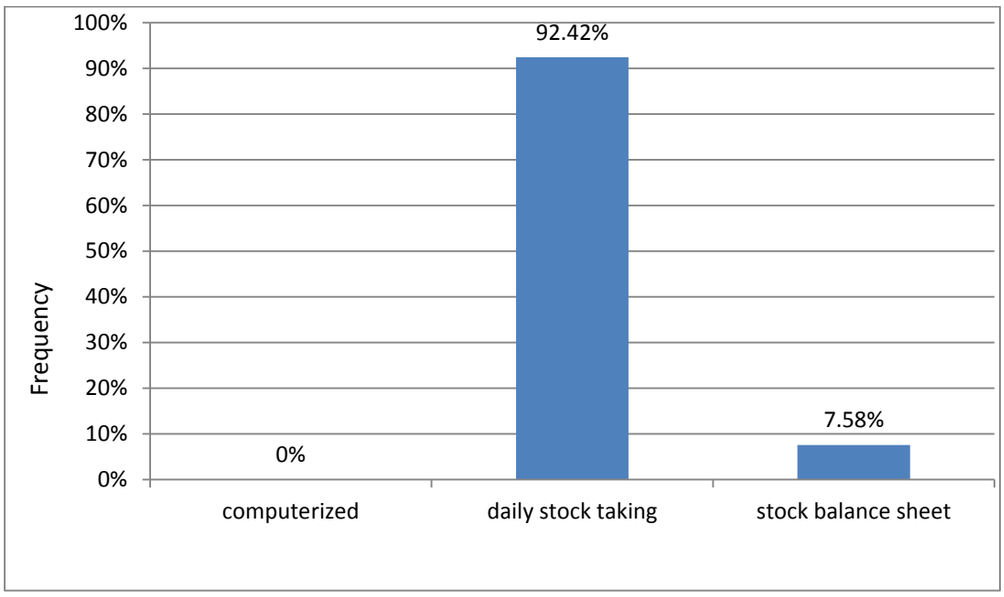

Figure 1: Material Record Systems

The results of the analysis in Figure 1 revealed that material record system is mainly by daily stock taking (92.42%) while 7.58% of the respondents record materials by stock balance sheet. None of the respondents have computerized material record system.

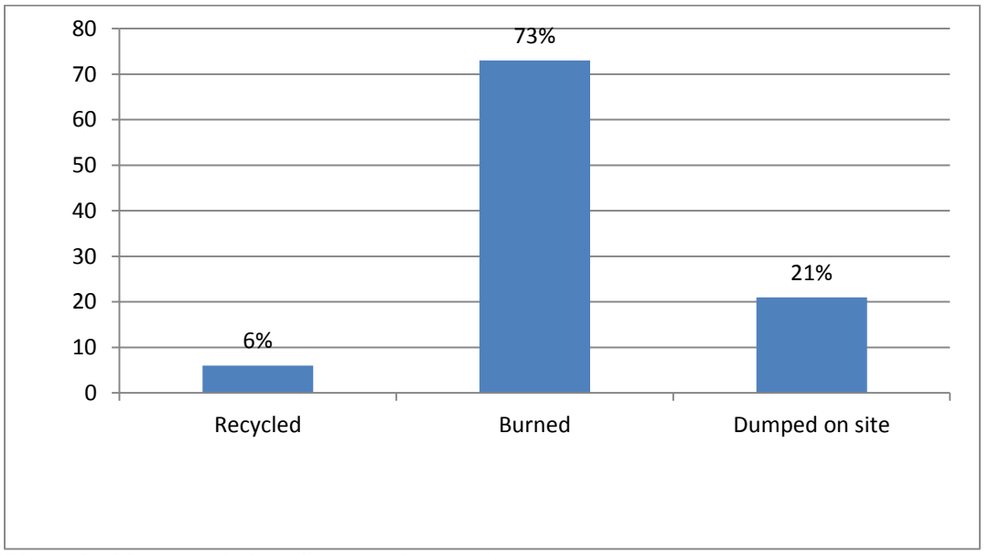

Figure 2: Methods of disposing materials on site

Figure 2 revealed the methods of disposing materials on site. 73% of the respondents burn materials on site, 21% dump materials on site while only 6% recycle their materials.

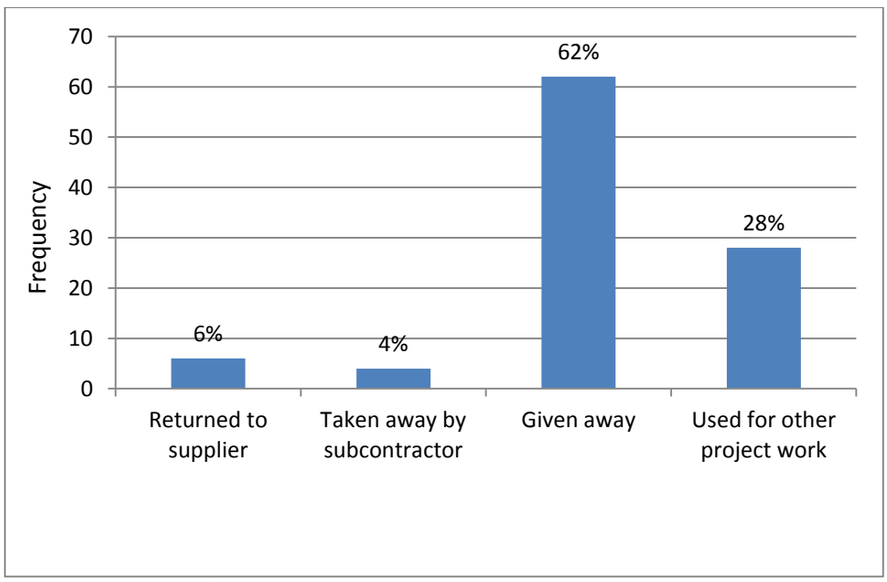

Figure 3: Method of disposing unused materials on the site

Figure 3 above shows the method of disposing unused materials on the site. 62% of the contractor respondents give away unused materials on site, 28% use the materials for other project works while 6% of the unused materials are returned to the supplier.

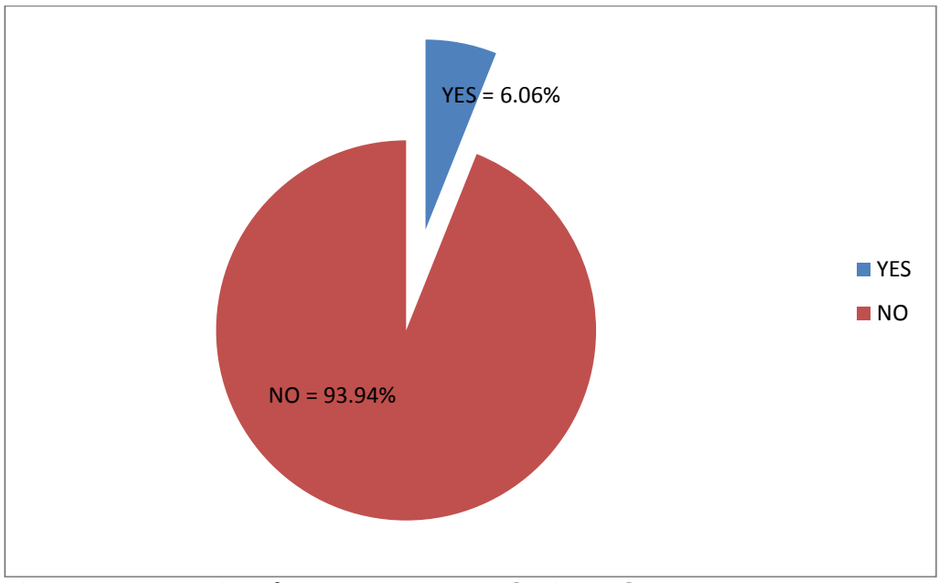

Figure 4: Incorporation of Waste Management Plan in Tender Document

Figure 4 above shows that 93.94% of the respondents do not incorporate waste management plan in tender documents when bidding for contracts. Only 6.06% of the respondents incorporate waste management plan.

Test of difference in wastage assessment of key construction materials obtained from site records and Bill of Quantities.

Table 8: T-test for Cement

	CEMENT (bags)				ANALYSIS			
Project Site	**Total usage** Estimated (bags)	Actual (bags)	**Wastage (bags)**	**Wastivity (%)**	**Mean**	**T-test**	**Significant value**	**Action on hypothesis**
1.	8,450	8,910	-460	-5.44				Statistically non
2.	6,480	6,720	-240	-3.70				significant, Accept
3.	9,200	10,320	-1,120	-12.17	-554.00	-1.21	0.298	Ho
4.	5,650	5,900	-250	-4.42				
5.	16,150	16,850	-700	-4.33				

It was observed that, the estimated and actual bags of cement had negative T-test value. Significant differences do not exist between estimated and actual, which therefore accept the hypothesis Ho. From the results above, it was inferred that the estimated bags of cement was not significantly different to the actual bags of cement. This was from the significance value of 0.298, which was higher than 0.05.

Table 9: T-test for blocks

BLOCK (NO,S)					ANALYSIS			
Project Site	**Total usage** Estimated (NO'S)	Actual (NO'S)	**Wastage (no's)**	**Wastivity (%)**	**Mean**	**T-test**	**Significant value**	**Action on hypothesis**
1.	53,200	54,700	-1,500	-2.82				Statistically non
2.	15,200	15,800	-600	-3.95				significant, Accept
3.	231,500	251,500	-20,000	-8.64	-5050.00	-1.348	0.249	Ho
4.	4,000	5,050	-1,050	-26.25				
5.	18,000	20,100	-2,100	-11.67				

It was observed that, the estimated and actual bags of cement had negative T-test value. Significant differences do not exist between estimated and actual, which therefore accept the hypothesis Ho.The non-significant values was greater than 0.05. From the results above, it was inferred that the estimated bags of cement was not significantly different to the actual bags of cement. This was from the significance value of 0.249, which was higher than 0.05.

Table 10: T-test for tiles

TILES (M2)						ANALYSIS		
Project Site	**Total usage** Estimated (no)	Actual (no)	**Wastage (M^2)**	**Wastivity (%)**	**Mean**	**T-test**	**Significant value**	**Action on hypothesis**
1.	140	145	-5	-3.57				Statistically non
2.	300	450	-150	-50.00				significant, Accept
3.	150	158	-8	-5.33	-12.20	-0.313	0.770	Ho
4.	350	258.32	91.68	26.19				
5.	50	39.66	10.34	20.68				

It was observed that, the estimated and actual bags of cement had negative T-test value. Significant differences do not exist between estimated and actual, which therefore accept the hypothesis Ho.The non-significant values was greater than 0.05. From the results above, it was inferred that the estimated bags of cement was not significantly different to the actual bags of cement. This was from the significance value of 0.770, which was higher than 0.05.

Table 11: T-test for form work

Form work (M)					ANALYSIS			
Project Site	**Total usage** Estimated (no)	Actual (no)	**Wastage (M)**	**Wastivity (%)**	**Mean**	**T-test**	**Significant value**	**Action on hypothesis**
1.	170	150	20	11.76				Statistically non
2.	300	320	-20	-6.67				significan, Accept Ho
3.	250	280	-30	-12.00	20.00	0.964	0.389	
4.	500	450	50	10.00				
5.	800	720	80	10.00				

It was observed that, the estimated and actual bags of cement had negative T-test value**.** Significant differences do not exist between estimated and actual, which therefore accept the hypothesis Ho. The non-significant values was greater than 0.05**.** From the results above, it was inferred that the estimated bags of cement was not significantly different to the actual bags of cement. This was from the significance value of 0.389, which was higher than 0.05.

DISCUSSION OF FINDINGS

The study ranked individual factors that contribute to material wastage on construction sites from the contractor and consultant respondents. It was found out that material handling and storage factors were mostly due to improper handling, negligence and poor storage of materials on site. This was due to improper handling of materials by construction workers on site, such as blocks which are prone to wastage. Some of the construction sites did not have a safe and secure storage. This resulted in poor storage of some materials such as cement, which were not properly protected from weather conditions. Design factors were majorly due to poor supervision, late changes / alteration and incorrect specifications. Due to the complex nature of construction works, it is hardly possible to complete a project without changes to original plans or the construction process itself. Many of the decisions made during the design stage of a project and the choice of construction method will influence the amount of waste produced during construction and over the entire life of the building. Late changes / alteration by clients in design while construction is in progress often

result in re-work / variation which account for more usage of materials that was not budgeted for in the bill of quantities thereby leading to cost overrun of the construction project.

Faulty workmanship and poor material management practices contributed to material wastage from operational factors. This was due to the fact that construction works were not properly supervised in accordance with design specifications and usage of unqualified work men. Skilled tradesmen are very important in the use of materials because there will be no rework if they are properly coordinated and supervised to know the schedule of different activities. This result agrees with the findings purported by Muhwezi (2012). The material wastage practice is mostly the 3 R's which is not sufficient enough to curb material wastage on sites. Site accidents also contributed to material waste as a result of site layout problems which hinder workmen from utilizing materials on site effectively. It was observed that standardized dimensions of some materials were not strictly adhered to which contributed to waste on sites.

Findings from the study also revealed overall rank of factors. It was seen that supply, material handling, storage, and operational factors were the most factors and should be given adequate consideration. The finding from this study is different from Olatunji and John (2013) and Akinkurolere and Francis (2005) as this study identified 23 individual factors and categorized them into five (5) major group. However some of the factors were adopted from Ekananaye and Okorie (2000). They were further subjected to rank analysis from the consultant and contractor perspective on waste in the construction industry.

The study also showed that material waste increases material shortage on site, reduces client value for his money, reduces contractor profit margin and increases project cost. The findings agree with that of Olatunji and John (2013) that material waste give rise to shortage of materials and increases project cost. Material waste has a very high effect on contractor profit and overall project cost. The objective of giving client value for his money is defeated and this jeopardizes the chance of the contractor winning further projects.

It was observed that the 3R's of waste management technique was very much in use as compared to other technique (lean construction, just-in-time principle and waste management plan), which were rarely used by the contractors on site. Findings from other studies concentrated on 3R's of material waste management (Dennis, 2001, Shen *et al.*, 2002, Mahesh *et.al*, 2011, Jannatun and Zulhabri, 2014, Sawant, Hedaoo and Kumthekar, 2016,). This study found that other waste techniques have been used by very few contractors but it is yet to be fully implemented on construction projects in Nigeria.

Majority of the contractor respondents do not consider waste management plan as part of their tender documents in producing their construction works more effectively. This document would have helped in planning resources in order to control waste especially when handling similar projects.

Materials are usually recorded by daily stock taking. There was no computerized method of material record in place. Unused materials on site are most times given away while on site materials are disposed by majorly burning and dumping on site. This brings to play lack of qualified personnel to purchase standard materials on site and lack of usage of Just – in – time principle and Lean construction techniques.

The quantification of waste method in this study is different from Situ and Wan (2013) as this study employed the use of wastitivity and t-test analysis. Although, Mahesh *et al.*,(2011) quantified material wastage of cement, steel reinforcement, sand, coarse aggregate and bricks; this study specifically covered cement, blocks, tiles and formwork.Findings from the T-test analysis hypothesized that there is no significant relationship between estimated and actual material waste on construction sites. This was from the P-value of 0.296 which was greater than 0.05, therefore the hypothesis was accepted. Cement, blocks and formworks had the highest wastage indices signifying that the wastage level of these materials and their contribution to building projects are most critical on construction sites.

The Contractors ranked proper storage, handling and usage of materials, use of quality materials and preparation of material element schedule as the major material waste control strategies on construction sites. Avoidance of late changes at critical stages; education and training of site personnel, effective waste accounting system and adherence to standardized dimensions were the least considered strategies by the contractors and consultants. The consultants ranked use of quality materials, Correct and comprehensive design details/specification and proper storage, handling and usage of materials as the major

material waste control strategies on construction sites. Education and training of site personnel ranked the least. This was due to the fact that sustainable built environment has not been made a priority amongst contractors. According to Al-hajj and Hamani (2011), he proposed that there is need for training site personnel on material storage systems.

CONCLUSION AND RECOMMENDATIONS

It was concluded that material wastage has an effect on contractor's profit margin and overall project cost which accounted for over 50%. This jeopardizes the chance of the contractor winning further projects. Cement, blocks and formworks had the highest wastage indices signifying that the wastage level of these materials and their contribution to building projects are most critical on construction sites. It was seen that supply, material handling, storage, and operational factors were the most factors and should be given adequate consideration. Late changes / alteration by clients in design while construction is in progress often result in re-work / variation which account for more usage of materials that was not budgeted for in the bill of quantities thereby leading to cost overrun of the construction project. It was observed that the 3R's of waste management technique was very much in use as compared to other techniques. Material waste management plan is not incorporated in tender document. Avoidance of late changes at critical stages; education and training of site personnel, effective waste accounting system and adherence to standardized dimensions were the least considered strategies by the contractors and consultants. The following recommendations were made for the study;

1. Materials with high wastage indices should be given greater attention, the concept of wastage index developed in this research can be used as basis for distributing available resources in planning, supervision and material control, storage and handling.
2. Firms should employ expertise in using computer on site for effective material record keeping system.
3. There is need for designers to remain in touch with clients in the design stages to avoid late changes / alterations during construction stage.
4. Contracting firms need to evolve better means and facilities in which building materials could be well stored with pallets at the base or as maybe applicable to prevent undue damage which may lead to wastages.
5. Site waste management plan should be incorporated in tender document.
6. Modern waste management techniques should be adopted over the already used 3-Rs technique.

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EVALUATION OF AN ECO-FRIENDLY APPROACH FOR THE PHYSICALLY CHALLENGED PEOPLE IN NIGERIA

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Globally, it has become an urgent measure due to the change in climatic conditions which shows that we have been over-dependent on our environment and most of our activities have caused more damage over-time. Effects of environmental degradation are felt all around the country, with disasters like floods, erosion and different levels of pollution on the increase. The construction industry is also part of the problem as many times before construction starts, proper analysis is not done to consider integration of environmental features in their natural state, or the use of environmental friendly materials and features in building, rather, an easier option of "clearing" or regular materials is preferred. Many people worldwide face similar challenges and the physically challenged people are not left out. Their case even appears to be worse because a lot of people are not drawn to their needs in the society. In Nigeria today, a lot is yet to be done to reach the desired or much needed acknowledgement and solution to basic needs of the physically challenged. This research is aimed at determining how many physically centres are in Nigeria and how they compare to others internationally in line with eco-friendly features and needs. The results of this paper will be rich enough to bring about the needed change in how we build as it affects our world.

Keywords: *climatic conditions, eco-friendly, passive solar building designs, physically challenged, pollution, sustainability.*

INTRODUCTION

Physically challenged or person with disabilities as the case may be is defined as considerable degree of restriction and limitation of an individual to carry out any work, practice an occupation, or socialize easily due to a physical, psychological, loss of sensual health therefore causing some level of impediment or obstruction, according to the disability act 2005 (United Nations, 2003-2004). There is a need to properly and definitely define exactly each human condition so that the proper help to be administered is understood (Bayes and Franklin 1971).

Some people feel that people are responsible of how they interpret the term used others feel the terms as a whole should be avoided if they make people feel offended. To this effect, this research will seek to adopt the use of the physically challenged. Okoye (2010) emphasized that physically challenged people tend to lose their importance, significance and their person in instances where they are not able to cope with the situation.

Adesokan (2003) agreed with this claim that many physically challenged people are stigmatized and in some cases physically and mentally abused by members of the public in most cases seen as 'objects' of ridicule and shame. Regardless, physically challenged people can still be able to realize their goals, desires and ambitions of which the right environment can help (Igwe, 1998). It is noticed that people will prefer to be referred to as 'disabled' rather than 'handicapped' especially in countries like the United Kingdom and they are referred to as people with disabilities or PWD. Likewise, as people age they tend to lose the use of some basic functions of their body and can also be classed by the society too as handicapped or disabled people, to which they also suffer similar fate.

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With the degrading condition of the atmosphere the mode of construction is going towards eco-friendly/sustainable architecture and mode of building, which entails buildings that are self-sustaining and ecologically friendly (little to no damage to the atmosphere) and in turn are cheaper to build, run and maintain. For a building to be termed "sustainable" it has to be eco-friendly.

A lot of damage has been done to the atmosphere by way of different types of pollution. There has to be a call for changes in the way we build which will play its part in saving a degrading ecological system. (Peter F. smith, 2001). Earlier great architects like Frank Lloyd wright (1867-1959) tried to make architecture organic inclined.

Boko, et al (2007), had argued that Africa is way behind may other continents and is easily septic to climatic challenges because of its many problems and its ability to cope with them. Meehl et al, (2007) gave an insight as to how climatic conditions will be in the foreseeable future and its impact as more intense, frequent and will span longer. Globally, awareness has been created to ensure that the environment is better efficiently protected from unnecessary usage/stripping of its natural resources, which is often a waste. The development of the energy crisis has caused a swing to the more positive approach to conservation, away from the more negative approach of destructive criticism. Mode of building in the past have been criticized because their sources of energy like power and heat are normally acquired the conventional way by turbines and wood burning which have destructive tendencies in the long run.

The program on environmental protection has emphasized the need for compulsory conservation of resources worldwide. The challenges of the physically challenged are enormous to which many countries are getting more aware of their needs and therefore see the need for inclusive designs. Therefore there is a need for a more eco-friendly approach when designing and building for the physically challenged people. This study seeks to determine how and eco-friendly approach to building affects the users and how it can be inculcated into the present facilities for the physically challenged.

Sustainable Concepts to Constructing for the Physically Challenged

Sustainability can be best put as the ability to endure and adapt. It is also a blend of features which are social and ecological in nature with a similar target or goal.

Leke (2009) describes sustainable concept as an adaptation or change in focus from ordinary sustained growth to one that will not negatively affect future growth. It is the vital incorporation of human environmental needs to achieve economic growth while improving developmental objectives. The sustainability concept shows that economic and social features are bordered by environmental constraints and the relationship is where sustainability is gotten. This was established in the 2005 world summit on social development. But previously in Rio de janeiro 1992, an earth summit (UNCED) took place and a communiqué was issued stating the urgent environmental challenges of the world and a program was drafted stating the action to be taken which is partnership to improving the pillars of sustainability (social, environmental and economic).

Sustainable buildings refer to structures that are efficient, environmentally safe/suitable, and self-supporting throughout its life cycle, from its design stage to completion.

From previous studies, it has been revealed that the building sector uses over one third of global energy, which means that this sector uses more than all the other sectors. Buildings within cities consume more energy which can be further reduced with improved efficiency, which has been known to effectively reduce green-house emissions and generally reduce the dwindling renewable sources of energy (Lee and Yik, 2004). Ward (1979) states that there is a need for contractors when building to make buildings that are all inclusive and accessible to all classes and categories of people even if there are specialists for building for the disabled, there is still need for all members of the design team to be abreast with the challenges the physically challenged experience which will make them sensitive to their plight and help reduce the discomfort. According to Oyetola, et al (2015), one would expect that since consultants when building know that they are building for the physically challenged and they will be the main people to use such facilities, they should make them exclusive but reverse is the case mostly with the facilities made to rather generate profit and save cost to the detriment of the physically challenged. The construction of buildings without adequate attention paid to the needs of the physically challenged, therefore depriving them

of using such building will also adversely affect the general populace by depriving it of the input and positive influence the physically challenged can provide (Soyingbe, et al 2003).

Passive Solar Building Design and Integration in Physically Challenged Facilities

According to Energy.gov (2016), for a design to be termed 'passive', it has to collect, store and distribute energy from the sun from different points in the building and does not require mechanical or electrical support. The use of the suns energy to either heat or cool spaces within a building can be termed passive (Sustainable Resources, 2016). Building designs can be made to handle/manage this energy from the sun in a way that it provides heating, cooling and power generation. For this to happen, the building has to take advantage of the energy features naturally generated and the heated air exposed to the sun.

Photovoltaic is the process of generating electrical energy from sun rays using solar cells for the conversion.

To effectively harness adequate sunlight, positioning of windows is very important at 30° of true south, and must be clear of all obstructions. Another important factor is the selection of materials which is very important so that such materials can absorb heat and store them from direct sunlight during the heating season and absorb them from the warm interiors during the cooler season. Heat is transferred by conduction, convection and radiation therefore, it is important to define the means of distribution of solar heat. It is also important to have control measures in place to oversee changes in radiation or temperature levels, and checkmate them. Odebiyi, et al (2013) explains that Africa with technology is at an advantage to other continents to bring about solar development. Therefore, making devices that will be powered by solar will only improve energy efficiency.

METHODOLOGY

The data drawn with the aim of this research are both from primary and secondary sources with qualitative and quantitative data. The extracted data is used to answer the posed questions and instrumental in developing this paper. The first series of data (figures 1,2,3 and tables 1,2,3)is acquired from the Nigerian Bureau of statistics (2011) with the aim of determining male and female comparison according to their geographical zones, location (urban/rural) and category of disability, while the second is from the perception of users (students and handlers) of School for the blind Zuba, and Niger state School for the handicapped Minna.

RESULTS AND DISCUSSIONS

Baseline survey for the physically challenged according to zones and classes

According to a baseline nationwide survey done by the Nigerian bureau of statistics (NBS) (2011) in 10,648 homes in all the states in Nigeria, with over 95% of questionnaires filled showing a general acceptance and wiliness to partake in the survey, as well as 60% amount in response in each state, with the north-west geo-political zone of the country amounting to the highest number of homes covered (2,069), with the lowest (1,449) being from the south-east region. About 60% of the people interviewed are below the age of 25, with about 62% single as well as 49% of males and 57% females are uneducated. The survey also showed that homes visited in total, on 3% had physically challenged people with many of them reluctantly accepting the fact, with 4% male and 3% female. The north-west and south-east have the largest amount of physically challenged people about 9.1% and the south-west having the least with 3.9%. As a whole, Sokoto and Niger state have the highest number of physically challenged people, 25.5% male and 18.1% female and 17.3% male and 10.7% female, respectively.

This result also shows that no part of the country is without people with physically challenges with about 3.2% of the total population of the country which is about 4.8million have one form of disability or another. The North-West with 5.0% comes as the zone with the highest physically challenged people, followed by the south-east with 4.5%, south-south with 3.3%, north-central with 2.6%, the north-east with 2.4%, and the South-West counts as the lowest

with 2.1%. If among zones it's analyzed according to gender, North-West will have 5.6% male and 3.5% female, with South-East having 5.3% male and 3.8% female, the South-South will have 3.7% male and 2.8% female, the North-Central will also have 3.4% male and 2.2% female, the north-east having 2.8% male and 2.0% female, and the south-west having 2.3% male and 1.6% female (table 1).

There seems to be a higher concentration or the physically challenged in the urban developments as against the rural areas, with the urban area attracting about 58.6% and the rural area attracting about 41.4%. If among zones it is analyzed according to urban and rural areas, the North-East will have 51.3% in the urban area that are physically challenged, with 48.7% in the rural area, with the North-West having 51.7% in the urban area, to 48.3% in the rural area, with the South-South having 61.2% in the urban area, and 38.8% in the rural area, and the North-Central having 68.2% in the urban area, and 31.8% in the rural area, with the South-West having 77.1% in the urban area, to 22.9% in the rural area. But in the South-East reverse is the case where we have more physically challenged people in the rural area, about 63.8% to 36.2% in the urban settlement (table 2).

The Nigerian bureau of statistics (NBS) (2011) also established that there are different forms of disabilities suffered by the physically challenged which include, leprosy which is about 27.09%, disability due to loss of hearing/ deafness, which is about 23.76%, mental challenges which is about 13.44%, loss of sight/blindness which is about 12.22%, autism which is about 3.02%, intellectual impediment which is about 7.26%, as well as speech defects which is about 6.41%, cerebral palsy which is at 3.68% and a few others which will be about 3.11%.

In each zone there are the physical challenges that are more pronounced. The North-East and North-West both have a prevalence of both mental and hearing deficiencies about 1,013 and 442 people respectively. While in the North-Central, there is a prevalence of physically handicap with about 478 people, as well as the North-West with 442, while the North-East with 375, with the South-South having 200 persons, South-West with 188 persons, and finally the South-East with 133 persons. The North-West has a prevalence of mental challenges with about 735 people as well as the South-East with 129 persons as compared to the South-West with 79 persons, 43 in the South-South, North-East and North-central with 28 and 13 people respectively. Visual disability is more prevalent in the North-Central with 431, as well as the North-West with 245 and North-East with 166, with the South-South (47), South-West (34), and South-East (12) coming lowest (table 3).

As for people with autism, survey shows that more than half the populations of sufferers are within the North-West region with the rest evenly spread through geo-political zones of Nigeria. Other forms of disabilities not specified are evident in the South-West, as well as the North-Central and North-West with 100, 88 and 40 sufferers respectively.

This survey shows that though a lot of physical challenges are known, quite a number are still unknown also quite a number of factors that cause disabilities are difficult to face. This means that most likely, we are going to always have people that are physically challenged in our midst due to the uncontrollable factors.

TABLE 1. : Male-Female Comparison Data from Nigerian Bureau of Statistics

ZONES	MALE (%)	FEMALE (%)	TOTAL (%)
NORTH-CENTRAL	3.4	2.2	2.6
NORTH-EAST	2.8	2.0	2.4
NORTH-WEST	5.6	3.5	5.0
SOUTH-EAST	5.3	3.8	4.5
SOUTH-SOUTH	3.7	2.8	3.3
SOUTH-WEST	2.3	1.6	2.1

Source: Nigerian Bureau of Statistics (2011).

TABLE 2.: Urban-Rural Comparison Data from Nigerian Bureau of Statistics

ZONES	URBAN (%)	RURAL (%)
NORTH-CENTRAL	68.2	31.8
NORTH-EAST	51.3	48.7
NORTH-WEST	51.7	48.3
SOUTH-EAST	36.2	63.8
SOUTH-SOUTH	61.2	38.8
SOUTH-WEST	77.1	22.9

Source: Nigerian Bureau of Statistics (2011).

TABLE 3.: Disability Data Ratio from Nigerian Bureau of Statistics

ZONES	CRIPPLED	DEAFENED	MENTAL	BLIND	INTELLECT	DUMB	CEREBRAL	OTHERS	TOTAL
NORTH-CENTRAL	478		13	431				88	1010
NORTH-EAST	375	440	28	166					1009
NORTH-WEST	442	1013	735	245	122			40	2579
SOUTH-EAST	133		129	12					274
SOUTH-SOUTH	200		43	47					290
SOUTH-WEST	188		79	34				100	401

Source: Nigerian Bureau of Statistics (2011)

From the survey carried out by the Nigerian Bureau of Statistics there are about 182 centres for rehabilitation within Nigeria (Federal Ministry of Women Affairs and Social Development 2011). It shows the amount in each state and the class it falls (Rehabilitation 2011).

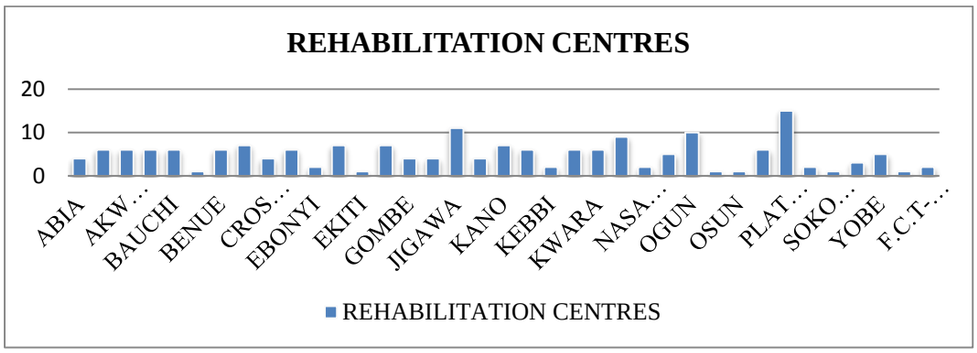

FIG 4: Various Rehabilitation Centres Across Nigeria
Source: Nigerian Bureau of Statistics (2011).

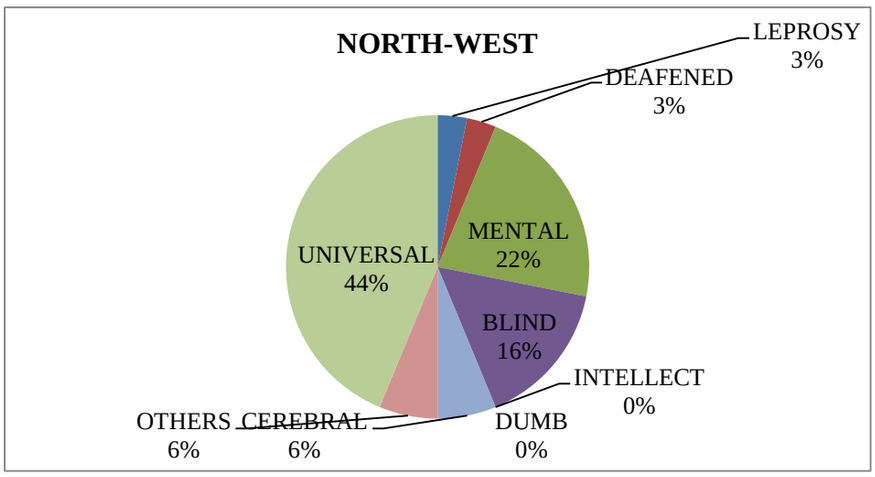

FIG 5: Classes of Rehabilitation Centres in Nigeria
Source: Nigerian Bureau of Statistics (2011).

Data from the Nigerian Bureau of Statistics

From fig 1 it can be seen that the north-west has the highest amount of physically challenged people while in fig 2 it is noticed that there are more physically challenged people located in the urban area of the south-west than other parts of the country, with the south-east having physically challenged people in rural areas. In fig 3 it can be seen that fig 1 is elaborated, emphasizing that there are more physically challenged people in the north-west and also the class of disability which is most common is the deafened. Fig 4 shows that plateau state has the highest amount of centres that cater for the physically challenged and that there are generally more universal centres that specialized ones.

All these help in defining the essence of this research as fig 1, 2 and 4 shows that the best location for implementation is plateau state. It is in the north-west zone and has the highest amount of centres where implementation can be done to existing projects while anticipating new ones which will be done to cater for the amount of physically challenged people in the entire zone.

From fig 3 it can be noticed that there are more deaf people than other disabilities which means that things like aesthetics, power generation, soft and hard landscaping will be of importance as they will be visibly noticed by the user and thus improve comfortability, because from the ratio in table 3, there will be more people who are deaf compared to other disabilities in each facility within the north-west zone. Figure 5 takes away any bias or fear that the implementation may be one-sided or that a centre within the north-west zone may have different needs from the others as 44% of the centres in this zone are universal.

Rating of Selected Schools

Two (2) samples of schools for the physically challenged where randomly selected which are Niger state school for the handicapped, minna and School for the blind, zuba-abuja, with the following questions asked and Likert scale measurement calculation used to determine the adequacy of the variables with 20 questionnaire tools shared because of the different classes of disabilities and respondents willingness.

RATING

Respondents perception based on the variables is weighted between score 1 to 4

Very Adequate	1
Adequate	2
Inadequate	3
Very inadequate	4

Table 4: Number of Respondents per of Opinion of Adequacy of Eco-friendly approach

Item Description	Very Adequate (X1)	Adequate (X2)	Inadequate (X3)	Very Inadequate (X4)	Total
How much was eco-friendly/sustainability features where used?	0	0	0	20	20
Is this building able to generate its own power?	0	0	0	20	20
Any alternative power source?	0	0	20	0	20
Are inclusive features present?	0	0	20	0	20
Is the facility properly located and oriented?	0	0	10	10	20
Does the facility have different changes in level within its spaces?	0	13	7	0	20
Any soft landscape?	0	1	0	19	20

Table 5: Sum of respondents' responses on Opinion of Adequacy of Eco-friendly approach

Item Description	Very Adequate (X1)	Adequate (X2)	Inadequate (X3)	Very Inadequate (X4)	Total
How much was eco-friendly/sustainability features where used?	0	0	0	80	80
Is this building able to generate its own power?	0	0	0	80	80
Any alternative power source?	0	0	60	0	60
Are inclusive features present?	0	0	60	0	60
Is the facility properly located and oriented?	0	0	30	40	70
Does the facility have different changes in level within its spaces?	0	26	21	0	47
Any soft landscape?	0	2	0	76	78

According to the Likert scale calculation, interpretation of the results is based on the following range scale:

1.0 – 1.49	Very Adequate
1.5 - 2.49	Adequate
2.5 – 3.49	Inadequate
> 3.5	Very Inadequate

The sum for each variable is divided by the corresponding number of respondents to determine the adequacy for each variable and is placed against it as shown in table 6. The variable measuring the availability of changes in levels within spaces is the only notable adequate option. This is because different types of buildings still apply changes in levels overboard to differentiate spaces from each other or when one leaves one space to enter another. It is therefore a common practice. The variable for eco-friendly/sustainable features and buildings self-power generation were termed inadequate which is due to that fact that many buildings today are not designed with eco-friendly materials and cannot generate power to tackle some basic power needs. There is no concise effort towards making these buildings especially for the physically challenged, more inclusive.

Table 6: Respondents' opinion on adequacy of Eco-friendly approach in facilities for the physically challenged interpretation

Measured Variable	Sum	Mean	Interpretation
How much was eco-friendly/sustainability features where used?	80	4	Very Inadequate
Is this building able to generate its own power?	80	4	Very Inadequate
Any alternative power source?	60	3	Inadequate
Are inclusive features present?	60	3	Inadequate
Is the facility properly located and oriented?	70	3.5	Very Inadequate
Does the facility have different changes in level within its spaces?	47	2.35	**Adequate**
Any soft landscape?	78	3.9	Very Inadequate

Alternative Power Source

Power generation is very important in any building and more so a facility for the physically challenged. Figure 5 shows us that there are more universal centres within Nigeria that centres that handle individual cases, which means that power generation is of utmost importance for the users of these centres. This greatly affects the comfortability of the users. Because of the unavailability of alternative power sources, the users will suffer from simple things like artificial lumination and ventilation especially at night this meant that the users who are physically challenged are always left in the dark once power from the national grid is unavailable. While figure 3 shows that the North-West has the highest amount of physically challenged persons (N.B.S, 2011) which cuts across the various classes with the zone enjoying a good amount of sunlight throughout the year. Solar cells as panels can be installed in these facilities to help covert sunrays in the day, into electricity at night. In table 6, it can be seen that all the respondents chose the inadequate option to the variable of alternative power source, which shows that there is a gap that should be filled and that power generation in one way or another affects us all. The solar cells can be installed at the roof of the building or used as window panels with an electrical room that will house the batteries for storage. This will mean that the users will have constant access to power when the one from the national grid becomes unavailable.

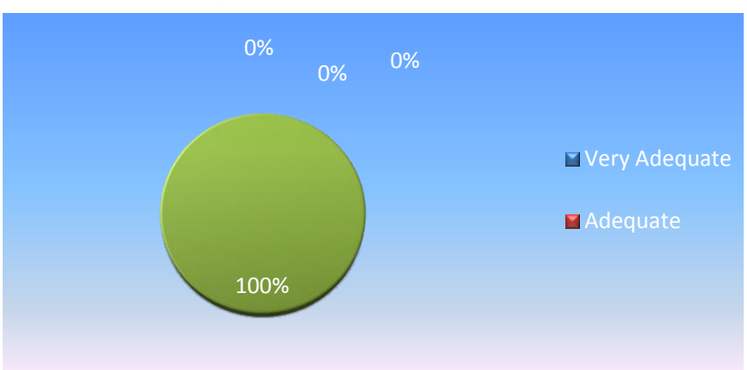

FIG.6: Adequacy of Alternative power sources within the facilities.
Source: - Author's Field Survey, (2016)

Availability of Soft Landscape

Landscaping is an integral part of construction and can also be known as environmental impact design according to America's National Environmental policy Act (NEPA, 1969), with the aim of mitigating the hazardous effects on the environment and advance the beneficial impacts on it. Usually, the entrances and general surroundings of these facilities are plain with little to no vegetation with the aim of eliminating obstructions. Over time asphalt or other hard surfaces will tend to emit heat as the sun peaks within the day making the surrounding and the occupants uncomfortable. As observed in table 6, 95% of the respondents think soft landscape is very inadequate. The implication is that the facility is less pleasing and surrounding becomes heated up easily as rays hit hard surfaces. The users will not be comfortable using the facility. So it is therefore important to add some soft landscape which will help reduce global warming no matter how little and act as guides for people with visibility disabilities.

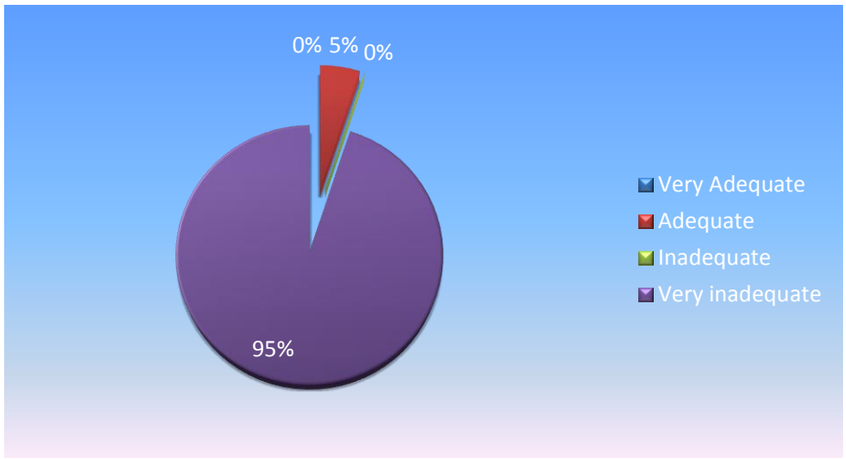

FIG.7: Adequacy of Alternative power sources within the facilities.
Source: - Author's Field Survey, (2016)

CONCLUSIONS

Eco-friendly/sustainability can be achieved by effective campaign aimed at stopping ecological degradation and inclusion of its features in architectural designs. When power generation is not adequate, the average person will look for any means to achieve this without giving proper care to how it's gotten or how it affects the environment. Passive solar building designing will help in bridging the power generation gap. It is important to inculcate eco-friendly/sustainability features in all forms of architectural designs especially in Nigeria where the harmful effects of its absence is clearly being felt in urban and rural areas alike.

Figure 4 shows that plateau state has the highest number of rehabilitation centres and will be a good point to start with the said implementation so as to achieve reasonable/maximum effect, figure 5 shows that there are more universal centres or centres that cut across all the classes of physical challenges, therefore this implementation won't be one sided rather it will touch a part of each class.

From the administered questionnaires and posed questions, it is noticed that the perception of users towards inclusive designing with eco-friendly features is bad/poor. This means most centres in one way or another aid in degrading the environment, starting from the construction materials used to how electricity is generated to power even very small appliances, and there is an urgent need for eco-friendly features to be included in modern day construction, which is obviously absent in this day physically challenged centres. Taking all these amounts of centres off the national grid will help improve electricity generation, generally, this may not happen overnight, but the effect will be felt over time, while making the physically challenged people feel carried along. This will be taking the energy provided in the environment to solve needs in the environment.

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EVALUATING THE BARRIERS IN DEVELOPING GREEN BUILDING IN NIGERIAN CONSTRUCTION INDUSTRY

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Green building design has been a major trend in the last decade which has largely affected the Architecture, Engineering and Construction (AEC) Industry. Construction industry has highly contributes to gross domestic product, and has an undeniable impacts on the economy. Although Green buildings provide a wide range of benefits for the society, and as well suffers from different kinds of market barriers in developing countries and Nigeria is not in exemption. The aim of this study is to evaluate the barriers in emerging green building in Nigerian Construction Industry. A quantitative research method was adopted for the study. A well Structured Questionnaire was self- administered to contracting firms within Kaduna. In this study; 24barriers related to developing Green Building were identified. 52% response rate was achieved and used for analysis. Descriptive statistics was used to establish the rate of responses for the background information and in evaluating the Barriers in emerging Green Building in Nigerian construction Industry. The research identified the Green Building Barriers with highest based on their impact as: Lack of building codes and regulation, Negative attitude by developers towards adopting /incorporating Green Building feature and Risk of investment and those with least impact as: Lack of technology, Lack of expertise and Lack of database and information. The study concluded that the practitioners should take note of these barriers and recommends that government roles especially incentive instruments such as structural incentives, subsidy and rebate program, tax incentive scheme, low interest mortgage loan, voluntary rating system and market and technology assistance are the significant drives for eliminating barriers to green building development.

Keywords; Barriers, Green building, and Sustainable construction

INTRODUCTION

The worldwide Population growth accompanied by massive resource consumption, waste generation, loss of arable lands and increased urbanization has led to environmental pollution, degradation and climate change with negative effects on the planet earth. These has led to the global recognition and consensus about the devastating effects of such and the need for drastic changes in policies and practices across various industries to ensure and promote environmental sustainability. Construction industry has highly contributes to gross domestic product, and has an undeniable impacts on the economy. Although Green buildings provide a wide range of benefits for the society, green building development suffers from different kinds of market barriers in developing countries including Nigeria.

Sustainable development can be defined "as growing natural and industrial resources which meet the energy needs of the present times without settling the ability of next generations for meeting their needs in the same manner" (Hill, 2003). In addition, the United Nations (1987) explains that "sustainable Word development is a collection of methods in order to relieve poverty, create the equitable standards of living, satisfy the basic needs of all peoples, and set up sustainable political practices all while taking the steps essential to avoid irreversible damages to be natural environment in the long-term".

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Green building is an important area where cities can implement sustainability objectives. Green buildings are designed to reduce negative impacts on the environment while increasing the occupant health, by addressing these five categories:

- Sustainable site planning
- Safeguarding water and water efficiency
- Energy efficiency, renewable energy and lower greenhouse gas emissions
- Conservation and the reuse of materials and resources, and
- Improved health and indoor environmental quality

The environmental impact of buildings is often underestimated, while the perceived costs of green buildings are overestimated. Kats et al. (2003) comprehensively examined the costs and benefits of green buildings for the state of California in the United State. The average cost premium over just building to code is less than 2%. The study reported that "minimal increases in upfront costs of about 2% to support green design would, on average, result in life cycle savings of 20% of total construction costs more than ten times the initial investment". The majority of savings from green building are in the maintenance part and utility costs (CEA, 2011). Sustainability in construction is all about following suitable practices in terms of choice of materials, their sources, construction methodologies, as well as design philosophy so as to be able to improve performance, decrease the environmental burden of the project, minimize waste and be ecologically friendlier (Abolore, 2013).

Every concept in project development comes with its unique benefits, challenges and factors that hindered its success and green building concept is not an exception. Such benefits, challenges and barriers differ perceptively among its stakeholders. This study aimed at evaluating the barriers in developing green building in Nigerian construction Industry, thus these aim was achieved via: Identifying the barriers in emerging green building, analysing the barriers in emerging green building and establishing new strategies or modify current strategies in order to eliminate barriers. Hence, despite all the obvious challenges of the need to adopt and embrace sustainable practices within the Built Environment, Green building developments and sustainable practices are embraced very slowly and practiced at slow pace in the Nigeria's construction industry. This is worrisome and perhaps due to some barriers hindering such pace or affecting the sustainable practices within its built environment.

LITERATURE REVIEW

Consequently, the various activities of the construction area have to be judged and examined when considering sustainable development. As a significant element in order to implement of sustainable development's goals in the construction industry, green building has an important role in achieving the aim of sustainable development (Fisk, 1988).

Sustainability is contested issue and there are many different definitions (Ravetz, 2000). These are often vague and are difficult to translate into practical actions that can be implemented in built environments (Curwell & Cooper, 1998). In order to be applicable to built environments, definitions must capture the essential characteristics of human and environmental systems (Curwell & Cooper, 1998). Definitions must also understand, and reflect, the complexity of the 'human system' being evaluated by reflecting the performance of both the technical systems, such as an electrical system in a building, as well as behavioural aspects, such as the way occupants use the electrical system (Williams, 2007).

Table.1: Project success factors based on Owner's, Designer's and Contractor's Criteria

S/No	Owner's criteria	Designer's criteria	Contractor's criteria
1	On schedule	Satisfied	Met schedule
2	Within budget	Quality architectural product	Profitability
3	Functions for intended use	Met design fee and profit goal	Under budget
4	End result as envisioned	Professional staff fulfillment	Quality specification met or exceeded
5	Quality (Workmanship, products)	Met project budget and Schedule	No claims for liability
6	Aesthetically pleasing	Marketable product/process	Safety

7	Return on investment	Minimal construction problem	Client's satisfaction
8	Building must be marketable	Building function as intended	Good customer buy out
9	Minimal aggravation in producing a building	Socially acceptable	Good direct communication
10		Client pays	Minimal or no surprises during the project

Source: Odusami (2003) as cited by Kumo (2012)

The sustainable construction practice is a trend that is two-three decades old in construction, but still lack sufficient data about the costs; absence of measured building performance data from currently operating sustainable designed buildings (BD&C, 2003; ENSAR, 2003; Andeau et al., 2004). "To be sustainable, buildings should usefully and last for many generations, this requires some knowledge of the future climate and the resources available to maintain the operations, in particular the energy consumption, of buildings" (Byrd and Leardini, 2011). Industry professionals, in both the design and construction disciplines, are generally slow to change, tend to be risk-adverse, lack sound knowledge, experience, and understanding of how to apply ecology to construction design; moreover, environmental or economic benefit of some green building approaches has not been scientifically quantified (Wang, 2013).

Green building projects design and construction is new in Nigeria and is characterized by the problem of lack of shared perception and agreement on the objectives and success/failure of the green building projects by stakeholders (Dalibi and Kumo, 2016); also Different Set of Criteria for success/failure for the project (Kumo, 2012) etc. Going by these characteristics, each stakeholder perceives the success according to a hierarchy of dimensions, which comply with their personal agenda.

The initial emphasis of sustainability was on Technical issues such as materials, building components, construction methodologies and energy related design concept (USGBC, 2012; epa.gov). However, the appreciation of the significance of non-technical issues (soft issues) has grown, giving recognition to Economic and Social sustainability concerns as well as Cultural heritage of the built environment as being equally important (Abolore, 2013).

Table.2: Barriers in emerging Green Building

Code	Barriers	Sources
B1	Lack of building codes and regulation	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B2	Lack of incentives	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B3	Higher investment cost	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B4	Risk of investment	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B5	Higher final price	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B6	Lack of credit resources to cover up front cost	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B7	Lack of Public awareness	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B8	Lack of demand	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B9	Lack of strategy to promote green building	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B10	Lack of design and construction team	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B11	Lack of expertise	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B12	Lack of professional knowledge	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B13	Lake of database and information	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B14	Lack of technology	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B15	Lack of government support	Golove et al., 1996; Ofori, 2006; Yung et al., 2002; Milad et al., 2013)
B16	A new change with its uncertainties)	(Kumo, 2012; Abolore, 2013; Nuruddeen and Gidado 2015; Dalibi

B17	Cultural, Economic, and Social(CES) barriers	Choi, 2009; and Kumo, 2016; *Dalibi, et al.,2017*)
B18	Lack of Sufficient information on costs and performances	(Kumo, 2012; Abolore, 2013; Nuruddeen and Gidado 2015; Dalibi
B19	Lack of In-depth Awareness on the Concept	Choi, 2009; and Kumo, 2016; *Dalibi, et al.,2017*)
B20	In-availability of Built Environment Professionals with green building Technical Know How	(Kumo, 2012; Abolore, 2013; Nuruddeen and Gidado 2015; Dalibi
B21	Lack of adequate information on Future asset value, Rental value and its sales value	Choi, 2009; and Kumo, 2016; *Dalibi, et al.,2017*)
B22	Perception on Expensive Concept	(Kumo, 2012; Abolore, 2013; Nuruddeen and Gidado 2015; Dalibi
B23	Divergent and Incompatibility of interests and views of success factors and success criteria of Green Building developments among stakeholders	Choi, 2009; and Kumo, 2016; *Dalibi, et al.,2017*)
B24	Negative attitude by developers towards adopting /incorporating Green Building features	Choi, 2009; and Kumo, 2016; *Dalibi, et al.,2017*)

RESEARCH METHODOLOGY

Research methodology includes research methods as well as the logic behind the methods used in the context of the research study. The chosen research approach was quantitative in nature, including Secondary sources of data such as journals, conference / seminar / workshop papers, text books, newspapers, magazines and internet sources a comprehensive review of relevant literature was undertaken to assess the concept, barriers and hindrances in emerging Green Building in the construction industry with particular emphasis on the Nigerian.

The population frame of this research was practicing contractors which are 303 in numbers. Typically, the population is very large; having made a census or a complete enumeration of all the values, so only a subset or sample of the population will be used. Due to the fact that it is not possible to survey an entire population for practical and cost reasons, a subset or sample of the population is usually considered. Also taking into considerations the likelihood that not all contractors will be experienced enough to provide reliable answers to the questions raised in the questionnaire. Kish, (1965)'s formula for calculating sample size i.e.

Using Formula:
n = n1/ (1+n1/ N) _____ (1)
Where n = Sample size
n1 = S2/ V2 _____ (2)
N = Population size
V = Standard error of sampling distribution = 0.05
S2 = P (1-P) = (0.5) (0.5)= 0.25
P = the proportion of standard deviation in the population element (total error = 0.1 at 95% confidence level.
Solving equation (2);
n1 =S2/V2
S = 1 – 0.5 = 0.5
n1 = (0.5) (0.5) / (0.05) (0.05)
= 0.25/0.0025 =100
Substituting in equation 1;
n = 100 / (1 + (100/303))
n = 100/1.03 = 97

A total of 97 sets of questionnaire were sent out and 49 (50.52%) questionnaires were received. Quantitative method has been used for analysing data through SPSS version 20. The questionnaire form is designed into the two following sections:

Section A

Part A: respondent's background.

Section B

i. Part A: the awareness about the green building.

ii. Part B: Green building development barriers.

Also, in the Section B, Part A of the questionnaire, the respondents were asked to indicate their awareness while in the Part B, Each level carries a 5 Likert ordinal scale value. For the level of readiness, the value 5-strongly agree, 4-agree, 3-somewhat agree, 2-disagree, 1-

strongly disagree. Reliability statistics used in this research is Cronbach Alpha. It is "determining the internal consistency or average correlation of items in a survey instrument to gauge its reliability" (Cronbach, 1951).

Cronbach is between 0 and 1. If Cronbach is less than 0.5, such data are not reliable; therefore, the results which were gained through the data analysis are not applicable. In opposite, when Cronbach is near 1, data are reliable. In this research, The Cronbach's α value used for this analysis is 0.82, indicating that all barriers exhibited high internal consistency and that the questionnaire was thus reliable. The results were achieved through the SPSS software version 20.

Table 3: section B; Part A: Internal consistency analysis: Reliability test

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
0.875	0.876	4

Table 4: section B; Part B: Internal consistency analysis: Reliability test

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
0.959	0.960	23

RESULTS AND DISCUSSION OF FINDINGS

To explore which barriers of green building are the most important compared to other ones in construction industry in Nigeria, respondents were asked to rate the different level of importance in each item. Data were analyzed based on the Mean and Median (Table 5 and 6) below.

First Step: Identifying the barriers in emerging green building

Second Step: Analysing the barriers in emerging green building

Third Step: Establish new strategies or modify current strategies in order to eliminate barriers

Table.5; An evaluation of the green building barriers by the contractors

Code	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
	5	4	3	2	1	
B1	41	21	15	11	9	97
B2	20	13	15	21	28	97
B3	21	17	21	12	26	97
B4	56	25	7	7	2	97
B5	45	32	8	8	4	97
B6	61	23	9	3	1	97
B7	17	11	13	21	35	97
B8	51	18	14	9	5	97
B9	26	12	13	25	21	97
B10	29	14	16	21	17	97
B11	15	11	12	22	37	97
B12	39	23	7	17	11	97
B13	11	9	5	29	43	97
B14	19	10	15	21	32	97
B15	37	11	17	25	7	97
B16	27	17	8	29	16	97
B17	25	15	12	21	24	97
B18	49	20	13	11	4	97
B19	33	23	11	18	12	97

B20	35	16	15	23	8	97
B21	39	17	21	14	6	97
B22	43	21	16	8	9	97
B23	53	19	17	5	3	97
B24	57	17	15	5	3	97

Table 6: Barrier's descriptive statistics

Code	Range statistics	Minimum statistics	Maximum statistics	Mean statistics	Rank
B6	4	1	5	3.80	1
B24	4	1	5	3.72	2
B4	4	1	5	3.68	3
B23	4	1	5	3.61	4
B8	4	1	5	3.52	5
B18	4	1	5	3.47	6
B5	4	1	5	3.41	7
B22	4	1	5	3.33	8
B1	4	1	5	3.21	9
B21	4	1	5	3.17	10
B12	4	1	5	3.13	11
B15	4	1	5	3.08	12
B20	4	1	5	3.06	13
B19	4	1	5	3.00	14
B10	4	1	5	2.96	15
B16	4	1	5	2.92	16
B9	4	1	5	2.88	17
B17	4	1	5	2.83	18
B3	4	1	5	2.79	19
B2	4	1	5	2.77	20
B7	4	1	5	2.69	21
B14	4	1	5	2.67	21
B11	4	1	5	2.54	22
B13	4	1	5	2.52	24

Table 6above shows the mean, standard deviation and ranking of these barriers based on their impact on green building, Lack of building codes and regulation has mean of 3.80, thus the 1st rank, followed by Negative attitude by developers towards adopting /incorporating Green Building features with a mean of 3.72 (2nd rank). The barrier with the 3rd ranking is Risk of investment also with a mean of 3.68 followed by Divergent and Incompatibility of interests and views of success factors and success criteria of Green Building developments among stakeholders (4th rank) with a mean of 3.61. The 5th ranking barrier is Lack of demand with a mean of 3.54. Lack of Sufficient information on costs and performances has a mean of 3.47, thus the 6th rank, followed by Higher final price with a mean of 3.41 (7th rank). Whereas, Lack of technology with a mean of 2.67 (22th rank), followed by Lack of expertise with a mean of 2.53 (23rd rank) and Lack of database and information with a mean of 2.52 (24th rank) were the green building barriers with the least scores and as such least impact on green building developments in Nigeria. The finding shows that the current incentives are not effective enough to encourage construction firms to enter green building development. Financial incentives are also not able to recoup the high upfront cost of green buildings and make it more affordable for construction companies

The study carried out by Bandy et al. (2007) shows that higher upfront cost (new design, technology and construction method) is the main impediment to green building development. Governmental financial incentives have essential rules to provide low risk and affordable financial resources for green developers in both commercial and residential sectors. Public awareness about green building has been an important component that led to high demand (Toronto green development standard, 2006).

Improvement in public awareness on green building will better inform the consumers who will demand better products from companies and encourage more green building development. In addition, cost savings can potentially increase a consumer's willingness to

pay extra. To achieve sustainable green home development and to make balance between green home owners' benefits and construction companies' profits are critical issues.

CONCLUSION AND RECOMMENDATION

This paper reports the results of a questionnaire survey conducted in Nigeria on the barriers of the green building development. The level of green building development from professionals' point of view has been evaluated and the most important barriers have been identified. The findings suggested that government roles especially incentive instruments such as structural incentives, subsidy and rebate program, tax incentive scheme, low interest mortgage loan, voluntary rating system and market and technology assistance are the significant drives for eliminating barriers to green building development.

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EVALUATION OF DESIGN FEATURES FOR ADOPTION OF BRIGHT GREEN CONCEPT IN HOTELS IN MINNA, NIGERIA

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The importance of energy to the running of human activities is unquestionable, however, energy consumption has to be significantly reduced to avoid occurrence of energy crisis as was seen in the years 1973 and 1976 respectively. It has been discovered that buildings contribute to the rise in energy consumption. It is for this reason that researches have been carried out on sustainability and smart building technology in the construction industry. These have brought about the emergence of the term 'bright green'. A bright green building is one that is sustainable and smart; it uses smart technology to reduce energy consumption, thereby improving indoor environmental quality without sacrificing the quality of the natural environment. With the application of bright green concept, some buildings around the world have been able to reduce their energy consumption by up to 50% and generate about 75% of the energy required for their operation. Being a commercial building, hotels consume a lot of energy due to their continuous operation all-day and all-night. For this reason, this paper carried out an investigation on Hotels in Minna metropolis, to ascertain their suitability for conversion to bright green buildings by evaluating the relevant design features. Data was obtained from the field using an observation schedule and analysed using Microsoft excel. Results indicate that the ten hotels sampled have less than 50% of the design features necessary for adoption of bright green concept. The paper concluded by recommending practices that would facilitate the adaptability of buildings to bright green concept.

Keywords: bright green, building, energy, green, smart.

INTRODUCTION

Over time, hotels have evolved from providing just bed and breakfast; to provision of additional services that guarantee a memorable and comfortable for their guests. These services translate directly to an increased rate of energy consumption, mostly in the areas of cooling, ventilation and lighting. According to Darwish (2017), the increasing energy used up by buildings for heating and cooling constitutes a serious contribution to global warming. For this reason, energy efficiency has become one of the major goals of twenty-first century architecture. In order to be called energy efficient, a building must be able to reduce its demand for energy and generate its own energy from renewable sources (Nwofe, 2014).

The search for renewable sources of energy, sustainable thinking and energy efficiency started developing after the first and second energy crises in 1973 and 1979 respectively (Amamata *et al.*, 2014) . These crises caused a change in human attitude towards the environment, and emphasized the importance of making our environment more sustainable. Buildings are responsible for a higher percentage of the world's total energy consumption (U.S. Department of Energy, 2012). Therefore, it is fast becoming a global trend to celebrate buildings that are termed "sustainable" and "green". An example is the Leadership in Energy and Environmental Design (LEED) certification of the United States Green Building Council (USGBC); it rates the design, construction and operation of green buildings (USDE, 2012). While in the Great Britain, the Building Research Establishment Environmental Assessment Method (BREEAM) helps to mitigate the environmental impacts of a building from the design stage (Michael *et al.*, 2007).

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Bright Green Building

The concept of bright green building seeks to improve sustainability by employing smart technology to reduce energy consumption, conserve energy and improve indoor environmental quality (Altan, 2015). In other words, a bright green building is first a green building and then a smart building. It combines the principles of smart building and green building to create a healthy, safe and comfortable environment; ensuring building occupants' wellbeing, while preserving the natural environment (CABA, 2008). This is done in several ways, one of which is energy efficiency (Khashaba, 2014).

Energy efficiency in bright green buildings start from the architecture of the building, and then is supported by intelligent features such as energy efficient lighting and ventilation (Townes, 2011). Smart or intelligent buildings incorporate the most recent and improved advancements in technology in order to make buildings more energy efficient, and in the long run, achieve social sustainability (Darwish, 2017, Reffat).

With building intelligence, smart buildings are able to regulate energy consumption to necessity (Khashaba, 2014). As a result of smart sensors, use of HVAC and lighting systems (amongst others) are controlled and regulated to necessity. This increases the lifespan of the systems and reduces the need for maintenance, repair and replacement (CABA, 2008).

Bright green buildings are energy efficient, cost effective and provide comfort and satisfaction for occupants' productivity (CABA, 2008). This is achieved by detecting human presence and changes in environment, analysing the changes detected, and giving the proper response (Khashaba, 2014).

They save energy cost over time by reducing energy consumption and utilising renewable sources of energy, thereby increasing Return on Investment (ROI) for building owners (CABA, 2008).

Retrofitting Bright Green Buildings

Buildings can either be designed to be bright green from the inception or made to be so after construction. However, it is cheaper and easier to make a building from the inception of the project than it is to retrofit a building with bright green design features. Although new buildings have been the focus for green and intelligent building industry, the existing buildings are the ones that pose the most challenge in terms of increased energy consumption (CABA, 2008). This means that even as efforts are being made for new buildings to be energy efficient, the existing buildings should not be overlooked as they too consume a lot of energy. A crucial step that needs to be taken in order to tackle climate change in our world is the improvement of energy efficiency and the environmental performance of existing buildings (Retrofitting Existing Buildings: The Low Cost, High Volume Solution to Climate Change). This study is aimed at examining Hotels in Minna metropolis, to determine their suitability for bright green retrofitting. Hotels have been chosen for this exercise because energy is one of the major challenges facing the hospitality subsector of the tourism industry in Nigeria.

Design Features for Energy Efficiency in Bright Green Buildings

For an existing building to be adapted for bright green concept, certain design features must be present to take care of the green aspect of the building. These design features help to reduce heat gain and energy consumption, while building automation and intelligence makes the buildings more sustainable.

With the help of Building Energy Management Systems (BEMS), energy consumption in buildings can be reduced by adapting the building's elements to rely more on natural light and renewable energy sources (Khashaba, 2014). He noted that other ways of achieving same result include relying more on natural ventilation and using architecture to reduce reliance on mechanical ventilation and air conditioning. Protection from solar radiation when it is not needed and admittance of solar radiation when needed are also ways to reduce energy consumption (Khashaba, 2014).

The design features necessary to achieve the conditions stated by Khashaba (2014) are discussed in Table 1 as gathered from Townes (2011) and the United-State Department of Energy (USDE, 2012).

Table 1: Design Features for Energy Efficiency in Bright Green Buildings.

S/NO	DESIGN FEATURES	PROPERTIES
1.	Windows	– Thermally insulated – Automated – Large enough to admit daylight and natural ventilation – Low-E glass.
2.	Doors	– Automated doors
3.	Glazing	– Double Glazing. – Oriented on south-facing wall to admit maximum daylight.
4.	Shading Devices	– Vertical shading devices on south-facing wall. – Horizontal shading devices on North-facing wall. – Roof overhang.
5.	Roof	– Green roof – Roof garden – Oriented for Solar application
6.	Landscaping	– Extensive use of trees and shrubs in and around the building to lower temperature and prevent unwanted glare. – Shading trees, particularly on the west-facing wall of the building.
7.	Building Orientation	– Oriented to maximise daylight, natural ventilation, passive cooling and renewable sources of energy. – Elongate building within 15 degrees due east-west axis.
8.	Building Façade	– Double skin façade for heat insulation and prevention of glare.

Source: (Townes, 2011, U.S. Department of Energy, 2012).

RESEARCH METHOD

For the purpose of this research, ten hotels were randomly selected as samples from the centre of Minna city. To check the adaptability of these hotels to bright green concept, the survey instrument was an observation schedule structured to confirm the presence or absence of the design features earlier mentioned. The names of these hotels and some general information about them are contained in Table 2.

Table 2: Hotels Studied

Name of Hotel	Location	Number of Hotel rooms available	Type of buildings in Hotel	Number of buildings in Hotel
NSDC Hotel	In the city	50	Multi-storey	1
Vagosh Hotel	In the city	73	Mixed	4
Princess Ah-zahra Lodge	In the city	39	Multi-storey	1
Nasfah Hotel	In the city	63	Mixed	11
Mairuwa Hotel	In the city	30	Bungalows	7
Saftec Hotel	In the city	41	Multi-storey	1
Dogon-koli Hotel	In the city	48	One-storey	1
Yayi Hotel	In the city	42	One-storey	2
Haske Luxury	In the city	26	Mixed	2
Brighter Suites	In the city	52	Mixed	9

Source: Author's fieldwork, 2017.

DISCUSSION OF RESULTS

Tables 3 and 4 represent the data collected from the field as it concerns the design features for Bright Green Building which were found in the Hotels sampled. At the end of each table, a percentage total is used to represent hotels with the corresponding design feature.

The results in Table 3 show that 40% of the hotels sampled have casement windows installed, which is good for natural ventilation while 20% of the hotels used shading devices to keep out excess sunlight and reduce solar heat gain. 10% of the hotels used shading trees to minimise heat gain in the building, while another 10% used double-skin façade to reduce solar radiation in the building. None of the hotels used double glazing for reduction in heat gain, none of them made use of green roof and automated doors were found to be absent in all the hotels sampled.

Table 3: Availability of Design Features for Bright Green Building in Hotels studied

Name of Hotel	Cross Ventilation	Double glazing	Casement windows	Double-skin façade	Shading devices	Automated doors	Shading trees	Green roof
NSDC Hotel	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent
Vagosh Hotel	Present	Absent	Absent	Present	Absent	Absent	Absent	Absent
Princess Ah-zahra Lodge	Absent	Absent	Present	Absent	Present	Absent	Absent	Absent
Nasfah Hotel	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Mairuwa Hotel	Present	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Saftec Hotel	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Dogon-koli Hotel	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Yayi Hotel	Absent	Absent	Present	Absent	Absent	Absent	Absent	Absent
Haske Luxury	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Brighter Suites	Present	Absent	Present	Absent	Absent	Absent	Present	Absent
Total	30%	0%	40%	10%	20%	0%	10%	0%

Source: Author's fieldwork, 2017.

The results in Table 4 reveal that all the hotels have their roofs oriented for solar application, which would provide some of the energy requirements of the buildings. 80% of the hotel buildings were oriented on the southwest-northeast axis, to admit more natural ventilation. Only one out of the ten hotels was found having trees large enough to provide shade on the west-facing wall where the impact of solar radiation. None of the hotels was found to have automated blinds and shutters which are controlled by BEMS and help to regulate admittance of sunlight and solar radiation.

Table 4: Availability of Design Features for Bright Green Building in Hotels studied

Name of Hotel	Roof oriented for solar application	Building properly oriented	Shading trees oriented on west-facing wall	Automated blinds/shutters	Photovoltaic panels
NSDC Hotel	Yes	Yes	No	No	No
Vagosh Hotel	Yes	Yes	No	No	No
Princess Ah-zahra Lodge	Yes	No	No	No	No
Nasfah Hotel	Yes	No	No	No	No
Mairuwa Hotel	Yes	Yes	No	No	No
Saftec Hotel	Yes	No	No	No	No
Dogon-koli Hotel	Yes	Yes	No	No	No
Yayi Hotel	Yes	Yes	No	No	No
Haske Luxury	Yes	Yes	No	No	No
Brighter Suites	Yes	Yes	Yes	No	No
Total	100%	80%	10%	0%	0%

Source: Author's fieldwork, 2017.

Table 5 reveals a percentage summary of design features for bright green design in the hotels studied. From the results shown, all the hotels studied have less than 50% of the design features required for adoption of bright green concept.

Table 5: Percentage Distribution of Design Features for Bright Green Building in Hotels studied

Name of Hotel	Percentage Total
NSDC Hotel	30.77%
Vagosh Hotel	30.77%
Princess Ah-zahra Lodge	23.08%
Nasfah Hotel	15.39%
Mairuwa Hotel	23.08%
Saftec Hotel	7.69%
Dogon-koli Hotel	15.39%
Yayi Hotel	23.08%
Haske Luxury	15.39%
Brighter Suites	46.15%

Source: Author's fieldwork, 2017.

Figure 1 reveals the results from checking the orientation of the hotel buildings. It can be seen that majority of the hotels have their buildings oriented to take advantage of natural shading and passive cooling on the northeast-southwest axis.

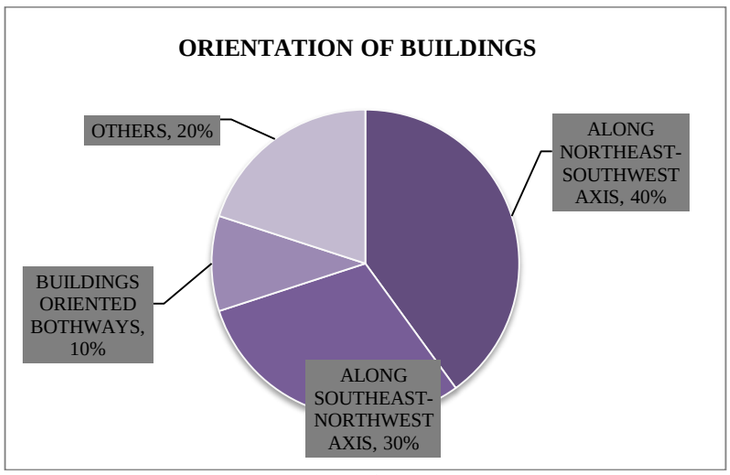

Figure 1: distribution of hotels by orientation
Source: Author's fieldwork, 2017.

Plate I: Layout of Dogon Koli hotel.
Source: Google Maps, 2017.

Figure 2 reveals that only a few of the hotels had any type of glazing at all, which was predominantly single glazing, out of which the majority had their glazing oriented on the south-facing wall where glare and solar radiation is strongly experienced. In this scenario, double glazed units would have helped reduce solar radiation and the effect of glare on the building.

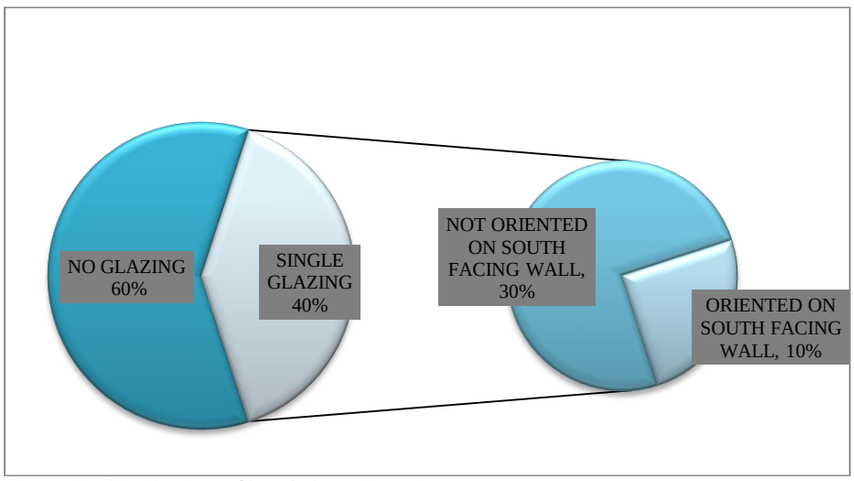

Figure 2: Distribution of hotels by orientation
Source: Author's fieldwork, 2017.

Figure 3 shows that majority of the hotels visited relied only on roof overhang of 600mm to provide shade from the sun and reduce the rate of solar radiation. This implies that the rays from the sun are largely unobstructed by shading devices, thereby exposing the building envelope and eventually the interior spaces to the sun's temperature.

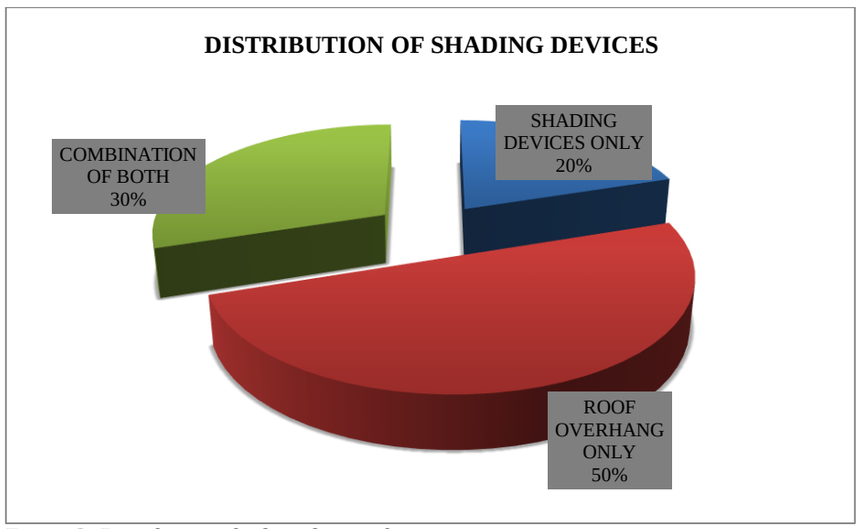

Figure 3: Distribution shading devices by type.
Source: Author's fieldwork, 2017.

Plate II: Shading devices at Princess Ah-zahra lodge
Source: Author's fieldwork, 2017.

Plate III: Roof overhang at Nasfah hotels
Source: Author's fieldwork, 2017.

From figure 4, it can be deduced that a larger percent of the hotel use sliding windows for the rooms. This means the area of opening for air inlet and/or outlet is reduced by half the size of the fenestration. This is because a greater percentage of the hotels used sliding windows. Since the hotels sampled were found to have the same size of windows (1200mm x 1200mm), the size of openings for those with sliding windows is reduced to about 600mm x 1200mm. Considering that 30% of the hotels sampled are not cross-ventilated, this size of opening is largely insufficient for air circulation. This implies that a lot of energy is consumed ventilating and cooling the rooms mechanically.

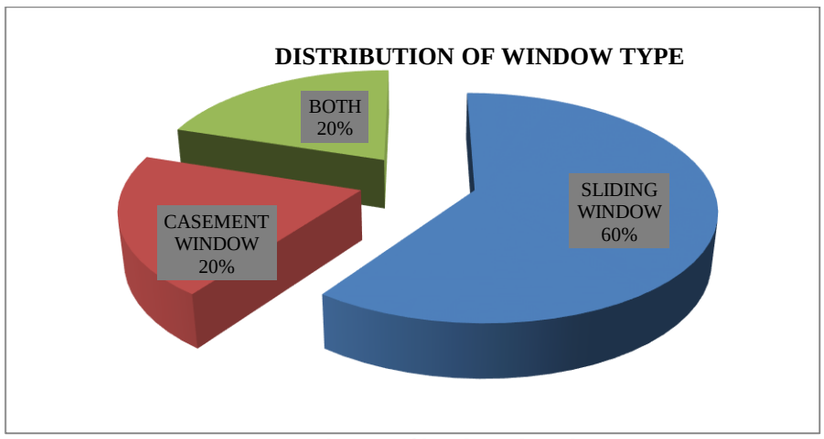

Figure 4: Distribution of hotel windows by type.
Source: Author's fieldwork, 2017.

Plate IV: Casement window at Princess Ah-zahra lodge.
Source: Author's fieldwork, 2017.

Plate V: Sliding window at Yayi Hotels
Source: Author's fieldwork, 2017.

Figure 5 reveals that little attention has been paid to landscaping. The largest percentages of the sample population only have shrubs covering about 750mm width around the building, leaving only 10% of the hotels with shading trees planted.

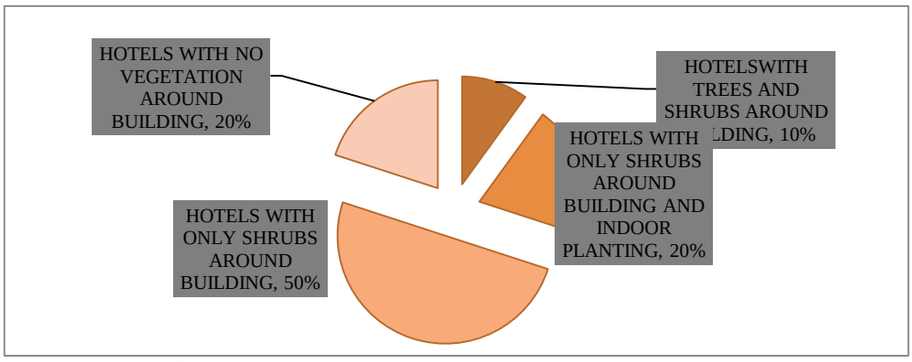

Figure 5: Distribution of vegetation around hotel building.
Source: Author's fieldwork, 2017.

Plate VI: Lawn and scanty trees at NSDC hotel. Hotels
Source: Author's fieldwork, 2017.

Plate VII: Hard Landscaping only, at Saftec

Source: Author's fieldwork, 2017.

From the study carried out, it was discovered that all the hotels in the sample population have less than 50% of the design features necessary for the adoption of bright green concept in buildings, this therefore means that energy consumption in these hotel buildings will be relatively high.

CONCLUSION:

This study has revealed that sustainability and energy efficiency were not considered in the design stages of the hotels, as most of the design features suitable for the adoption of bright green concept are found to be absent in these hotels. Although it is still possible, it will be a great task for these buildings to be converted to bright green buildings as changes required would be mostly structural.

From the study conducted, the author recommends that:

- Green building design should be made a criterion to be met by design proposals before approval for construction is given. This is to ensure that an energy crisis is averted, and the preservation of the natural environment.
- Nigeria, should adopt the tradition of celebrating green and smart buildings as a way of encouraging sustainable building design.

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URBAN GREEN INFRASTRUCTURE PLANNING IN EUROPE AND THE UNITED STATES: LESSONS FOR NIGERIAN CITIES

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The increasing impacts of climate change on natural systems and human livelihood necessitate the adoption of green infrastructure in urban development planning. It was discovered in the literature that the socio-economic and environmental benefits of green infrastructure far outweighs that of grey infrastructure and other engineered approaches to climate change mitigation and adaptation. It is environment-friendly and also has the advantage of long term effectiveness for enhancing resilience as well as biodiversity conservation and nature preservation. Against this backdrop, this paper explored green infrastructure planning in Europe and the United States (US). Four cities (Barcelona and Copenhagen in Europe; New York and Chicago in the US) that have successfully implemented green infrastructure plans were selected for this study. In these cities, green infrastructure offers a unique opportunity for developing urban resilience through the appropriation of natural ecosystems and green networks which provides an array of services: flood alleviation, cooling of heat islands, carbon capture, water filtration, etc. Experience gained from these cities provides lessons for Nigerian cities.

Keywords: climate change, Infrastructure, green, environment-friendly resilience

INTRODUCTION

Green infrastructure has been looked upon as one of the contemporary elements of the urban fabric as its economic and environmental imports upon the urban milieu is of immense significance. Town Planning Utopians have long understood the role of urban green infrastructure as evident in the garden city movement and designation of parks and biodiversity paradise in urban areas. Green infrastructure planning contributes to building urban resilience by rehabilitation and expansion of natural ecosystems within built areas.

Green infrastructure provides a space for habitat and biodiversity, which in turn provide services to the urban environment that are not available through traditional grey infrastructure. In contrast to many grey assets, which are typically geared towards a single purpose, green infrastructure is naturally multi-functional, simultaneously providing an array of services such as flood alleviation, cooling heat islands, carbon capture, water filtration, local food production and the provision of recreational spaces (Belanger, 2009, Roe and Mell, 2012).

From a strategic planning perspective, green infrastructure offers a unique opportunity for adaptive planning and developing urban resilience through natural resource management (Ahern, 2011). The premise of green infrastructure planning is that if ecosystem services are valued and systematically planned alongside the services produced by conventional infrastructure, they can contribute to society's everyday functioning and build urban resilience at the same time. This rationale encourages the extension and maintenance of existing green networks and the implementation of green infrastructure solutions which can improve water quality, attract investment, encourage redevelopment, provide recreational opportunities and revive distressed neighbourhoods.

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Natural and engineered green infrastructure solutions can create unprecedented opportunities for building resilient urban area for the future. Not only does urban green infrastructure mitigate climate change by eliminating green house gases from the atmosphere, it also helps mitigate the risks of flooding, drought and associated climate related hazards and disasters. This paper examines urban green infrastructure planning in Europe and the United States. This is with a view to drawing lessons for Nigerian cities.

Conceptual Anchor

The concepts of green infrastructure and green cities provided the conceptual anchor for this work. The term green infrastructure is synonymous to "green space", "green networks" and "green ways". Urban green space includes everything in cities that has vegetation. Collectively it is sometimes referred to as "green infrastructure", encompassing the entire working landscape in cities that serve roles such as improving air quality, flood protection and pollution control (Girling and Kellett, 2005). Whereas green space may refer to anything in the city that has vegetation, green infrastructure encompasses more than green spaces but the agglomeration of greens within the city and it also entails design interventions that adopt creating hubs of biodiversity within the cityscape. Common types of green spaces which combine to provide green infrastructure in the city include: doorstep and communal green space (including balconies and courtyards); private gardens; institutional land; local parks; district and regional parks; river corridors and floodplains; and coastal zones. Therefore, urban green infrastructure can be summed up as the agglomeration of green spaces, green networks and green ways within the city.

In more specific terms, green infrastructure refers to the interconnected set of natural and man-made ecological systems, green spaces and other landscape features. It includes green assets which may be networks of planted and indigenous trees, wetlands, parks, green open spaces, original grassland and woodlands as well as building and street-level design interventions, incorporating vegetation such as green roofs (Schaffler *et al.*, 2013). Green infrastructure presents an unprecedented opportunity for the uptake of alternative approaches to city planning and management. The green infrastructure approach has emerged internationally as a way of understanding how green assets and ecological systems can work as part of the infrastructural fabric that supports and sustains society and builds resilience.

According to UCD (2008), although, green infrastructure holds different interpretations for different people, the underlying factor is the integration and proliferation of natural features within the urban environment. In an urban area, from a social and recreational perspective, it may refer to the trees, shrubs and grasses in the city which provide the necessary 'green' benefits, while from an engineering perspective, it may involve the integration of several technical approaches such as swales, green roofs, gardens and parks which are applied to facilitate various environmental benefits.

From a planning perspective, the green infrastructure approach makes use of the natural environment in a way that it maximises its functions and seeks to put in place, either through regulatory or planning policy, mechanisms that ensure protection of natural environment (Benedict and McMahon, 2006). Green infrastructure is viewed as the basis for the "green city" or "new urbanism" precipitated upon the foundations of improving the natural features in cities. Beatley (2000) argues that it may be improper to dispel other attributes of the environment and situate green urbanism as a unified problem-solving approach for the city because it is increasingly difficult to postulate a distinct strategy or approach for green infrastructure planning.

The planning approach adopted to implement the green infrastructure framework differs from region to region. For instance, the approach towards green infrastructure in European countries refers to the new or existing interlinked networks or corridors of green routes and hubs of biodiversity which is recognised as a valuable approach for spatial planning and is now seen in national, regional and local planning and policy documents and strategies (Murphy, 2009; Lafortezza *et al.*, 2013). There is a variety of national and local planning cultures and needs present, as a result of which no single narrative of green infrastructure planning exists, rather, a set of shared principles have been developed as guidance for diverse contexts, terrains and regions (Ranjha, 2016). Although, this makes it increasingly difficult for experts to come up with a consistent unified strategy towards managing urban green infrastructure, it affords the opportunity for creativity and flexibility in proposing and utilizing various planning concepts and land use appropriation to suit the specific needs of a region.

Green infrastructure differs from other approaches in landscape planning because it considers ecological and social values in combination with other land use developments. Planning of green infrastructure, therefore, relates to policies and planning activities, in particular through the processes of land use management and the development of nature areas and elements. A number of strategies for protecting and promoting green have been pursued and one approach has been to mandate a high degree of green and nature-enhancing features as part of new development or redevelopment schemes. Beatley (2000) surmised that new development projects should incorporate, or have incorporated, extensive natural areas in close proximity to residents. In part, this is made more feasible by the higher degree of control the public exercises over the design and planning of new development and redevelopment projects down to the point of specifying the number and location of trees and vegetation on a building plan. This strategy proposed by Beatley (2000) requires strict monitoring of development. In instances where development control is still at its infancy especially in developing countries like Nigeria, such a strategy may not be effective. It may even be rigidly opposed by the people or sabotaged.

In addition, several strategies may lead to the same result. However, the cost of implementation and its overall outcome in the long run may be undesirable. As an example, green infrastructure reinforces the ideals of connectivity of street-scale, neighbourhood-scale, city-scale, to regional-scale ecosystems. As proposed by Juntaek and Uoo (2015) several types of connections may be adopted (Figure 1). Each of these models may be context-specific and may not be applicable in another instance. Besides, it may be possible to combine these models within the same area.

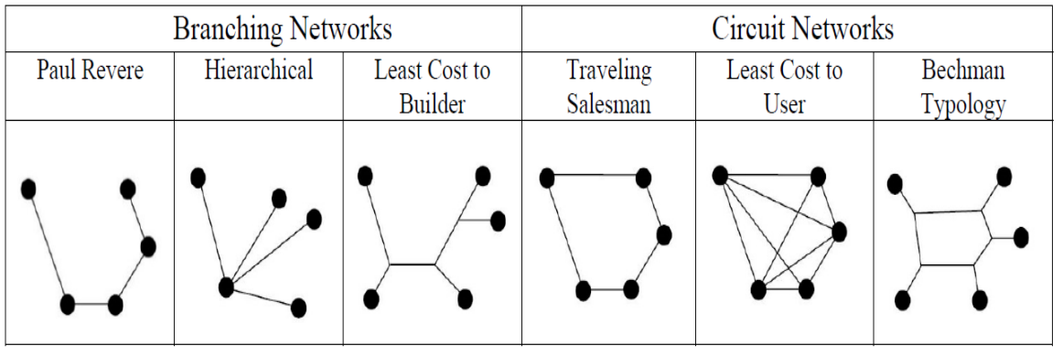

Figure 1: Network Typology for Greenway Source: Juntaek and Uoo (2015)

Green infrastructure is a strategic and spatial approach to landscape and urban planning. It is spatial because it is a network of patches and corridors of land that are planned and managed for biodiversity conservation, "nature" protection, water resources, land protection, recreation, cultural uses, urban development control, and more recently, for climate change mitigation and adaptation. A green infrastructure network or system may include networks of greenways, open spaces, greenbelts, urban greening, cultural landscapes, urban open spaces, ecological networks, agricultural land, and natural systems (and all un-built land that could support vegetation) that form the necessary support system for living. Green infrastructure can be conceived and understood by stakeholders, planners and policy makers (Benedict and McMahon, 2002; Ahern, 2007; Forman, 2008; Mell, 2009).

Green infrastructure is sometimes appropriated in terms of open green spaces per capita in urban systems. This parameter has also been widely exploited in selecting the greenest cities in the world. Thus, Green infrastructure forms the backdrop for green cities. At present, regions and states have different standard green spaces per capita recommended in urban areas. The European Union has been one of the most active regional bodies in promoting green infrastructure. International organisations such as the World Health Organization (WHO) and the United Nations Food and Agriculture Organization (FAO) suggested a minimum availability of 9 square metre green open space per city dweller (Haq, 2011). A number of standard green spaces per capita across some regions and states across the globe are illustrated in Table 1.

Table 1: Estimates on Urban Green Spaces in Different Regions of the World

Region/Country/City	Estimated Size of Urban Green Space/Woodland Resource
Europe	The study of 386 cities suggests 18% average woodland cover. Another study suggests 18.5% cover within municipal limits of 26 large European cities, i.e about 104m^2/ inhabitant.
France/Paris	About 80 m^2 of urban forest per inhabitant in the Greater Paris region (Konijnendijk, 2003).
The Netherlands	Average green space cover is about 19% for 22 largest Dutch cities i.e about 228m^2/inhabitant.
Australia/Canberra	Estimated crown cover of about 24 million metre square amounting to 228m^2/inhabitant.
China/Nanjing/Wuhan	On an average China's cities have 32.54% green cover. This varies greatly in Chinese cities like Nanjing and Wuhan, i.e 44.3 m^2/person and 10.3m^2/person respectively.
USA	Average green cover is about 27% i.e about 32 m^2/inhabitant
Hong Kong	Average green cover is about 27% i.e about 32 m^2/inhabitant
Singapore	Average green space cover is about 17.8% i.e 7.5m^2 per capita
India/Delhi	Average tree and forest cover is about 20% of geographical area and about 20 m^2 inhabitant.
India/Chandigarh	Average tree and forest cover is about 35.7% of geographical area, i.e about 55m^2/inhabitant.

Source: Singh *et al.*, (2010).

Green cities minimize environmental impact and maximize opportunities to improve and support the natural environment. Green cities are energy efficient and reduce reliance on non-renewable energy sources; actively encourage waste reduction and management; include green and resilient infrastructure, low-carbon transport, and water cycle management; and deliver improved quality of life outcomes for residents. Green cities can be considered the contemporary name for which areas develop in a manner that is socially responsible, and environmentally and economically sustainable.

Although there is no uniform definition of "Green City," several central themes help shape and define what a green city is. Such themes include energy efficiency (including built form) and reducing reliance on non-renewable energy sources, sustainable and low-carbon transportation systems, green and resilient infrastructure, waste reduction and management, increased green areas, water cycle management, and integrated planning. How a city develops as green varies across geography, sector and pace at which it occurs.

URBAN GREEN INFRASTRUCTURE PLANNING

In this section, green infrastructure planning in selected cities of Europe and the United States are examined. Specifically, green infrastructure planning approaches in Barcelona (Spain), Copenhagen (Denmark), Chicago and New York are appraised.

Barcelona's Green Infrastructure and Biodiversity Plan 2020, Spain

Barcelona is one of the most densely populated cities in Europe, with 1.62 million inhabitants living in an area of just 101.21 square kilometres. While Barcelona has a relatively low ratio of green space per inhabitant, it has more street trees than most other European cities – currently there are around 161.423 trees of 150 different species lining the streets of Barcelona (URBES, 2014).

The relevance of green open spaces is clearly accentuated in Barcelona's green infrastructure and Biodiversity Plan 2020 which envisages a city in which nature permeates urban life and green infrastructure is fully integrated into city planning and management. The plan, launched by the Barcelona City Council, presents a vision of Barcelona in 2020 where green infrastructure is an essential element of a healthy and productive urban environment. Green infrastructure was targeted to effectively curb pollution levels in the city, with a broad metropolitan scale and more integrated approach to green infrastructure in urban planning and management.

The Barcelona Green Infrastructure and Biodiversity Plan 2020 highlights that the city's trees (including street trees, trees in parks, shrubs and natural areas) play an important role in filtering harmful substances from the air. It is estimated that in 2008, they offset around 19,000 net tonnes of CO_2 from the atmosphere, and eliminated slightly more than 305 tonnes of air pollutants (URBES, 2014). By reducing the amount of pollutants in the air, these urban trees are providing an invaluable ecosystem service, particularly given that air pollution is a major environmental challenge for the city.

Green corridors are a predominant component of the plan where strips of urban land covered in vegetation are linked together to help connect green areas and enhance biodiversity within the city while also linking urban areas with the surrounding environment such as the coastline and the Collserola Natural Park (Figure 2). The plan also emphasized filling built up spaces such as courtyards, roofs and walls with greenery – a process known as naturalisation – which also helps to absorb pollutants from the air, reduce noise, balance the water cycle, reduce energy consumption and hence CO_2 emissions, and foster biodiversity. These strategies create a more appealing environment for people to live in, while at the same time improving the health of urban citizens. Barcelona is working to achieve its vision for 2020 through a set of targeted actions that maximise green space in the city and raise awareness for the importance of integrating green infrastructure into the urban landscape. The city of Barcelona prior to the launch of its green infrastructure plan regularly exceeded the European Union (EU) limits for annual concentrations of nitrogen dioxide and particulate matter.

Figure 2: Existing green corridors in the eastern area of Barcelona Source: URBES (2014)

Beyond Green Copenhagen Approach, Denmark

Beyond Green Copenhagen focused upon integrating green infrastructure into city planning and management. This involves the creation and delineation of green spaces and green corridors, establishment of new parks and urban gardens, urban tree planting and other subtle green infrastructure approaches such as green roofs, rainwater harvesting and permeable pavements.

Greener local drainage of rainwater and diversion of storm water to reduce flooding is cheaper than traditional measures (such as expanding the sewage network), while simultaneously improving the quality of life for urban residents through increasing the number of parks, streams, and ponds (Infrangalis, 2013). This approach has been widely employed in the city of Copenhagen.

Beyond Green Copenhagen aims to position the city to be the first "carbon neutral" capital city in the world by 2025. The city believes that green must be seen in a broader perspective than strictly environmental. It is not only about reducing CO_2 emissions, it is also about improving quality of life and creating jobs and business opportunities throughout the entire economy – not just in the clean-technology sector.

PlaNYC and the Green Infrastructure Plan, United States

In recent years, green infrastructure has gained traction especially in New York City (NYC) which has a combined sewer system. New York City receives more than 50 inches/year of precipitation, the most rainwater of any of the 10 largest cities in the United States (US). With PlaNYC and the Green Infrastructure Plan, the city strives to find environmentally friendly alternatives to expensive treatment plants and so called gray infrastructure (Foster *et al*., 2011). PlaNYC themed "A Greener Greater New York" is a city wide program striving to make the largest city in the US more sustainable, sets the foundation for all sustainability initiatives in NYC including the green infrastructure plan. In its own words PlaNYC has "implemented numerous innovative initiatives, including the City's Greener Greater Buildings Plan, Clean Heat program, climate resilience initiatives, Million Trees program,

Green Infrastructure Plan, and more" and thereby trying to build a modern, more sustainable city by 2030 (PlaNYC, 2013).

In September 2010, New York City (NYC) released the NYC Green Infrastructure Plan which presents an alternative approach to improving water quality that integrates "green infrastructure," such as swales and green roofs, with investments to optimize the existing system and to build targeted, cost-effective "grey" or traditional infrastructure (EPA, 2014). According to the Center for Clean Air Policy, the socio-economic benefits accruable from the New York's Green Infrastructure Plan are summarised succinctly as follows: "The cost to implement the overall Plan is $1.5 billion less than grey, with green stormwater capture alone saving $1billion at a cost per gallon of about $.15 less. Sustainability benefits over the 20 year life of the project range from $139 - $418 million depending on measures implemented. The plan estimates that every fully vegetated acre of green infrastructure would provide total annual benefits of $8,522 in reduced energy demand, $166 in reduced CO_2 emissions, $1,044 in improved air quality, and $4,725 in increased property value (NYC, 2010).

The NYC Green Infrastructure Plan seeks to achieve multiple benefits including climate adaptation via a multi-pronged sustainability effort that will reduce the urban heat island effect, enhance recreational opportunities, improve quality-of-life, restore ecosystems, improve air quality, save energy, and mitigate and adapt to climate change. These goals, as well as improved water quality, are substantially advanced by green infrastructure in ways that traditional grey infrastructure cannot match (Foster *et al*., 2011).

The plan identified green infrastructure investments as pivotal to simultaneously encourage economic activity and improve watershed health in ways that are cost effective and equitable. It further recognizes that green infrastructure could solve several community challenges, including loss of tree canopy and park space, the demand for more walking and biking trails, and limited availability of fresh, local food. It recommends strategies to acquire additional parkland in underserved neighbourhoods, expand the off-street bicycle network, and remove barriers to the expansion of community gardening (EPA, 2014).

In addition, the plan aims to reduce the city's sewer management costs by $2.4 billion over 20 years. One of the main goals of the plan is to cost effectively reduce Combined Sewer Overflow (CSO) from 10% of the impervious surfaces in the city. It estimates that the city can reduce CSO volumes by 2 billion gallons by 2030, using green practices at a total cost of $1.5 billion less than traditional methods (Foster *et al*., 2011). Capturing rainfall from 10 per cent of impervious surfaces in CSO areas through green infrastructure provides substantial, quantifiable sustainability benefits such as cooling the city, reducing energy use, increasing property values, and cleaning the air.

The NYC Green Infrastructure plan has achieved multiple successes. In 2011 and 2012, the NYC Department of Environmental Protection (DEP) constructed scores of right-of-way bioswales and green streets in addition to numerous other projects that are in the planning and developmental stages. To increase transparency and promote the work, the NYC DEP created a Green Infrastructure Map available on their website that displays current sites and projects that are being implemented (Foster *et al.*, 2011).

In line with the green infrastructure plan, in 2011, the Design Trust for Public Space collaborated with the New York City Department of Parks and Recreation to publish New York City's High Performance Landscape Guidelines: 21st Century Parks for NYC (EPA, 2009). The document is the first comprehensive, municipal design primer for sustainable parks and open space in the United States. The document offers detailed guidelines for creating sustainable urban parks and open spaces that provide a range of environmental services and recreational opportunities. The guidelines address best management practices for soil, water and vegetation. Implemented citywide, these strategies will help address many of the environmental concerns New York City faces. The Parks Department has high hopes for the guidelines improving practice because the recommendations are clear, incremental and implementable at scale.

A clear example of the green infrastructure approach for best water management practice in the city is the Solaire Building. Rainwater is collected in a 10,000 gallon cistern located in the building's basement. Collected water is used for toilet flushing and make-up water. The system and other measures have decreased potable water use in the building by 50% earning the building New York State's first-ever tax credit for sustainable construction (EPA, 2008). The EPA has stated that the use of green infrastructure is an effective response to a variety

of environmental challenges that is cost-effective, sustainable, and provides multiple desirable environmental outcomes (EPA, 2014).

Another notable model in New York City is the Staten Island Bluebelt program. The rapid development that occurred on Staten Island after 1964 when the Verrazano Bridge was completed, resulted in a large quantity of stormwater runoff as the land area covered by impervious pavement increased (Foster *et al*., 2011). The Bluebelt system offered a solution. The Staten Island Bluebelt programme consists of an extensively constructed and planned stormwater management system (Figure 3).

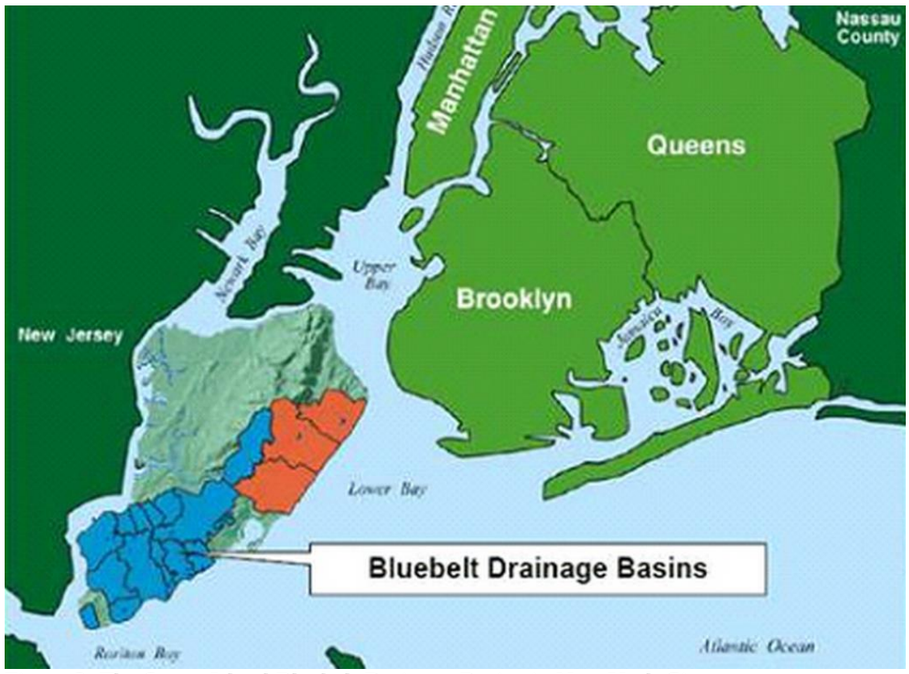

Figure 3: The Staten Island Bluebelt Drainage Basins in New York City
Source: Foster *et al.* (2011)

The Bluebelt system uses strategically placed wetlands within a watershed to temporarily store and filter 350,000 gallons of stormwater during a storm event. Soil placement and layering, vegetation, and rocks reduce the speed of the runoff providing more time for sediment, chemicals and other toxins to percolate into the wetland. Slower and less stormwater runoff from these areas reduces the load on the single sewer plant in Staten Island, giving it more time to treat and discharge water. Since the water that does not reach the treatment plant has already been naturally filtered through percolation, higher quality water will be discharged into the streams, rivers and the Atlantic. This system results in cleaner runoff, reduces the amount of water flowing into the sewer system at a given time and helps to protect downstream property from flood damage.

According to Gumb (2007), perhaps the best testament to the success of the Bluebelt has been its stellar performance during major storms and hurricanes. Hurricane Ivan, which dropped 2.3 inches (5.8cm) of rainfall over a 24-hour period, passed quietly through the region on September 17-18, 2004. Tropical Storm Tammy and Subtropical Depression 22, which combined to produce 6.4 inches (16cm) of rainfall over a 24-hour period, went by unnoticed on October 8-9, 2005. Areas that were once flooded even by minor precipitation events handled these major storms without issue.

By naturally draining over 14,000 acres and saving over $80 million in conventional sewer costs, it became clear that the Bluebelt system should be expanded to other areas (Rosenzweig *et al*., 2007). As such, other Bluebelt models have surfaced, since the success of the Staten Island system. A NYC Green Infrastructure project in the Bronx Botanical Garden has four catch basins with the capacity to hold 5,770 gallons stormwater/minute and a wetland water quality basin that filters and cleans the water discharged from the basins. A conservative estimate is that the Bronx Botanical Garden Bluebelt system treats 8.4 million gallons of stormwater every year and thereby reduces costly CSO events (NYC, 2012). Currently, New York City is planning to build constructed wetlands in and around Shoelace Park to protect the Bronx River (Foster *et al*., 2011).

Chicago Green Action Plan and Wilderness Green Infrastructure Vision, USA

Climate forecasts for Chicago for the new millennium indicated an expected increase in noon temperature at or above 90°F from 15 days to 66 days per year under projected high rates of greenhouse gas emissions and an additional 30 days over 100°F (Economides, 2014). Overall, heat waves were projected to be longer, more frequent, and more intense with associated increases on public health impacts, including mortality. In addition, the frequency of rainfall events delivering more than 2.5 inches in 24 hours were also projected to increase, accompanied by associated changes in flood risks and the need for improved stormwater management (EPA, 2014). The challenges accompanying these were envisaged thus, the establishment of the Chicago Green Action Plan and Wilderness Green Infrastructure Vision.

Chicago's Green Action Plan calls for 6,000 new green roofs, more than a million new trees, a watershed plan that factors in changes expected due to climate change and other actions. In the first two years after implementation, more than 4 million square feet of green roofs were completed or planned, and 32,000 square feet of Chicago alleyways were reconstructed with permeable materials (Economides, 2014).

Chicago Wilderness is a landscape-level conservation initiative that connects people with nature in the greater Chicago region. The initiative brings together more than 250 organizations to restore ecosystems and protect natural resources. Chicago Wilderness created the Sustainable Watershed Action Team to assist with implementation of neighborhood and community scale work related to the infrastructure plan. The organization is reaching out to local government officials in northeastern Illinois who are struggling to manage sprawling development patterns. The SWAT offers "hands-on technical assistance to improve their planning infrastructure and incorporate sustainable development practices (Hayhoe and Wuebbles, 2008).

The Chicago Wilderness Green Infrastructure Vision (GIV) paints a bold picture of what a region can look like when care is taken to protect the natural areas, corridors and open spaces that are critical to quality of life. The Vision envisages how we can live in and among natural areas in a sustainable way and to mutual benefit, by using tools such as conservation development, conservation easements and thoughtful land use planning. It is a guide to creating a region where healthy ecosystems contribute to economic vitality and a high quality of life for all residents. Part of the framework provides principles to guide local governments and developers on the planning and design of new development and redevelopment projects, to protect and enhance nature as an integral part of the development process. The principles are largely focused on the natural resource aspects of sustainable development - land, water, habitat and soils - and recognize that having healthy nature in communities also creates positive economic and social benefits.

In Chicago, public officials are experimenting with different ways of encouraging property owners to incorporate best management practices into renovations, redevelopment projects and new developments. One approach is the city's Green Permit Program. Permits are expedited for qualifying projects that incorporate greening into their proposals. Eligible projects may also receive a permit fee discount. For qualifying permittees, the wait time for approval is reduced to as little as two weeks from the date of submission, resulting in significant cost savings for developers. The more green strategies, the faster the review process for permits. The program explicitly calls out "Exceptional Water Management" as one of the greening strategies. Projects are rewarded for reducing water consumption and stormwater runoff since they lessen the demand on city infrastructure and preserve Lake Michigan and the Chicago River. The program is seen as benefitting all parties involved. City officials use the program to influence private development to meet citywide sustainability goals. Developers save money and time and gain access to technical assistance and design advice about efficiency opportunities that they might not have known about already or were unskilled at deploying (Hayhoe and Wuebbles, 2008).

Chicago presents itself as a leader in green infrastructure. For example, the city's commitment towards building green roofs is among the most ambitious in the US. The Green Roof on City Hall, constructed in 2001, ignited movements such as Chicago Green Roofs and the Green Roof Grant program. The city realized the benefits of energy savings through green roofs and only parenthetically notes the water cleaning and water retaining qualities.

The Chicago Green Roof organization mapped out every green roof constructed in the city and made it publicly available (Figure 4).

Figure 4: Green Roof Locations Throughout Chicago
Source: Chicago Green Roof Map
http://www.artic.edu/webspaces/greeninitiatives/greenroofs/main_map.htm

The City Hall had a 20,300 square-foot green roof installed as part of Mayor Daley's Urban Heat Island Initiative (Figure 5). The roof includes 20,000 plants, shrubs, grasses, vines and trees. When compared to an adjacent normal roof, the City Hall's green roof is nearly 56°C lower in addition to other benefits which include improved air quality, reduced storm-water runoff of 75 per cent for a 1 inch storm, and energy savings. From the green roof experiment, the city expects annual savings of more than 9,270 kWH of electricity and nearly 740 BTUs of natural gas for heating. This amounts to more than 6.3 tons of CO_2 saved, using EIA conversion factors. Total energy cost savings in the city as a result of the proliferation of green roofs is estimated at $3,600-$5,000 annually, increasing with higher energy prices. To date, Chicago has over 400 green roof projects in various stages of development with 7 million square feet of green roofs constructed or underway which is more than that of all other U.S. cities combined (EPA, 2008).

Figure 5: Chicago's City Hall Green Roof

Chicago is a pioneer of green alleys and streets. The city has 1,900 miles of public alleys with over 3,500 acres of paved surfaces. In 2007, 30 green alleys with permeable pavement and reflective concrete had been installed, along with over 200 catch-basins across the city. Landscape ordinances encouraged tree planting and installation in alleys of natural landscaping, rain-gardens (i.e., vegetation in artificial depressions) and bio-swales (i.e., artificially contained vegetation). Green alley design also encouraged homeowner involvement in disconnecting of rain-gutter downspouts from the sewer system, addition of rain-barrels to capture rooftop runoff, and backup power supplies to sump pumps in basements. The goal of these measures was to slow the rate of storm-water runoff onsite and through alleys, allowing water to soak into the surrounding neighbourhoods more naturally, thus, avoiding localized basement and surface street flooding and to support the capacity of aging infrastructure to handle extreme precipitation events.

LESSONS FOR NIGERIAN CITIES

The descriptions of selected cities in the Western world deemed inarguably green and designated as models of green urbanism and resilience may seem excessively optimistic. Although, these are clearly cities making impressive strides and moving significantly in the direction of more sustainable futures, even for the most holistic and forward-thinking amidst them, implementing the ideas of green urbanism raises serious challenges and dilemmas (Beatley, 2000). These cities, despite their tremendous accomplishments, are not perfect examples of sustainable places, but struggle with difficult conflicts and trade-offs in sustaining their resilient label. Thus, Nigerian cities should also strive to be models of green urbanism. This is with a view to becoming resilient cities.

From green infrastructure plans developed in Europe and the United States, one can posit that green infrastructure contributes to urban resilience. Green infrastructure play a paramount role in carbon storage and sequestration by counteracting anthropogenic CO^2 emissions because of their inherent capacity to store and trap CO^2 in their biomass while increasing the soil surface (pervious surface) of cities which otherwise would have been a non-permeable surface. It also has the ability to reduce water runoff and improve water quality. Vegetation functions as a natural filter by retaining sediment and organic matter from overland flow (Dipeolu and Elemide, 2015). The reduction of flow volume and rate by urban greens reduces flooding hazards and decreases surface pollutant wash off.

Developmental progress relies on the resilience of poor communities. Without communities evolving the capacity to cope with shocks, long-term development simply cannot be achieved. With enhanced resilience, individuals and communities are able to build assets, improve livelihoods, boost food security, and overall sustainability. They can then better weather hazards, wade through exposures to risks, recover more quickly, build up and bounce forward even stronger. Therefore, it is imperative that resilience-building is integrated into urban development strategies as quickly as possible. Investing in the resilience of infrastructure to natural disasters and climate change is imperative. To survive and thrive in volatile times, Nigerian cities and their people must mitigate crises and seize opportunities to shape the future they desire. They must be, in a word, resilient.

Green infrastructure has been acknowledged across the academic domain and international framework as a strategic norm for enhancing resilience. The multi-functional nature of urban green infrastructure necessitates the application of planning and management approaches that account for the full value of these urban landscapes. This is especially so in the face of predicted changes in future climate and parallel pressures of land use development and change. For developing countries, the implications of climate change create a new urgency to seek ways of building general resilience through cost effective "no-regrets" interventions. Pursuing resilience governance in poorly resourced urban areas requires that efforts be directed towards green infrastructure as opposed to expensive grey infrastructure development, for the simple reason that well-planned systems of green landscapes have the potential to generate net social and ecological benefits under a range of future scenarios.

According to a report by Forest Research (2010) cited in Krause *et al* (2011), green infrastructure can mitigate risks from climate change by protecting urban regions against floods and other negative effects of changing weather patterns. Trees and other plants have been labelled as the "lungs of cities" because they have the ability to remove contaminants from the air that is breathed (Dipeolu and Elemide, 2015). Acting as natural filters and reducing air pollution, plants generate substantive health benefits by reducing mortality rate and disease overload. Every tree helps fight global warming by eliminating greenhouse gases from the atmosphere. The structural value of the benefits from urban forestry in Chicago totals $2.3 billion and the total carbon sequestration rate is 25,200 tons/year equivalent or a value of $14.8 million/year based on an estimated market value for carbon (Foster *et al*., 2011). By absorbing carbondioxide and pollutants fuelling climate change, parks and green space offset the warming effects on cities, making them cooler. In Barcelona, it is estimated that in 2008, trees offset around 19,000 net tonnes of CO_2 from the atmosphere, and eliminated slightly more than 305 tonnes of air pollutants (URBES, 2014).

From the biodiversity perspective, green infrastructure help to restore and protect the organisms, species, and various populations which might have been depleted from an environment due to human practices like urbanisation, deforestation and various form of bush burning. Specific aspect of green infrastructure like urban agriculture, urban forests are not only important for forest genetic conservation but are also habitat for insects and wild

animals (Benedict and McMahon, 2006). Therefore, green infrastructure is helpful for biodiversity conservation due to their ability to increase habitat connectivity. They also help species to migrate and survive hazards which may be caused by climate variability. Specifically, greens in the cityscape provide wildlife habitat and visual amenity, absorb airborne particles by up to 75% and produce oxygen, act as a carbon sink, create energy savings by providing wind protection to exposed buildings, increase humidity and provide a cooling effect, attenuate noise and introduce a pleasant noise of their own, introduce an element of natural scale to streetscapes, reflect the changing seasons and provide a psychological link with nature, increase property values by up to 18% and spending in "leafy streets" by up to 10% (Johnston and Newton, 2004; TCPA, 2004).

Apart from the tangible quantifiable benefits of green infrastructure, there are benefits it gives to urban residents, particularly if this takes into account low-income areas. This relates explicitly to some of its attributes in the creation of natural areas for recreation, exercise, and social meeting which promotes healthier and happier people. In addition to the environmental benefits, there are also potential well-being benefits of green infrastructure like increased life expectancy, better mental and psychological health and improved communal interactions (Nordh *et al.*, 2009).

However, several dilemmas arise from the objective of promoting nature within the city. Many cities may have managed to protect extensive parks and open spaces, however, competition for land and development pressures coupled with development policies do often result in the gradual loss of vacant green areas within the cities. For instance, the Amsterdam Physical Planning Department reported in 1994 that "In the past few years Amsterdam's compact-city policies have led to a more intensive use of land, the expansion and compaction of the city have largely been carried out on open space in the city districts. Sports fields have been rezoned for housing purposes, parks and gardens have also been used" (Beatley, 2000: 408). The urban designers and physical planners at the Physical Planning Department proved unable to redirect the powerful thrust of these policies and the value of this green space for the city as a whole was ignored. If this is the case of a capital city in Europe, one can only imagine what obtains in the cities of the developing countries (Nigeria included) considering the sporadic urbanization and competition for urban land. According to several reports, the rate of ecosystem loss in cities is unprecedented (MA, 2005).

UN Habitat (2006) corroborated the consensus claim that cities are increasing exponentially particularly in the developing world. If cities are developing and increasing exponentially, it is obvious that this development is occurring spatially and eating up the natural environment. Agbola and Olurin (1998) corroborated by Hahn (2013) stated that Nigerian cities appear to be growing beyond the control of planners, beyond management capacities and beyond available resources producing miseries that are often difficult to comprehend particularly the rapid deforestation and destruction of eco-system that follows urban growth and sprawl. As a result, increasing urbanization and spiraling physical development may constitute a significant impediment to urban green infrastructure in Nigeria. One important response to the gradual loss of green spaces within cities in addition to protecting a certain green structure that should at some point be considered untouchable is to actively "green" existing areas of the built environment, via tree planting, green roofs, green walls and taking up impervious surfaces (Beatley, 2000).

CONCLUSIONS

The increasing impacts of climate change on natural systems and human livelihood necessitate the adoption of green infrastructure in physical development planning in Europe and the US. However, in Nigeria like other nations in the developing world, economic challenges have led to emphasis upon social amenities and infrastructural facilities to the detriment of green infrastructure thereby escalating existing climate change impacts. Urban green infrastructure planning provides an array of services such as flood alleviation, cooling heat islands, carbon capture, water filtration, local food production and the provision of recreational spaces. The scope and potential for the uptake of a green infrastructure approach in urban planning, design and management is extensive. The vast wealth of green spaces, both natural and man-made, together with green corridors injects life into urban nodes and creates a prime canvas for the implementation of alternative infrastructure for building urban resilience. It is hopeful that the summation in this paper will provide innovative latitude for

beneficial future research outcomes and policy interventions anchored on urban green infrastructure planning in Nigeria.

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HEALTH AND SAFETY ISSUES

EFFECT OF HEALTH AND SAFETY MANAGEMENT PRACTICES ON SAFETY PERFORMANCE OF CONSTRUCTION CONTRACTORS

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The construction industry plays a significant role in the economic development of a nation. However health and safety performance of the industry is a challenge to the developmental initiative of the country. The research addressed the problem of inadequate measures of H&S management practices and regulations capable of guiding construction activities on the safety performance of building contractors. This led to the evaluation of the effect of the H&S management practices on the safety performance of contractors with a view to determining measures for effective safety performance. The use of quantitative approach was adopted for this research. The research data were collected with the use of a well-structured questionnaires. The questionnaires were administered to 50 selected construction companies registered with Federation of Construction Industry in Abuja. The response rate of the questionnaire was 84%. Mean item score (MIS) was used to rank the major H&S practices and regulations in order of implementation by construction companies on a 5 - point Likerts scale. Correlation analysis was used to determine the relationship between H&S management practices and safety performance of contractors on sites. The research found that H&S management practices of construction contractors have non -significant influence on the safety performance of contractors on sites. The research recommends that contractors should be compelled to draw up safety responsibilities and put more emphasis on the role of management of H&S practices and provisions should be made to make it a statutory duty for every contractor to have a safety management programme on site for improved safety practices.

Keywords: *Contractors, Health, Management, Performance, Practices, Safety*

INTRODUCTION

The construction industry plays a significant role in the economic development of a nation. The manner in which health and safety in the industry is considered is a major subject to be evaluated in any nation (Okolie and Okoye 2013). International labour office noted that accidents related to work and sickness account for about 3.9% of every case of death. A quarter of the world population have been affected by various level of work related accident per year.

The British were the first to introduce programmes related to health and safety in Nigeria Onyejeji (2011). Under the programme, specialist on occupational health usually go out to industries to monitor if safety measures are adopted. This resulted in the 1974 labour act, the 1987 factory act and the 1987 act on the compensation of workers who suffer loss as a result of occupational accident or death. There are other important acts on labour health in Nigeria. These include the 1990 labour act and the 2004 act, which meant for the compensation of workman. In a similar note, Adeogun and Okafor (2013), reported that several workers are exposed to the risks of unhealthy work environments by their employers because these acts are not enforced.

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Nigeria is a signatory to the occupational and safety law of the 1981 convention in Geneva and has not till date implemented it in its construction industry. On this premise, (Idoro, 2008; Idoro, 2011), made a conclusion that there is little or no effort on the part of authorities in charge of health and safety and has not reflected in their scope of operation. This has resulted in increased accident rate in many industries.

Most efforts made in the improvement occupational safety has not seen reasonable result and as a result construction workers have been confronted with injury and in some cases, death (Okoye, 2010).

There is a high rate of accident in Nigeria and this is associated with ineffective management practices like inefficient monitoring, reporting and control safety practices. Despite the fact that some level of improvement has been notice, there have also been cases of unreported accidents in construction sites. This is because workers are not adequately educated on the principles of health and safety at work places.

In the report of Famakin and Fawehinmi (2012), the rising cases of accidents in construction site has resulted in high awareness level on the importance of health and safe practices and hence its inclusion in the criteria for the award of contracts. It can therefore be noted that with adequate observation of health and safety practices in every construction site, there will be better performance level in every construction projects in Nigeria.

It is as a result of these that this study set out to examine the effect of health and safety management practices on safety performance of contractors using Abuja as a case study. The choice of Abuja was for the fact that Abuja being the capital city experiences rapid growth in terms of construction of public buildings especially for commercial and official purposes. Most of these buildings are constructed in Abuja Central Area and most of the old residential buildings are bought and converted to public buildings for commercial and official purposes. Majority of the people resident in Abuja have businesses in this area. Therefore the level of compliance to the requirements of health and safety performance in these building types can never be over emphasized due to the population of lives and worth of properties accommodated therein. As a result of the problem identified, the following are the questions to be answered by this research:

i. What are the health and safety practices required on building projects sites?
ii. What are the regulations capable of guiding construction activities on sites?
iii. How well do building contractors comply with health and safety practices on project sites?
iv. How can health and safety management practices improve safety performance of construction contractors on sites?

The Concept of Health and Safety

The construction industry has been considered as a hazardous industry with reference to health and safety since most of its activities is a potential source of risk and danger to construction staff and users of such facilities (Idoro, 2011). The International Labour Organisation (2001, 2005) and Kheni and Braimah (2014) reported that about 40% of death in the world occupational environment is linked to construction activities. In the view of Akpan (2011), many developing countries as characterised with poor management policy with respect to health and safety of staff leading to regular occurrence of accidents, hospital bills, payment of wages for employees on admission and compensation affected workers. Other challenges noticed in such circumstances include increase in the cost of labour, absence from duties, poor relationship between management and workers, reduced efficiency in operation and poor performance. Some factors that trigger high risk of accident include carelessness, overconfidence, refusal or inability to make provision for health and safety measures and none availability of seminars and workshop for stakeholders (Okpan and Agha, 2013). Awodele and Ayoola (2005) and Olatunji and Aje (2007) reported that the increased occurrence of death, disability and unfavourable environmental conditions in Nigeria are associated with poor safety and health practices.

In the study of Idoro (2011), it was reported that there were two (2) accidents in every 100 workers and in every 100 workers, 5 cases of injuries are reported. This has posed a threat to the general performance and efficiency in the construction industries. This level of risk is generally unacceptable and measures taken to reduce it have not been satisfactory among developing countries (Gibb and Bust, 2006; Kheni *et al*., 2007; Kheni, 2008). These losses with regards to life, properties, time and moral according to Ogunsemi (1994) justify the

reason for adopting Construction Policy in Nigeria. In addition, it was asserted by Tanko and Anigbogu (2012) that most construction worker does not wear Personal Protective Equipment (PPE) which is meant to ensure general health and safety among worker in construction sites. This is because they sometimes do not feel comfortable wearing the Personal Protective Equipment (PPE).

The above reports reveal that the efforts made to minimize health and safety hazards on construction sites in Nigeria are inadequate. In the light of this, Idubor and Osiamoje (2013) stressed the need for companies to consider the safety of their employees as their responsibility and maintain high operational standard with regards to safety. Adeniran (2013) reported, that it was with the realization of the fact that "labour cannot be considered as a commodity but a vital economic factor that must be protected by the government and various agencies such as Federal Ministry of Labour Employment, Labour and Productivity and Federal Ministry of Health among others. These departments are responsible for formulating policies, administering policies, operational principles and laws that protect worker against unfavourable work conditions.

Construction companies have different level of health and safety practices as determined by their organizational characteristics. The organizational characteristics of construction companies are the unique or distinguishing features which define the performance of the construction companies. Some of the important ones are age, size, experience, annual turnover and growth rate of construction companies (Dada *et al*., 2012; Shittu *et al.*, 2016). In developing countries and indeed Nigeria, the number of large construction companies are small when compared to the number of small and medium size companies (Kheni, 2008; Idoro, 2011). These small and medium-sized construction companies (construction SMEs) lack the capability to manage complex construction projects in a safe manner. They are therefore known to have peculiar health and safety problems as reported by Shittu *et al*. (2016). Kheni *et al.* (2007) and Kheni *et al*. (2008) found that only foreign contractors in Nigeria incorporate the policies of health and safety practices in their construction sites and these policies are those of their countries of origin. On the contrary, indigenous companies do not have a wide perspective of the policy of health and safety but are only limited to issues of clean working environment.

In the light of this, Kheni (2008) recommended that developing countries should have a holistic perspective of health and safety practices when dealing with construction sites in Nigeria.

RESEARCH METHODOLOGY

This study adopted a quantitative research approach. The study encompassed a review of literature survey from journals, conference papers and past projects to identify the major barriers in the evaluation of health and safety management practices. Data collection was from both primary and secondary sources. The secondary source of data was based on published and unpublished material on previous similar works while the field work represented the primary source of data. Data collection was done through the review of literature and well-structured questionnaires.

The first stage of the study was done by literature review to identify the health and safety management practices of construction contractors, the health and safety regulations capable of guiding construction activities on sites. Data obtained was also used to determine the relationship between contractors' health and safety management practices and safety performance of contractors on sites.

The questionnaires were self-administered to contractors, consultants, project managers, quality and safety managers, and contract administrators/managers The study's population size was 50 which included contractors, consultants, project managers, quality and safety managers, contract administrators/managers among others and those who have responsibility for ensuring that health and safety practices is achieved and managing cost and project schedule registered with the Federation of construction industry FOCI in Abuja. The sample population in this study is few (50) and therefore it was possible to sample all members of the population for the study as reported by Watson (2001). The sample size therefore comprised the total number of construction firms registered with and contained in the list of contractors compiled by FOCI, Nigeria which is 50 just as population. FOCI had 84 registered construction firms in Nigeria out of which 50 only operate in Abuja. It was not

necessary to adopt any special method to select members since all members of the target group will be used. Watson (2001) makes this justifiable by reporting that on the off chance that your populace is little (200 individuals or less) it might be desirable over do an enumeration of everybody in the populace as opposed to test. The method of data analysis used was both descriptive and inferential methods to analyse the collected data.

RESULTS AND DISCUSSIONS

The ranking of the health and safety practices of construction companies identified from review of literature was done in this section in order of importance on a five – point likerts scale. The level of implementing the important H&S practices by construction companies was done using mean score on a five – point scale. The results of the level of implementing the important H&S practices by construction companies (on a 5 – point scale) were the variables subjected to Mean Item Score and used to represent the H&S practices used in the Mean Item Score Analysis. This was followed by the ranking of the level of compliance of construction companies with the H&S Regulations which was also carried out using mean score on a five – point scale.

Important Health and Safety Practices

From the review of literature, 58 health and safety (H&S) management practices were identified and ranked in order of importance using a five – point scale. These health and safety practices were categorized in to five core practices which are Company's Commitment, H&S Communication, H&S Planning, Workers' Consultation and Participation and H&S Education and Training. The mean score used to rank the health and safety practices revealed 15 important H&S practices from the 58 practices identified. The most important health and safety practice was revealed to be "Use of more directly employed labour" with a mean score of 4.83 while the least important health and safety practice was "Safety Pre-task Planning" with a mean score of 2.51.

The identified important health and safety management practices of contractors were ranked using MIS and the results are presented in table 1.

Table 1: Level of Implementation of contractors' health and safety management practices

S/No	Contractors' health and safety practices	Mean Score	StDev	Rank
1	Desire to improve staff morale and productivity	4.2143	0.7236	1st
2	Use of more directly employed labour	4.1190	0.8057	2nd
3	Jobsite inspection	4.0238	1.5138	3rd
4	Adequate work space and neat environment	4.0000	0.9019	4th
5	Formal safety inspection per month	3.8810	1.2667	5th
6	Job hazard analysis	3.8333	1.5697	6th
7	Safety pre-task planning	3.8095	1.9341	7th
8	Fencing of sites	3.8095	0.9706	8th
9	Effective identification and hazard elimination and control	3.7857	1.4548	9th
10	Minimization of cost of ill health and injury	3.7857	0.6136	10th
11	Workers involvement	3.7619	0.9707	11th
12	Accountability/responsibility and safety budget	3.5854	1.7313	12th
13	Safety meetings	3.5000	1.1441	13th
14	Use of posters and other signs to give safety education	3.2619	1.3834	14th
15	Average length of employment/Safety reward	3.1667	1.1633	15th

Table 1 gives a summary of the results of the ranking of the health and safety regulations capable of guiding the activities of construction on sites.

Table 2 revealed that the health and safety regulation capable of guiding construction activities on sites implemented the most is fire service regulations 1988 with a mean score of 3.98. The health and safety regulation capable of guiding construction activities implemented the least is the Workmen's compensation act with a mean score of 3.52.

It can be deduced from the assessment of the level of implementation of the construction companies with each of the Health and Safety Regulations that the construction companies attach the most significant importance to the fire service regulations 1988 than other Health and Safety Regulations.

Table 2: Level of Implementation of health and safety regulations

S/No	Requirement/Regulations	Mean Score	StDev	Rank
1	Fire service regulations 1988	3.9762	0.8488	1st
2	Factory's Act 1990	3.7381	0.7384	2nd
3	National environmental standards and regulations enforcement agency (NESERA) Act 2007	3.6905	0.7636	3rd
4	Labour, Safety and welfare law 2012	3.6905	0.7258	4th
5	Public health Act 1990	3.6190	0.7514	5th
6	Workmen's compensation Act	3.5238	0.7273	6th

Relationship between Health and Safety Management Practices and Safety Performance on Construction Sites

Five analyses were carried out using the Spearman's Rank Correlation Analysis in order to determine the relationship between the health and safety practices and safety performance of contractors. The results of these analyses are summarized in Table 3.0.

It was observed from the first analysis that there exists a weak, positive and non-significant relationship between the level of implementing H&S practices and cost of insuring workers. The correlation coefficient (R value) observed was 12% indicating weak degree of association between the variables. The positive correlation observed between the variables indicates a tendency that an increase in the level of implementing H&S practices will lead to an increase in the cost of insuring workers against accidents and vice versa. This also implies that there is the need for contractors to insure workers against accidents on sites. The probability (P) value of 0.459 observed was greater than 0.05. This led to the acceptance of the null hypothesis in this case.

The second analysis showed a weak, negative and non-significant relationship between the level of implementing H&S practices and the amount of compensation aid to victims. The R value observed was -14% indicating weak degree of association between the variables. The negative correlation observed between the variables indicates a tendency that an increase in the level of implementing H&S practices will lead to a decrease in the amount of compensation paid to victims and vice versa. This also implies that there is the need for contractors to improve their level of implementing H&S practices in order to reduce or have cost savings in the cost of paying compensation when accidents occur due to poor implementation of H&S practices. The P value of 0.387 observed was greater than 0.05. This also led to the acceptance of the null hypothesis in this case.

It was also noticed from the third analysis that there exists a weak, negative and non-significant relationship between the level of implementing H&S practices and number of accidents recorded. The correlation R value observed was -11% indicating weak degree of association between the variables. The negative correlation observed between the variables indicates a tendency that an increase in the level of implementing H&S practices will lead to a decrease in the number of accidents recorded on sites and vice versa. This also implies that there is the need for contractors to improve their level of implementing H&S practices in order to reduce the rate of accidents on sites because the number of recorded accidents was due to poor implementation of H&S practices. The P value of 0.490 observed was greater than 0.05. This also led to the acceptance of the null hypothesis in this case.

The fourth analysis showed a weak, negative and non-significant relationship between the cost of insuring workers and the number of accidents recorded on sites. The R value observed was -15% indicating weak degree of association between the variables. The negative correlation observed between the variables indicates a tendency that an increase in the cost of insuring workers against accidents on sites will lead to a decrease in the number of accidents recorded on sites and vice versa. This also implies that there is the need for contractors to improve practice of insuring workers on sites in order reduce the rate of accidents which usually occur as a result of poor implementation of H&S practices. The P value of 0.361 observed was greater than 0.05. The null hypothesis was therefore accepted.

A weak, negative and non-significant relationship was also observed between the numbers of accidents recorded on sites and the amount of compensation paid to victims in the fifth analysis. The R value observed was -3% indicating weak degree of association between the variables. The negative correlation observed between the variables indicates a tendency that an increase in the number of accidents recorded on sites will lead to a decrease in the amount of compensation paid to victims and vice versa. This also implies that there is the need for compensation to be paid to accident victims to be set aside in order to motivate contractors to improve in their level of implementing H&S practices to reduce the rate of accidents which will reduce the amount of compensation to be paid as a result of poor implementation of H&S practices. The P value of 0.854 observed was greater than 0.05. The null hypothesis was also accepted in this case.

Table 3: Relationship between health and safety management practices and safety performance on construction sites

Analysis No.	Variables		Observations		Inferences		
	X_1	X_2	R (%)	P_{value}	Strength of Relationship	Remark	Action on H_0
1	Level of Implementing H&S Practices	Cost of Insuring Workers	11.70	0.459	Weak	NS	Accept H_O
2	Level of Implementing H&S Practices	Amount of Compensation Paid to Victims	-14.00	0.387	Weak	NS	Accept H_O
3	Level of Implementing H&S Practices	Number of Accidents Recorded	-11.00	0.490	Weak	NS	Accept H_O
4	Cost of Insuring Workers	Number of Accidents Recorded	-15.00	0.361	Weak	NS	Accept H_O
5	Number of Accidents Recorded	Amount of Compensation Paid to Victims	-3.00	0.854	Weak	NS	Accept H_O

KEY: NS = Not Significant

CONCLUSION AND RECOMMENDATIONS

The following conclusions were made from the research findings of the analysis carried out in order to offer solution to the identified problem of the research, which was the inadequate measures of health and safety management practices and regulations guiding construction activities on the safety performance of building contractors.

i. Improving safety performance of construction lies in the ability of contractors to change their behaviours to health and safety management practices such as provision of personal protective equipment for site workers, use of safety gadgets, posters, safety reward, safety pre task planning, jobsite inspection, job hazard analysis, safety meetings, responsibility/accountability of safety budget, adequate work space and neat environment, effective identification and hazard control.

ii. Noncompliance to health and safety management practices actually affects the project performance in terms of time, cost, quality, environment and productivity delivery. It is also established that the decision made by contractors to implement health and safety regulatory requirements is influenced by the perceived cost of saving accidents.

iii. The level of implementation of health and safety management practices therefore increases with the increase in the value of contractor's safety performance.

iv. The research established that all the health and safety management practices were not significantly related to safety performance of construction contractors

although it was indicated that a likelihood in the rise of financial implication of insuring workers against accident on construction sites will lead to a growth in the level of implementation of health and safety management practices of contractors as well as increase in the level of implementing H&S practices will lead to a decrease in the amount of compensation paid to accident victims and reduction in the rate of the number of accident recorded on construction sites. In the light of this relationship between health and safety management practices and contractors safety performance indicated that construction safety can be improved through positive behavioural change of contractors towards health and safety management practices on construction sites.

RECOMMENDATIONS

The following comprises the recommendations made by the study based on the findings of the study which have been detailed in preceding sections.

i. In order to enhance the role of management in health and safety the existing legislation should be amended to put more emphasis on role of management. Provisions should be made to make it a statutory duty for every contractor to have a safety management program on site. Contractors should be compelled to draw up safety responsibilities and authority structure which should be available in every site to inform all parties as to their responsibilities as far as health and safety is concerned.
ii. There exist needs to urgently adopt the measures that will improve the level of awareness of contractors' health and safety management practice through safety meetings, education of workers on the importance of safety performance of contractors on site.
iii. The regulatory bodies within the construction industry should work out measures to enhance the rate of adoption of health and safety regulations guiding construction activities. This was based on a mean score of 3.9762 for the fire service regulation workers need to be insured and all other regulations need to be implemented on construction sites for better performance.
iv. For the health and safety management practices and safety performance of contractors on sites to be effective, the following conditions should be met:
i. Companies to insure workers against accidents on sites.
ii. Improve their level of implementing H&S practices in order reduce or have cost savings in the cost of paying compensation when accidents occur due to poor implementation of H&S practices.
iii. Improve their level of implementing health and safety regulations on construction activities.
iv. Compensation to be paid to accident victims to be set aside in order to motivate contractors.

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ASSESSMENT OF PATTERN OF ACCIDENT OCCURRENCE ON BUILDING CONSTRUCTION SITES IN ABUJA, NIGERIA

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The construction industry has earned the reputation of being a dangerous and highly hazardous industry because of the disproportionately high incidence of accidents and fatalities that occur on construction sites around the world (Smallwood and Haupt, 2008). Despite previous studies as regards to construction worker's accident, there has not been any study relating to the pattern of accident occurrence to construction workers most especially in Abuja, Nigeria. This goes to show that there is indeed a great need to study the pattern of accidents to construction workers. This paper views accident patterns as it occurs according to fatal and non-fatal accidents, age range of accident victims, month the accident occurred and the types of accidents. A descriptive research design was used in executing the study using 20 randomly selected companies which tick off the selection criteria for collection of archival data. Data collected were analyzed using percentile analysis. Results from the data analysis show that an up and down pattern exist in accident occurrence in the Nigerian building construction industry and recommends the creation of a construction health and safety agency that will oversee the implementation of safety laws.

Keywords: Accident, Construction, Health, Pattern, Risk, Safety and Worker

INTRODUCTION

An accident is an unforeseen event characterized by sudden and external force or violence, which may result in injuries, damages and losses to properties or people. The construction industry has earned the reputation of being a dangerous and highly hazardous industry, because of the disproportionately high incidence of accidents and fatalities that occur on construction sites around the world (Smallwood and Haupt, 2008). In many countries, the construction industry is an important part of the economy and often seen as a major part of economic growth especially in developing countries. Typically, construction industry contributes about 11% of gross domestic products (GDP) in most developing countries (Giang and Pheng, 2010). In the development of a nation, the importance of the construction industry cannot be over stressed. This is due to the fact no less than 50% of the investments in different development plans are mainly in construction. Okeola (2009) reported that all around the world, construction workers are 3 times more likely to die and twice as likely to be injured in comparison with workers in other occupations.

In Nigeria, there is no reliable data on accident cases in construction, because contractors fail to neither report accidents to the appropriate ministry nor keep proper records on accidents. In Nigeria, the challenge of health and safety in the workshop, sites, field and built facilities cannot be exaggerated, therefore, overconfidence, carefree attitudes and inability to provide healthy and safe working measures, episodic health and safety meetings for the stake holders and the public in general causes a high risk of accident in the construction industry (Okpan and Agha, 2013).

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Adeniyi, &Mohammed (2018). **ASSESSMENT OF PATTERN OF ACCIDENT OCCURRENCE ON BUILDING CONSTRUCTION SITES IN ABUJA, NIGERIA.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

Death tolls, permanent disability and serious environmental risk has been on the increase in Nigeria, especially 2005 until date caused by building collapse and major operational accidents in port Harcourt, Abuja and Lagos (Awodele and Ayoola, 2005; Olatunji and Aje; 2007). A study carried out by Idoro (2011) of 40 contractors in Nigeria, showed that the rates of injuries and accidents in the industry are high. The best safety ratios in 2006 were 2 accidents per 100 workers and 5 injuries per 100 workers. This unlucky situation has been a massive threat to the productivity and total performance of construction projects in the country. Idubor and Oisamoje (2013) stressed that it's is the duty of all organizations to make sure that all employees as well as other people who may be affected by the dealings of the company remain safe at all times because ensuring and maintaining a high level of occupational safety and health is to the advantage of all. As far as safety is concerned, building industry in Nigeria needs special attention. This is because the industry houses a lot of quacks and questionable tradesmen. Most building contracts in the rural areas both government and private contracts fall into the hands of uneducated "money bags'' who have control over constructing jobs in Nigeria. Statistics published by the Federal Tenders Board, (1985) in Lagos State stipulates that "this category of contractors handles a significant proportion of contracts; yearly as they make up about 70% of the contractors who handle jobs below five million naira (5,000,000.00). The other 30% of the contract involves professionals in building contraction. Since the formal possess a lot of influence and have more weight to throw around, they are always better favoured in the awarding of contract than the professional group. This has made safety in the building construction industry to attract little or no attention over the years which should have been of vital concern. The visible neglect might be interpreted as meaning accidents are rare and insignificant on construction sites, but this isn't so, as many accidents are observed daily on sites. Accidents resulting from lack of awareness occur mostly in specialized or disciplined operations. Other cause of accidents in the construction sites includes indiscipline, inadequate communication and site characteristics. It has been observed that due to insufficient technical expertise by the builder, many accidents have occurred (Ayodele, 2004).

Ogunjobi (2003) opined that under normal circumstances, there should be a person specifically in charge of safety in a contracting organization; but this practice is almost non-existent in Nigeria. On the contractor's part, ensuring that the building is situated in the most effective manner is an important part of a good planning process. The proper position of items such as site accommodation, material sheds, storage area, temporary roads, mechanical plants, scaffolding, services and hoarding should be shown on a proper site layout. In order to ensure the prevention of accidents, easy movement of labour, materials and plant should be provided for. Temporary services like electricity should be provided electrocution is unlikely to occur. To provide a safe method of working and means of easy access, scaffolding should be properly erected. Hoarding is a safety measure that can help ward off unwanted interference of work by the public, including children.

Aim of Research

The aim of this research is to assess the pattern of accidents occurrence to construction workers on building construction sites in Abuja, Nigeria.

Objectives of Research

To examine the pattern of occurrence of fatal and nonfatal accidents to the construction workers over the period of study.

To determine the frequency of occurrence of types of accidents to the construction workers.

To determine the frequency of periodic occurrence of accidents to the construction workers.

To determine the occurrence of accidents according to age range of the construction workers.

Methods and Suggestions to Improve Safety on Construction Site

Due to the alarming state of construction site safety in the world, most in particular the developing countries, several researches have been carried out on the methods and ways of improving safety on construction site (Foad, 2011). To reduce the hazardous physical condition on construction site, the following arrears where identified.

a. Safety and Health Management Systems

One way to avoid unplanned happenings is through planning and management. Effective and efficient safety management can help avoid injuries while working and since these injuries and accidents are unplanned events. Safety management must be detailed and applied to all aspects of the job. It must start from the estimating phase of the project till the completion of the project, and the last worker has exited the surroundings. All parties to a construction project must be included and responsible to the safety program. Virtually all respondent in Australia, agreed with the statement "safety is the responsibility of both workers and management" (Hassouna, 2005). Hassouna, (2005), in his study concluded that clients as part of safety responsibility must ensure that project designs are of a safe nature. He should ensure that the contractor has a safety program and the client, includes the safety program as part of the bidding technicalities.

b. Safety Programs

For a safety program to have the most effect on site safety, it must consist of managerial discussions on safety, safety booklets provision, provision of safety equipment's, provision of a safe environ and appointment of trained safety representatives on site (Aksorn et al., 2009). Hassanien (2007), surveyed the nature of safety programs in the largest 100 construction firms in the USA, and resolved that larger firms had more formal safety program. Companies that afforded workers with formal safety orientation, companies were safety representatives were employed full time, and companies that provided incentives to foremen and workers, were found to have lower injury rates. Safer performance was noted to occur when safety representatives were hired and trained by safety directors (Hassanein et al. 2007). Safety programs though do not need extensive elements, but should include at least critical elements such as safety policy, safety inductions, safety committees, safety inspections and safety training (Aksorn et al, 2009).

c. Safety Training

For each project, it is a requirement that anyone working on site should receive a minimum of eight hours of safety training (Huang and Fang, 2003). Many researchers in the construction industry have addressed the importance of safety training to improve safety performance (Aksorn et al., 2008). One sure way of improving construction site safety performance of construction workers is effective training.

d. Accident Investigation

Meaningful information that can be used effectively to reduce and eliminate foreseeable hazards can be derived from the investigation of an accident (Hassouna 2005). The majority of respondents in a survey carried out in USA agreed that the investigation of accidents were vital to improved safety performance. In Hong Kong, the most significant contributor to reducing the frequency rate of site accident was found to be accident reporting and investigation program (Poon Ma and Ho, 2003).

Safety Meeting

Hassanein (2007), concluded that, projects which employed safety officer, conducted job site safety inspections, and included safety in coordinated meetings were noted to have lower injury rates. To communicate safety information to all parties, regular safety meetings are necessary. In a study, 36% of the respondents claimed that they participated in regular safety meetings, and the other indicated that safety issues were presented and discussed at construction planning meetings. However 87% of the respondents in a survey carried out in china argued that safety meetings are rarely attended by top management (Tam et al, 2004).

RESEARCH METHODS

For the purpose of this study, quantitative method was be used. The study is criteria based, in which certain criteria were outlined for the selection of the construction companies. Which formed the study's population. These criteria are:

The construction firm or site must be a firm concerned with building construction.

The construction firm/ site must be located in Abuja, Nigeria.

Construction firm must have a history of not less than 10 years in the building construction industry.

The construction firm must have a project execution capacity of not less than 100 million Naira.

Primary sources of data collection were employed in the course of this research work through a well- structured table used for archival data collection which was administered to relevant and appropriate firms which suite the selection criteria above in Abuja, Nigeria. The population size for this study comprised of registered contracting firms. The sample size is a representative number from the population. The samples were drawn from a list containing the information of the contracting firms to be studied. The use of simple random sampling technique was employed to draw the representative number (sample size) from the total population. A total of twenty (20) contracting companies were selected for this study, this selection is similar to that of Yakubu (2016). A well formulated table was used in collecting archival data from the 20 selected companies over a period of 10 years (2004-2013).

RESULT AND DISCUSSIONS

Fatal and Non-Fatal Accidents

A wide range of activities such as repairs, alterations and constructions are the kind of activities that take place in a construction industry, making it a really hazardous industry. Fig 1.1 shows the up and down pattern of fatal and nonfatal accident occurrence for each company for a period of 10years.This can be attributed to the fact that as human beings in general, we tend to relax when things happen as we want it to. Thereby, attaining a lackadaisical attitude and ensuring its possible decline. It shows that nonfatal accidents occur more frequently than fatal accidents. Below is a graphical breakdown of fatal and nonfatal accident occurrence based on its year of occurrence.

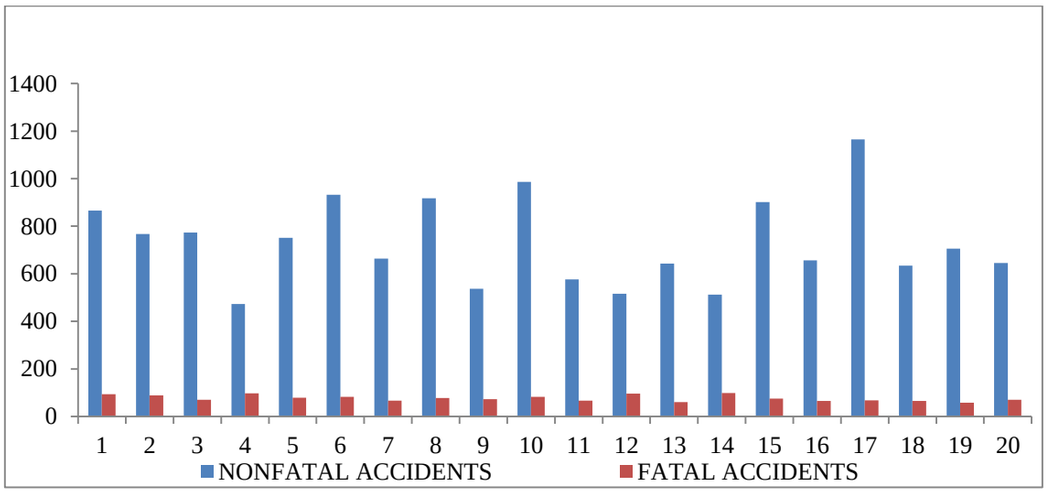

Figure 1.1 Chart Representing Record of Fatal and Non-Fatal Accident Occurrences Against Companies.

Figure 1.2 shows the rate of accident occurrence between the years 2004-2013. It shows that as the year progresses, the number of accident occurrences reduce due to continuous study of the causative factors of accidents and the illumination on ways in which accidents on site can be stopped or drastically reduced. The diagram drawn from the research findings portrays an increase in the number of fatal and non-fatal accident occurrence in the year 2008 , this is due to the relaxation of both management and site personnel's as the continuous reduction of the rate of accident caused a lax in managements and labourers attitude to accident prevention and safety insurance.

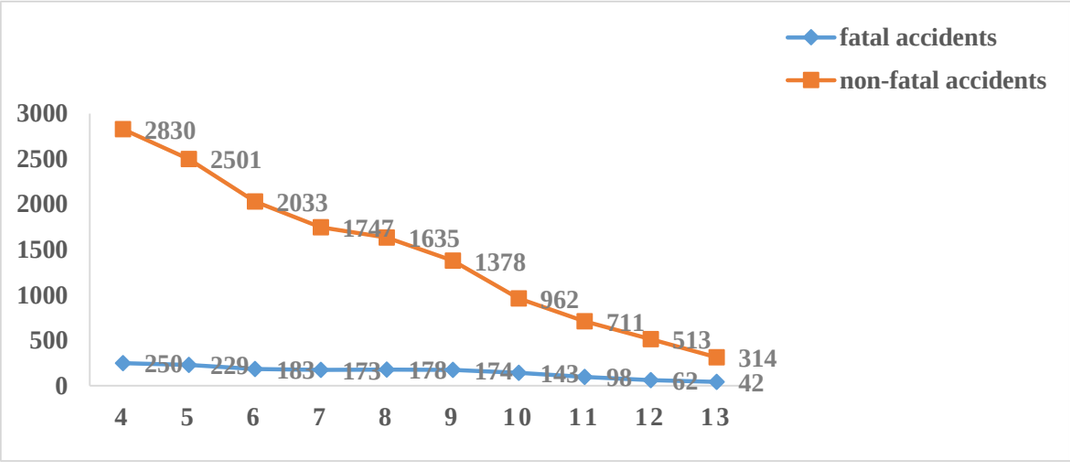

Figure 1.2: Chart Representing Record of Fatal and Non-Fatal Accident against Year of Occurrence.

The causes of fatal and non-fatal accident occurrence from the research findings have been deduced to be:

Improper inspection of site equipment's: it is to be insured that all equipment's are in a good working condition. Unusual noises, jerky movements and other unusual concurrences should be looked out for, put in writing and forwarded to the management.

Insufficient safety and operating process: it is imperative that all personnel's be properly and adequately trained for proper execution of work (mechanical equipment operators, most especially). This training can be carried out either on site or at a designated training facility.

Improper and inefficient personnel protective equipment (PPE): personal protective equipment (PPE) should be provided by employers for employees. Sometimes there is a lack of PPE at most sites and where available, worn out. These PPE include safety goggles and boots, hard hats, earplugs, work gloves and face masks.

4. Standards of the Occupational Safety and Health Administration (OSHA) are not adhered to in some sites. All mandates, standards and recommendations from occupational health and safety inspectors are expected to be followed.

5. Absence of walk through site: this is a process that involves a periodic walking around site premises, identifying and noting down workplace hazards for managerial notification for proper action.

6. Lack of readiness for emergency: first aid training should be giving to site personnel's in case of an emergency especially in regards to power failures, electrical and mechanical accidents.

Frequency of Occurrence of Types of Accident

Figure 1.3 shows the percentile distribution of the types of accident that occur in a construction industry. Falls from height with a percentage of (55.93%) stands as the most occurred accident type, hit from a falling object follows with a percentage of (23.35%), slips and falls with a percentage of (10.57%), welding, cutting and bracing accidents follow next with a percentage of (4.55%), electrocution (3.86%), and crane accident (1.74%).

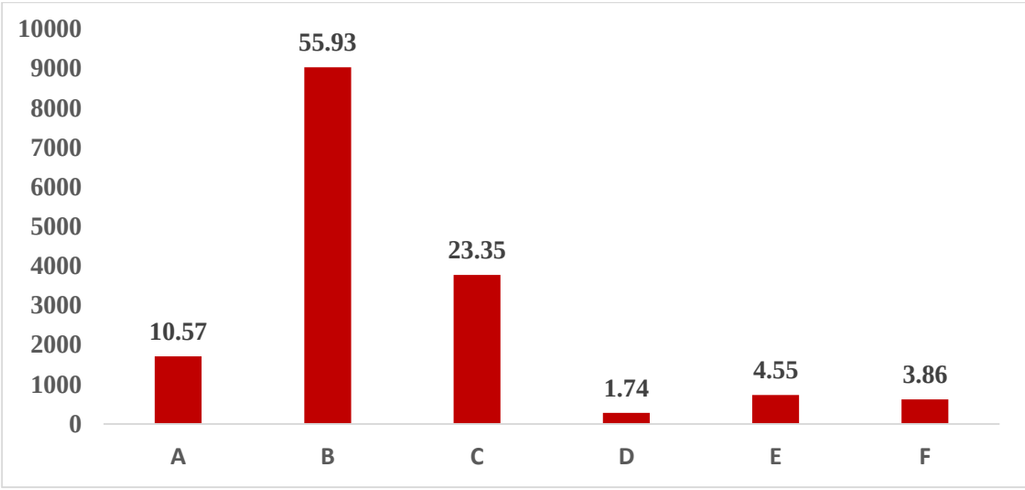

Figure 1.3 Graphical Representations of Frequency of Occurrence of Accident Types

LEGEND: A. Slips and falls
B. Fall from height
C. Hit from falling from object
D. Crane accident
E. Welding, cutting and bracing incident
F. Electrocution

Really, it is unrealistic to totally and absolutely prevent falls in the construction field, but the use of safety methods should be encouraged. The use of safety nets, security platforms and belts help to reduce the injuries that accrue from these falls (Murty et al, 2006).This research finding is in correspondence with other research which show that falls from height is one of the major types of accidents that occur in the construction site. These include 51.95% of Yakubu, (2016). Hit from falling object with a percentage of 23.35% and slips and falls with 10.97% also prove to a cause for concern. This goes to show that construction workers are exposed to great risks and this should be a great concern to construction practitioners. Under this period of study, crane accidents fell under a percentage of 1.74%. Though one of the lowest shouldn't be neglected. In a research by Murty et al (2006), crane fatal accidents is at a percentage of 8.29%, and fatal crane accidents at 1.94% and non-fatal crane accidents at 14.19% (Yakubu, 2016). This surely shows that crane operators are at risks. Suruda, et al., (1997), opined that 13% of the victims of construction deaths related to crane where crane operators. This was discovered in an investigation of 502 crane related deaths carried out by occupational safety and health (OSHA). Therefore, crane safety research should cover risk factors for crane operators and those working near the crane (Richard, et al, 2001). In an effort to reduce the crane accidents fatalities amongst workers and ensure the safety of construction sites, a guideline has been released by OSHA. These guidelines include prior to using a crane, an inspector must confirm that the crane machine is indeed in a good condition and more comprehensive inspection must be carried out regularly to determine if there is a crack, faulty wiring, worn out ropes and other damaged parts that could lead to possible accidents (MacCollum, 1993). Electrocution lies at a percentage of3.85% among the types of accidents that occur in the construction sites. In comparison with 5.99% and 10.08% according to previous research carried out by Yakubu (2016) and Abdul et al Rahim (2008).

This research stands slightly above the research carried out by Yakubu (2016) and more than half the finding of Abdul et al Rahim (2008). Absence of ground fault protection, power line, incompliance with manufacturer's guidelines and instructions, improper grounding of electric equipment's and wrong use of flexible cords and extension are according to OSHA, the most common cause of electrocution accidents. On site, electrocution accidents can be done by:

Power cords and electrical equipment of construction companies should be inspected regularly for problems that need to be corrected.

Proper training on the safe handling of power lines should be given to all workers and not just electricians.

All construction companies should adhere to OSHA guidelines and regulation for ensuring safety of construction workers on site.

Frequency of Periodic Occurrence of Accident

Accidents occur more at the end of the year i.e. the third quarter of the year, followed by the first quarter of the year. This research does not coincide with previous researches carried out

by Yakubu (2016) and Murtyet al (2006). Which show that accidents occur more at the last quarter year followed by the second quarter of the year.

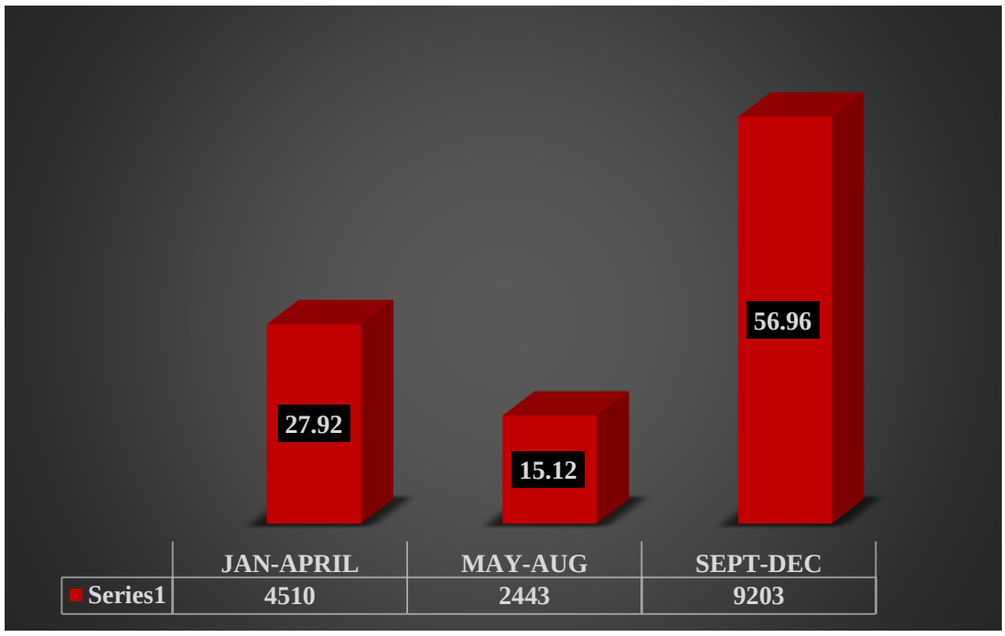

Figure 1.4 Charts Representing Periodic Occurrence of Accident

The high rate of accident at the end of the year could be attributed to the need to settle payments before the year closes and due to the festive periods (Murty et al, 2006). In Nigeria, these festive periods include the Eid-el-fitri and the Christmas celebration, (September - December). During this period, workers usually rush engagements so as to complete as much jobs as possible. Thereby, ensuring better financial supply to participate in the festivities. This research also shows a high percentage of accident occurrences during the first quarter of the year (January - April). This is due to the desire of the workers to offset debts accrued during the festive period and pay bills due at this time of the year such as school fees, house rents, among others. This leads to an increase in speed of work, taking up much work than necessary, recklessness and poor decision making which in turn leads to an increase in the occurrence of accident.

Accident According to Age Group

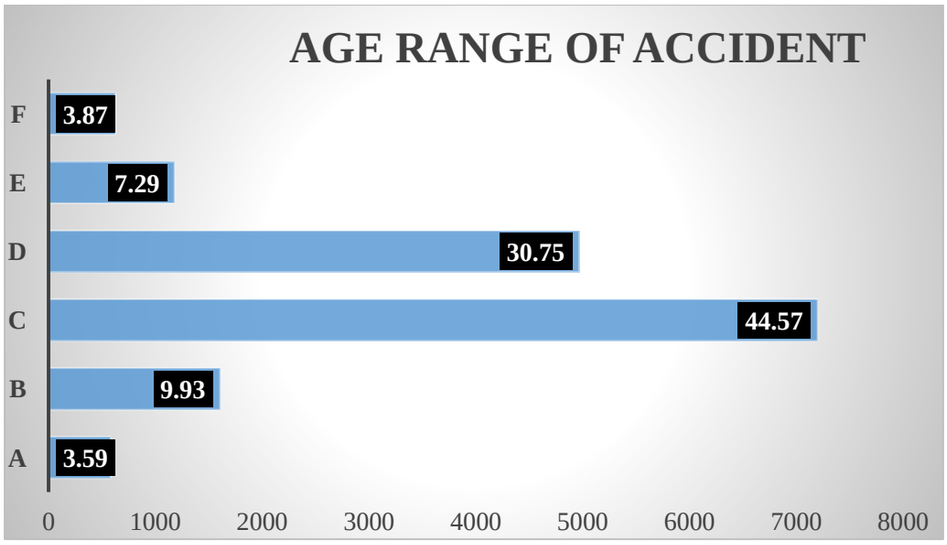

Figure 1.5 Representing Percentage of Accident Occurrence against Age Range

LEGEND – A. 0-15years
B. 16-25years
C. 26-35years
D. 36-45years
E. 46-55years
F. 56 and above

In a research work carried out by Murty et al (2006) and Yakubu (2016), 21 - 50 years had the highest percentage of accident occurrence. This research tallies considerably with both research works. This age group holds a high rate of accident occurrence because of short attention span, little or no family responsibilities, impulsive attitude and overestimation of capacity that young workers suffer (Murty et al, 2006).Other studies however reveal that

older workers are prone to accidents more due to poor coordination, poor mental ability, inability of older workers to learn easily when put in to an unfamiliar situation, the probability of serious complications and difficulty to heal after injury (MaCann, 2002).

CONCLUSION AND RECOMMENDATION

It can be concluded that the rate of accident occurrence in Abuja is on the increase, but no clear and conclusive pattern can be mapped out. It has been discovered that laws and regulations alone cannot guarantee practices on the construction sites that are safe and healthy. The engagement of Contractors who are safety conscious, supported by well experienced and trained employees should be embraced and put into practice. In order to reduce the level of construction sites accidents, it is necessary to effectively assess safety and health on construction sites. This research shows that notwithstanding the involvement of the construction companies in the practice of safety and health policies, accidents still occur at a very high rate. It was also observed that accident does occur in a pattern which relates to the type of accident, calendar time of occurrence, age range of victim, workers factors, site factors and equipment factors. In Abuja, the construction sector is organized but could be better. The rate of accident occurrence in Abuja can be reduced by imbibing some precautionary steps and measures but bringing its rate to a complete stand still would be impossible due to factors which cannot be fully controlled.

It is recommended that a construction health and safety agency that will oversee the implementation of safety laws should be created, in order to improve safety management on site, contractors must educate their workers as well as outsiders affected by the work that safety is a responsibility for all and first aid training should be given to all workers as this might very much save lives in a situation whereby professional help cannot be accessed on time.

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IMPACT OF SAFETY MANAGERS' LEADERSHIP STYLES ON WORKERS SAFETY BEHAVIOR ON CONSTRUCTION SITE IN ABUJA

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A Safety Manager's leadership style has a great impact on workers' safety behaviours on construction sites. Effective leadership styles of Safety managers have been associated with benefits such as: increased operational efficiency; reduction in insurance cost and workers retention and satisfaction. The aim of the study is to assess the safety managers' leadership styles on construction workers, in Abuja. The study used structured questionnaires to solicit information with respect to the investigation. The questionnaires were administered to site workers on 5 selected construction project sites in Abuja. . The total population of respondents on these site was 550 however, 226 was the total sample size in this study Correlation analysis was conducted in order to determine the relationship between safety manager's leadership styles and worker's safety behaviours and the result was found to be significant ($P<0.005$). This relationship was modelled using simple linear regression and from the model the result shows that improvement on the safety manager's leadership styles on sites will improves worker's safety behaviour. Therefore, workers' safety behaviour significantly influences the overall benefits of safety management system on the construction sites. As such there is need for potential improvement on the safety manager's leadership styles as perceived from the analysis in order to bring about the expected high performance of worker's safety behaviour on construction sites.

Keywords: *Behaviour, Construction Worker's, Leadership Styles, Safety Manager's, Safety Management.*

1.0INTRODUCTION

Construction industry is an important aspect of any nation owing to its contribution to national economy. But over the years health and safety issues within the construction Industry has become the concern of everyone in the industry and also the entire nation, because of the alarming rate of fatalities and hazards that has characterize its operation, it has shown negative impact on social and economic life of the society (International Labour Organisation 2011). In the meantime there is report of high rate of fatalities and hazards in terms of injuries, and disability recorded in the industries (kheni, 2008). For instance, Okorie, *et, al* (2015), observed that Nigerian construction industry within two years (2005-2006) experienced over 300 fatalities and more than 23,000 disabilities. Moreso, an estimated 180,000 days (work productivity period) were believed to have been lost due to injuries alone. In monetary terms, the loss to the Nigerian construction industry traced to health and safety related issues is in excess of N500 billion. Organização Internacional do Trabalho, (2001) reported that, rate of injuries and fatalities in construction is 7-10 times than that in other industries. Also International Labour Organisation (2005) stated that construction work environment, particularly project sites have been identified as the most hazardous. Because the activities involved pose serious health and safety risks to workers and other stakeholders. Supporting acknowledged that between 25% – 40% of fatalities in the world's occupational settings are contributed by construction industry (ILO, 2001, 2005a and 2005b).

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The proceeding views agree with a common axiom that "safety is everyone's responsibility" however, is ideology may not be a true reflection of the need to specifically assign the responsibility for the health and safety management of construction site and their leadership roles to competent individuals. Leadership can be define as a process of modifies the motivation and competencies of others in the group or organization." It can be described as "the process of interaction between leaders and followers, through which leaders can exert their influence on followers to achieve organizational safety goals under the circumstances of organizational and individual factors" (Wu et al., 2007). Previous researches revealed the importance of leadership to safety (Griffin and Hu, 2013 and Hofmann *et al.*, 2003). Leadership is fully embedded in safety, and the majority of previous studies focused on the full-range model of transformational and transactional leadership styles (Barling *et al.*, 2002 & Kelloway *et al.*, 2006 & Lu and Yang, 2010). Transactional leader styles are related to monitoring and reward whereas transformational leader styles are tending towards inspiring and genuinely motivating the workforce (Reid *et al.*, 2008). Transformational leadership style can be categorized in four ways, i.e. idealized influence (charisma), inspirational motivation, intellectual stimulation, and individualized consideration. Meanwhile Transactional leadership style contains two dimensions, contingent reward and management-by-exception (Avolio & Bass, 1994). In particular, the effectiveness of transformational leadership style in motivating and inspiring employees is shown by a multitude of empirical studies. These studies found that transformational leadership style is related to enhanced employee work motivation, Shamir et al., (1993), employee satisfaction Podsakoff *et al.*, (1990), innovative performance Pieterse *et al.*, (2010), and commitment to the organization Avolio *et al.*, (2004). All of these traits are closely related to employees' safety involvement and behaviour improvement. The transformational/transactional leadership style framework can be regarded as the foundation of the factor structure of safety manager leadership style. Many other studies constructed their specific dimensions of safety leadership style in order to better measure it. Dimensions of safety leadership reported in the literature include safety motivation, safety inspiring, safety policy, safety concern, safety monitoring, safety learning, safety coaching, safety caring, safety controlling, etc. (Griffin & Hu, 2013; Lu & Yang, 2010;Wu, 2005 and Wu *et al.*, 2007). However, almost all of these studies took into account different aspects of transformational/transactional leadership, resulting in that the identified dimensions have close relationships with those of transformational/transactional leadership styles. For example, safety motivation and safety inspiring have similar meanings with idealized influence and inspirational motivation. Safety caring and safety coaching overlap with intellectual stimulation. Safety caring is related to individual consideration. Safety policy, safety monitoring, and safety controlling are closely linked to contingent reward and management-by-exception. The strong predicting power of transformational/transactional leadership to safety performance has been demonstrated in a number of previous studies, some of which have developed safety-specific constructs arising from the original ones (Barling *et al.*, 2002). In this situation, safety manager leadership style can be seen as transformational/transactional leadership styles focusing on safety issues. When promoting an organization's safety culture, it is necessary to select appropriate people to be safety manager, otherwise the safety culture will stagnate (Tweeddale, 2001). Some authors (Adams, 2000 & Blair, 1999 & Swuste and Arnoldy, 2003) noted that the ideal safety managers must have both technical and management skills. Hale (1995) observes that in a complex occupational health and safety environment, the relationship between safety manager and line managers is complex and dynamic. He also suggests that safety manager can perform three leadership styles: the expert, the coordinator, and/or the controller. However, safety controlling has been defined as "the process of monitoring safety performance, comparing it with safety goals, and correcting any significant deviations" (Robbins & De Cenzo, 1998 and Wu, *et al.*, 2008). Hopkins (2006) argues that optimum H&S performance depends largely on effective managers leadership styles at all levels of management The importance of safety managers' leadership styles in terms of organizational effectiveness, according to Northouse (2011) is that no amount of detailed regulations for safety improvements could make up for deficiencies in safety manager leadership styles. Leadership and leaders' commitment to workers' H&S are critical for effective H&S management in any contracting firm. Lees and Austin (2011) argue that leadership is not a panacea to all management problems and state that leaders have been found to often lose focus and become overwhelm. Nevertheless, leaders have the ability and personality to direct, influence and motivate groups or workers/employees to achieve organizational set goals and improve their behaviour toward safety agenda. The construction workers occupation has been observed as the most

dangerous in term of accidents and fatality rates. Leung, *et al.* (2010) stated that Construction workers are obliged to work in a poor physical environment, tolerating extreme outdoor temperatures, poor air quality, excessive noise from bulky equipment, various hazards from working at height, poor housekeeping, and exposure to chemicals, and additional factors. Prolonged work under such adverse physical conditions induces stress in construction workers, such as emotional and physical fatigues, however operating under poor physical environment, which may cause discomfort to construction workers, subsequently reduces their attention on safety behaviours. The concepts of safety culture and safety climate are important contributions from the behavioral and social sciences to workers understanding of occupational safety. In most construction sites, poor safety awareness, lack of skills, unclear safety responsibilities, boring and simple safety activities or education etc., are major factors affecting workers safety behaviour at construction sites.

Most of the literature above, deal with rate of accidents on construction sites and their cost implication, as well the role that safety manager's leadership styles on construction sites worker such as inspiring and genuinely motivating the workforce. Emphases have never been on the impact of such leaderships on workers behaviour. As such, this research tends to assess the impact of safety manager's leadership styles on workers behavior as regard to safety and health measures on construction sites.

RESEARCH METHOD

Creswell, (2003)stated that factor to be consider in selecting the best research methodology should be the impact that such method have on the research problem and objectives. The target construction companies for this study are large size (with more than 100 workforces) with both permanent and temporary construction workers. The reason was that large construction companies tend to have a high degree of safety awareness and commitment of the concepts and notions of management system. Therefore, this study is a criteria – based study, in which certain criteria were outline for the selection of the construction companies and their construction workers. Those criteria are:

1. The construction company must be built/civil engineering, construction.
2. The construction firm or company must be more than twenty (20) years in civil/building construction work.
3. The construction workers must at least be with the construction company for not less than fifteen (15) years.
4. The workers must hold a minimum of secondary school certificate.
5. The construction firm must have at least one safety supervisor, or safety and health officer (safety manager)
6. The location of the study is Abuja, the Nigeria federal capital.

The five construction sites meet the research criteria, the five construction site selected were of similar work of Wu *et al* (2008) & Lu and Yang (2010). The respondent samples used in the study were drawn from the total population of permanent construction workers in the five (5) construction sites selected for the study. The total numbers of permanent construction workers that meet the study criteria in the 5 construction companies are 550 while 226 were selected for the study following the rules of Krejcie and Morgan, (1970). The research questionnaires were administered on 226 permanent construction workers within the 5 construction site in Abuja.

RESULT AND DISCUSSION

Correlation analysis was conducted in order to determine the relationship between safety manager leadership styles and construction workers safety behaviour. Table 3.1 shows the result of the correlation analysis.

TABLE 3.1 Safety Manager Leadership Styles (Avgsmls)

Component	R	p
AVGSMLS	0.313	0.001
		listwise N=226

Where,
SMLS = Safety Manager Leadership Styles

CWB= Construction Workers Safety Behaviour

Table 3.1 reveal the correlation of average safety manager leadership styles and its correlation is significant at the 0.01 level (2- tailed). N = 226. The Pearson's correlation reveals a positive, and significant relationship between average safety manager leadership style and average workers safety behaviour, The Pearson's correlation (r*)* from table 3.1 is 0.313 while its P< 0.001. This means that as the level of safety leadership styles practice on sites improves there is corresponding improvement on the safety behaviour of construction workers, also high level of general safety manager leadership styles on construction workers improve safety performance of workers on site. Following the existing of positive relationship between the variables, there is a need to predict the outcome of the variables. Therefore, simple linear regression is adopt, the simple linear regression seek to examine the effectiveness of safety manager leadership styles on site. In the simple linear regression model develop, workers safety behaviour is the dependent variable while safety manager leadership styles is the independent variable. The result of simple linear regression analysis are presented in Table 3.2

Table 3.2 Simple linear regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the estimate
1	.459	.393	.321	1.54873

a. Predictors: (Constant): SMLS
b. Dependent Variable:CWSB

Table 3.2 shows that 39% (R2 = 0.39) of the proportion of variation in workers safety behavior is explained by the variation of level of safety manager leadership styles. The R2 adjusted is 0.321 implying that the model explains 32% of the variation in the workers safety behavior within the population leaving 68% unexplained. The level of awareness of construction workers on safety management standard on site fails to explain all possible variation in the workers general knowledge. Inadequate time spent on site by the safety manager which is just about an hour a day according to factories and machine act Regulation (1986) being in operation in Nigeria, Lack of individual competency understanding of workers and supervisors, ineffectiveness or lack of training and certification of competency for such knowledge failure.

CONCLUSION AND RECOMMENDATION

The effectiveness of safety manager leadership style has a great impact on the behavior of construction workers on site. It was revealed that a reasonable correlation exists between safety manager leadership styles and construction workers' behaviour ($r = 0.313$, $P < 0.001$). This means that workers' safety behaviour and safety manager leadership styles are significantly related. The regression models finding indicate that additional improvement on the level of safety manager leadership styles among the workers' will spring up enormous benefit of workers safety behaviour on the construction sites. Those are the evidence that improving safety manager leadership styles would impact positively on safety and health measures on construction sites which will in high level change the safety behaviour of construction workers on site. Also, positive workers safety behaviour established in the correlation significantly influence the overall benefits of safety leadership style employed by the manager on the construction sites. The implication of the finding is that while it might be important for contractors to put in place all necessary training relating to safety management system, the training program identified may not bring about the expected high impact standard of safety and health on construction sites. There is need for potential improvement on the manager leadership styles as perceived from the analysis in order to bring about the expected high performance standard on construction sites. The effective safety manager leadership style is an important consideration to effective safety behaviour on site as high safety and health performance could improve the organization image through less accident, less absentees of workers from work, less medical bills, etc. The importance of safety behaviour among construction workers is that it will encourage the manager to develop and implement an effective safety leadership styles in construction industry. The models could be of help to the stakeholders in the construction industry in developing an effective safety management. Adequate training of workers is important in order to increase their awareness most especially as regard to identifying and minimizing risks/hazards on the sites. Many safety professionals were of the opinion that training and educating construction workers help in reducing cost and save lives.

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ASSESSMENT OF HEALTH AND SAFETY MEASURES IN SELECTED BASIC SCHOOLS IN ABUJA

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School is the second most important place for children, after the home. A school is a grooming place where children are educated and modelled, preparing them to take respective positions in the society when they come of age. The unhealthy school environment has been noted by researchers as one of the problems militating against effective teaching and learning in schools at all levels of education. This paper examined the health and safety measures provided in the private primary schools in the Garki district of Abuja. Survey method is employed in the study and data were collected through questionnaires and observation schedule on the health and safety measures provided within the schools and the awareness of health and safety measure among the students. Nine private basic schools were selected from Garki district of Abuja and 263 students were sampled from a population of 9342; and 204 teachers drawn from a population of 819 using a simple random sampling technique. Findings revealed that safety awareness and education is high among the students, but there were inadequate provisions of health and safety measures in the schools for health and safety living of the students. This paper recommends adoption of the enforcement of health and safety building components' measure as a basic requirement in building design for primary school and provision of health and safety ancillary's facilities within the school premises.

Keywords: Building, Children, Health, Safety, School,

INTRODUCTION

Safety and health go hand in hand; treat to safe living is a treat to healthy living. The World Health Organization (WHO) identified safe and healthy environment as one of the determinants for health. The healthy schooling of children is a business for all, especially the school that they attend for a minimum of six hours in a day. The amount of time spent in schools by children has great impact on children, which makes health and safety the nest important aspect of school after leaning. After the family, schools are the most important places of learning for children; they have a central place in the community, school is a stimulating learning environment for children and initiate change, if health and safety design conditions are put in place, it will greatly improve the standards in school environment (UNICEF, 2012). The Royal Society for the Prevention of Accidents (2012) asserts that the school environment is safe and healthy when it is ideal and conducive for teaching and learning to the extent that the teachers and students are comfortable. For teaching and learning to be effective and result oriented, there is the need for a safe environment to be created and sustained in all schools. Healthy living of children most especially in a school environment revolves around the level of hygiene around the school. With the increasing number of children attending school and strong campaign against illiteracy in developing countries, the United Nation Children Education Fund (UNICEF, 2012) is of the opinion that there is strong and growing evidence from many countries of inadequate access to safe water, sanitation and hygiene in schools in resource-scarce setting.

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The Royal Society for the Prevention of Accidents (RSPA, 2012) identified the problem of safe and healthy school has; lack of basic water supplies, sanitation and hygiene-enabling facilities; inadequate or hazardous outdoor space; and overcrowded classrooms, poor lighting, poor seating, excessive heat or cold, damp and poor indoor-air quality. They assert that a strong and safety culture, pays for itself many times over in preventing injuries and loss of staff time, strong and safety culture avert: serious preventable injuries; work related illnesses like stress and back pain; lost workdays due to work-related illness and workplace injury; and the cost and disruption of damage only accidents. Many children learn some of their most important hygiene skills at school, and for many this is where they are introduced to hygiene practices that may not be promoted or possible in the home (Adams *et al.*, 2009).

A comprehensive health and safety guide was prepared for primary and secondary schools in Great Britain to serve as disaster and emergency preparedness. The guide classified health and safety in school into three; the student and staff protection, educational continuity; and the culture of safety (International Finance Corporation-World Bank Group, 2010)

Water and sanitation related diseases are on high prevalence in many countries, most especially the children leading to high infant mortality. Hygiene behaviours, appropriate water and sanitation facilities are needed to allow people to transform intention to change into real change (UNICEF, 1998).

Every school required the provision of water and sanitary facilities prevent water borne diseases and sickness. Adams *et al.* (2009) were of the opinion that water points should be sufficiently close and at a suitable height for users to encourage them to use water as often as required in the school.

RESEARCH METHOD

Survey method was employed in the study, which involved an interactive session with the students, observation and the use of questionnaires to acquire data. Nine schools were sampled from different districts of Abuja which formed the population of the study. The sample size formula was used to arrive at 263 of the students from a population of 9342 and 204 of the teachers from the population of 819 as the sampling size presented in the table 1. A multilevel sampling technique was used, which involves stratified sampling of 1 school per zone and purposive sampling for administration of questionnaire to teachers and students.

Table 1: Sample frame and sample size for the study

School Names	*No of Students	**No of students sampled	*No of Staff	**No of staff sampled
ECWA Academy, Karu	1760	49.55 ≈ 50	140	34.87 ≈ 35
Start-Rite Schools, Gudu	978	27.53 ≈ 28	106	26.40 ≈ 26
Doveland International Schools,	124	3.49 ≈ 3	110	27.39 ≈ 27
Regent International Schools,	860	24.21 ≈ 24	76	18.93 ≈ 19
Chris land Schools, Lokogoma Noble	820	23.08 ≈ 23	59	14.70 ≈ 15
Height Academy, Wuye	1100	30.97 ≈ 31	100	24.91 ≈ 25
Perfect Steps Primary and Secondary School, Garki	2500	70.38 ≈ 70	130	32.38 ≈ 32
Bristol Academy Primary and Secondary, Wuse	800	22.52 ≈ 23	68	16.93 ≈ 17
Total Academy, Lubge	400	11.26 ≈ 11	30	7.47 ≈ 8
Total	**9342**	**263**	**819**	**204**

Source: *****Schools administrative records, ** calculated by Author (2017), Note: Students' sample size was used for parent based on the assumption of one student per parent which was 263.

RESULTS AND DISCUSSION

Health and Safety Facilities Provided in the Schools

The health and safety facilities provided in the schools were assessed based on requirement of Universal Basic Education for running of School Mini Clinic, which include; First aid box, wash hand basin, dustbin and safety tips and charts wall-paper. From the survey carried out only 3 schools out of 9 sampled have Mini Clinic, and as presented in Figure 1, 4.56% of all the three categories of respondents assert the provision of Mini Clinic for first aid treatment of sick or injured students. This indicates absence of health facilities and workers that can provide care in time of emergence in the schools. The provision of First Aid boxes to substitute for the absence of Mini Clinic is also asserted to be low, 7.67% of the students assert provision compared to 23.56% of the teachers, which is a very low proportion, the provision of Wash hand basin is also discovered to be low based on students response of 7.4% although 19.93 of parents and 32% of the teacher assert there were provision for wash hand basin.

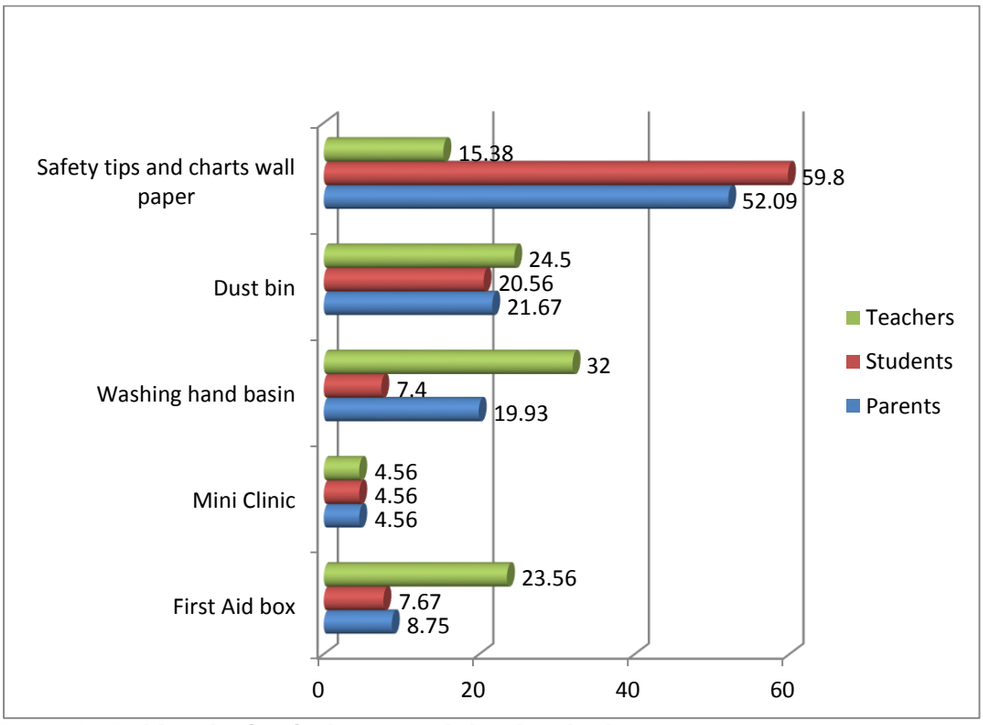

Figure 1: Health and safety facilities provided in the school
Source: Author field work, 2017

There was close range of response from students, parents and teacher on the provision of dustbin in the school premises, which is very low 24.5%, 20.56% and 21.67% for teachers, students and parents respectively. For safety tips and charts wallpaper provision, there was a sharp contrast from the teachers and students-parents response. 15.38% of teachers were of the opinion of that safety tips and charts wallpaper were provided within the school, which is very low and compare to 59.8% of students and 52.09% of the teachers. This indicates that there is provision of safety and charts wallpaper within the school, but only the teachers recognised the inadequacy of this provision. Considering the health and safety facilities provided in the school, it can be asserted that the facilities is very low which can put the students at risk.

Location of Wash Hand Basins

The location of the wash hand basins was assessed to project the easy accessibility of the facilities to the users, the four locations (inside the classroom, outside the building, the entrance of the classroom, toilets) presented in Figure 2, were of significant value as they were meant to serve different kinds of purpose. The location of wash hand basins outside the building was asserted by the students to be the highest (98) with close responses from teacher 95 and parents 86, and for the location of wash hand basin inside in the toilet, parents were made to believed that there is provision of wash hand basin as shown by their response 92, compared to 59 responses from student and 34 from teachers. The provisions of wash hand basins inside the class were very low.

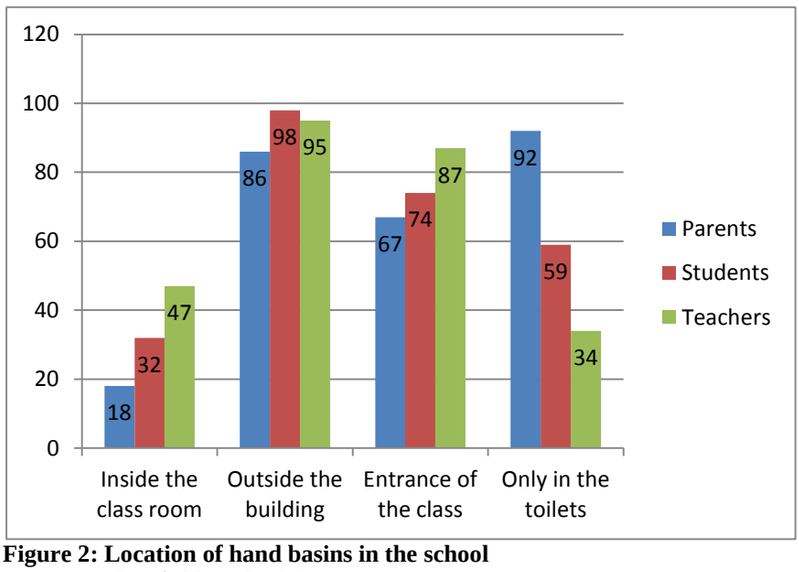

Figure 2: Location of hand basins in the school
Source: Author field work (2017)

Type of Toilet provision

Based on students' response, squat toilet type was asserted to the most provided with 198 responses while water closet has 65 responses. The response of parents and teacher were in the opposite direction, with a high margin from the students' response as presented in Figure 3. This indicates that the students as the users can give realistic judgment than the teacher and the parents.

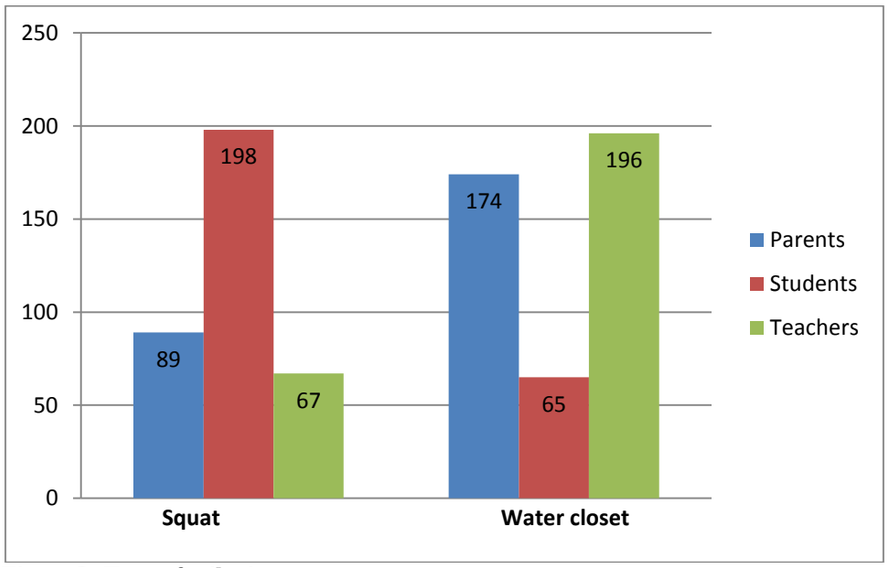

Figure 3: Type of toilet in use
Source: Author field work, 2017

Sources of water within the school premises

The availability of water for domestic usage is an essential component of daily needs for healthy living, provision of water within the school is very important to meet the daily need of the children. Borehole is the second source of water in the Abuja city after pipe borne water, the study area is not yet connected to the pipe water network, which makes borehole the only source of water in the area. Figure 4 presents the sources of water within the school, the majority of the students (220) and parents (195) asserted that there were no sources of water within the school premises while 167 teachers claimed there were provision for borehole within the schools.

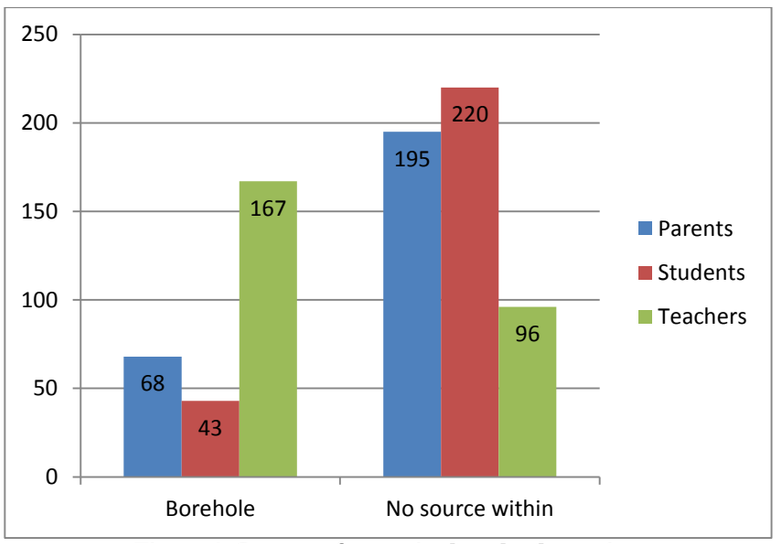

Figure 4: Sources of water in the school premises
Source: Author field work, 2017

Satisfaction level measure

The satisfaction level was assessed based on the binary opinionated design of yes or no due to the class of respondents (children) dealing with. Figure 5, indicates that 168 of the students were not satisfied with the level of provision of health and safety facilities provided in the school.

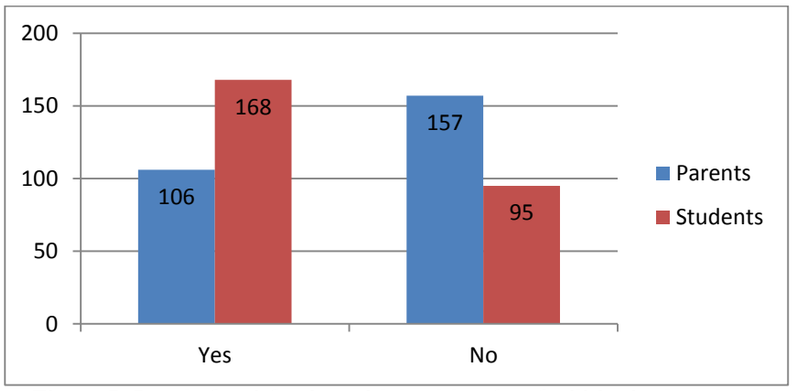

Figure 5: Level of satisfaction with health safety facilities in the school
Source: Author field work, 2017

Opinionated need assessment

The opinionated need assessment for health and safety facilities in the basic schools was assessed independently of each other. Figure 6, indicated that the from the students' perspective, adequate water supply has 78 response as the highest and other safety facilities were also important with the considerable response from the students. Provision of dustbin has the highest response from parents' perspective; this was due to returning of some wastes back home by some student has complained by the parents interviewed.

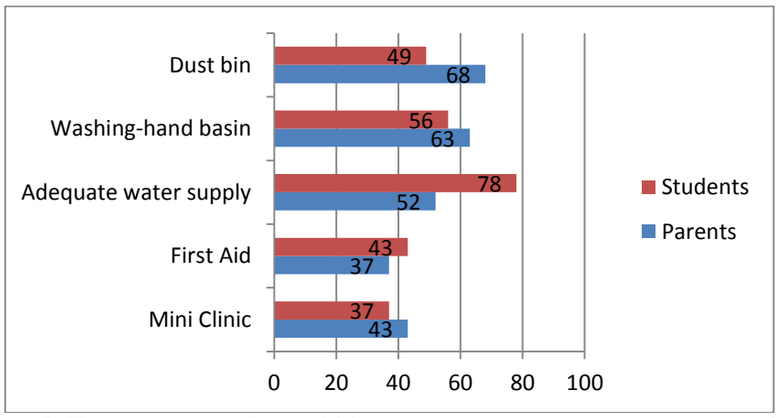

Figure 6: Type of health safety facilities students and parents want to be provided
Source: Author field work, 2017

CONCLUSION

As noted by UNICEF, health and safety in schools help to save teachers teaching' time and stress in the school. Drawing judgement from the students' opinion, the study revealed that there is a gap between the health and safety measures within as claimed by the teachers and the students' opinions. There were inadequate provision for health and safety measures within the school,which called for urgent reaction by the concern authority. The paper recommend inspection of the school facilities by the concern authority so as to enforce the provision of health and safety facilities and measures within the school premises and school authorities were also pray to place the interest of their students above the monetary profit from the school.

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INFORMATION TECHNOLOGY AND BUILDING MAINTENANCE

FACILITY MAINTENANCE MANAGEMENT PLAN A CASE STUDY OF KASHIM IBRAHIM LIBRARY, AHMADU BELLO UNIVERSITY, ZARIA

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The university library – an educational facility, plays a vital role in learning by providing a serene and conducive environment for study and research; thus influencing the standard of education provided by the university(Uwameiye, 2004).Maintenance works ensure that facilities retain their optimum structural, functional and aesthetic conditions throughout their lifespan, and are most effective when carried out according to comprehensive plans and procedures (Atkin and Brooks, 2005).The physical condition of the library therefore determines the conduciveness of the learning environment. Kashim Ibrahim Library (KIL) of Ahmadu Bello University (ABU), Zaria - as a backbone of learning, should not be managed without an efficient Maintenance Management Plan (MMP). The MMP ensures that facilities support the core objectives of the organization by pre-emptively planning, and working against total breakdown and dilapidation, (Wordsworth, 2001; Chanter & Swallow, 2007; Cruzan, 2009; Lee, et al. 2008). The problem therefore is in adopting and implementing appropriate maintenance strategies to address dilapidation. This research aims at analysing the effectiveness of the MMP used for KIL by assessing the physical condition of the facility. A building condition survey and interviews were conducted to establish the condition of KIL - revealing a deplorable condition of KIL, and the absence of a documented MMP respectively; signifying a direct connection between building condition and MMP. It is therefore recommended that a MMP is vital to maintaining a good physical condition for KIL (or any other facility).The outcome of this research provides a basis for developing a MMP for KIL and other facilities.

Keywords: Facility, Maintenance, Management, Plan

INTRODUCTION

Part of the mission goals and statement of the Kashim Ibrahim Library (KIL) is to support teaching, learning, and research activities of the University through the provision of facilities, appropriate infrastructure and technologies for operational efficiency and effectiveness, ("Our Mission", n.d). As the library caters to the needs of thousands of students and staff of the university community, the pressure on the facility - building elements, finishes, furniture, and fittings and so on – made it necessary for continuous maintenance and efficient management to keep the facility functioning optimally and in good condition. KIL as an educational facility serves as the backbone of learning in ABU Zaria, it is one of the most reputable libraries in West Africa. The historical and functional importance of the university cannot be overstated. Thus, KIL is an essential facility that should not be run and managed without an efficient MMP to check dilapidation.

In Nigeria, the abandonment of public buildings soon after completion despite the huge sums of money spent in procuring them leads to rapid deterioration, disrepair and subsequent high long run maintenance cost-which is not sustainable, (Olufunke, 2011). Lack of maintenance in public buildings leads to rapid deterioration threatening their functionality (Waziri & Vanduhe, 2013). Poor maintenance culture in Nigeria has adversely affected the condition of public buildings, (Mbamali, 2003).

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Adenuga, et al, (2007) attributes the poor maintenance culture of public buildings to the absence of a maintenance policy, insufficiency of funds, inexperienced workmanship, and unsupportive attitude of management; while maintenance management is affected by the inflation of maintenance costs, substandard materials, and lack of agreements for the continuous supply of essential parts. Dilapidated and unhealthy buildings in any environment can express a negative quality of life and contribute in some way to anti-social behaviour, (Alexander 1996). In the case of the university environment and it's educational facility - library, this anti-social behaviour could be expressed in the form of poor reading culture amongst the student population due to the poor condition of the library.

Facility management (FM) ensures that the structure and other systems of a building are kept at optimum functioning capacity, and through maintenance works extend the service life of the building. Maintenance works are most effective when carried out according to well laid out plans and procedures - designed to ensure prompt execution of works and economical allocation and use of resources, (Atkin and Brooks, 2005).The MMP therefore provides the basis for the efficient management of a building by pre-emptively planning and working against total breakdown and dilapidation.

Poor maintenance culture is further amplified by the absence of a documented maintenance strategy, thus causing deterioration, and dilapidation of facilities – which in turn affects the organizations capacity to meet its primary goals. The problem therefore is in developing and implementing the appropriate maintenance strategy for effective facility maintenance management. The aim of the research is to analyse the effectiveness of the MMP utilized in KIL, this will be achieved through the following objectives:

i. Building condition survey: To establish the physical condition of the facility.
ii. Interviews: To establish the existence of a documented MMP and its effectiveness.
iii. Literature review: To establish an understanding and relevance of a MMP and other related terminologies.

The paper is in five sections, following this introduction is the literature review section- which sheds light on relevant theoretical concepts and terminologies. The next section will briefly highlight the background information on KIL. The research methodology section will outline the tools and techniques used in conducting the research. The findings section showcases the results of the investigations, which are analysed under the discussion section. The paper ends with recommendations based on the research findings.

LITERATURE REVIEW

Facilities Management

Facilities Management (FM) is a broad discipline that integrates the services of several other disciplines. There are as many functions of FM as there are definitions. The definitions that suits the context of this research is based on the operational maintenance of the premises, which states that FM is technical and concerned with the practical utility of the physical infrastructure to ensure that it supports the core activity of an organization, (Felice, Fornasier, & Nonino, 2006). FM is also the process by which an organization ensures that its buildings, systems and services support core operations and processes as well as contribute to achieving its strategic objectives, (Alexander, 1998). This definition outlines two distinctive activities that take place within a facility, these are:-

a. Core processes: The organization's primary business objective.
b. Support activities: Operations that ensure the provision and maintenance of a conducive work environment.

FM manages infrastructure so as to support the goals of the organization, contributing to occupational efficiency and productivity (Lee, et al. 2008; RICS, 2013).The alignment of FM functions with the objectives of a business improves the benefit of the building to its users, (Zheng, 2012).

The core objective of KIL is the promotion of learning and research, while, the support service - maintenance management, is required to retain the facility in good working condition to meet the core objective. This implies that the condition of a building directly affects the capacity of the organization utilizing it to achieve their core objectives.

Building Maintenance

Maintenance is the amalgamation of all technical and associated actions intended to retain or restore an item to a state in which it can perform its required function (BS 3811, 1984).Building maintenance falls under one of the core competencies of FM – Operations and maintenance. Some definitions of building maintenance are as follows:-

a. The action of ensuring that a building remains in good working condition by preserving it from deterioration, decline, or failure, (Harris, M., 2006).
b. Work undertaken in order to keep restore or improve every part of the building, its services and surrounds, to a currently acceptable standard, and to sustain the utility and value of the building, (Seeley, 1976).
c. A combination of any actions carried out to retain an item in, or restore it to an acceptable condition, (BS 3811: 1984)

According to (Cruzan, 2009), maintenance is generally categorized as follows:-

a. Planned maintenance: Work is scheduled and carried out according to predetermined procedures before problems occur or become visible.
b. Unplanned maintenance: Work is carried out as or after the occurrence of problems.

Figure 1 shows further sub categories of maintenance (Chanter and Swallow, 2007). A planned maintenance approach therefore involves the anticipation of failures and adoption of appropriate procedures for their rectification, (Wordsworth, 2001).

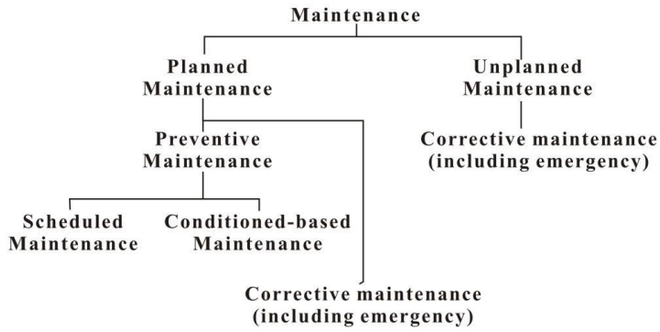


Figure1: Types of maintenance (Source: Adopted from Chanter and Swallow, 2007)

Maintenance Management Plan (MMP)

A facility MMP is a comprehensive document which outlines all the activities and procedures involved in retaining and restoring buildings in/and to a good condition. It is a planned course of action for risks that have not yet occurred. These will involve building condition survey and report/inventory, building condition rating policy, maintenance budget, maintenance planning and implementation strategy (proactive or reactive), schedules of routine inspections and repairs, performance monitoring and evaluation. The objectives of the organization and how maintenance can be used to achieve them should be captured by the MMP. Service level agreements, service standards, repair/replace decisions policy, and response to call outs should also be captured in the MMP. The ultimate objective of a comprehensively documented plan is to ensure that the organization's core objectives are supported by the infrastructure with efficient use of resources – money, time, and man power, (Wordsworth, 2001; Chanter & Swallow, 2007; Cruzan, 2009; Lee, et. 2008).

The level of defects and deterioration in a building are indicators of the building performance (Mustafa, et al., 2010). Therefore, the capacity of a building to support its primary function effectively is an indicator of the lack or quality of the MMP in use. Where there is no MMP in place – the report from a building survey will provide a starting point for developing one.

Building Condition Survey (BCS)

The quality and efficiency of a MMP depends on building condition information, (Siti et al., 2011).A BCS provides a quick estimation of a buildings condition and also establishes a basis for further comprehensive investigations like Building/Facility Performance Evaluation (BPE/FPE).The scope of the investigations are usually limited to the purpose of the survey. Various terminologies have been coined to describe the investigations carried out on facilities by industry professionals, such as 'Building Condition Survey (BCS)',

'Facility Condition Assessment (FCA)', and 'Property Condition Assessment (PCA)' and so on. The results obtained from such investigations are usually in the form of technical reports which may contain quantities, material specifications, structural information, recommended remedial actions, and so on, depending on the scope of the investigation.

A BCS is defined as the assessment of the fabric or physical condition of a building, usually in preparation for maintenance programme; investigations are guided by a checklist form for the recording of factual information. The BCS can be for the purpose of property valuation, schedule of condition and so on. Such surveys may recommend that more detailed investigations be carried out. The outcome of the investigations is necessary for the planning and/or execution of maintenance/remedial works. Photographs, sketches and drawings may be used to support the survey report, (Chanter & Swallow, 2007; (Douglas & Noy, n.d.).

The condition survey is therefore the principal means of obtaining information about the construction and state of a building, (Mustafa et al., 2010).The scope of which will vary based on the purpose of the information required, ("Types of building survey", n.d.). Some of the information that can be obtained from a building inspection/survey as outlined by (Che-Ani, 2008) are:-

a. An image of the physical condition of a building's fabric.
b. Cost estimates of remedial works.
c. Reference information for future design.

Facility Performance Evaluation (FPE)

Zimring (2014), describes FPE as a systematic evaluation of the effectiveness of one or more aspects of buildings – such as functionality, sustainability, accessibility, aesthetics, cost, safety and so on. Investigations are carried out through field observations/investigations - aided by checklists, questionnaires, interviews, photographs, instruments and so on. The information provided is useful for the following:-

a. Design analysis for future projects – informing on whether to adopt, improve upon, or avoid certain design features.
b. Facility maintenance and management issues.
c. Expense/Budget defence and improvement of the long term performance of buildings.

KASHIM IBRAHIM LIBRARY - Background History

Established in 1962 and located in the Samaru campus of ABU Zaria, KIL is bordered to the north, south, east and west by Ribadu hostel, Iya Abubakar computer centre, faculty of environmental design, and the department of microbiology respectively; as shown in Figure2. KIL was designed in 1970 by Egbor and associates, and in December of 1976 it was finally commissioned by Sir Kashim Ibrahim (after whom it was so named).

Design and Construction

The design of the library is a rectangular plan, in a grid form consisting of uniformly spaced columns and beams. The construction is of reinforced concrete, with the individual spaces delineated by solid partition walls. The floors are mostly finished in terrazzo for the public spaces, and Polyvinyl Chloride (PVC) tiles set with glue on cement sand screed. Suspended acoustic boards are used for the ceilings. The building has undergone some modifications and repairs over the years which saw the replacement of some areas (usually the offices) with vitrified floor tiles. The windows, especially in the reading areas are floor to ceiling level. The walls are finished with cement plaster and paint, except in some areas of the lobby where polished wood is installed. The roof is made up of a combination of flat reinforced decking covered with asphalt mat, and a system of barrel vaults, of steel lattice truss covered with metal sheets. The roof system has drainage gutters for water run-off.

Figure1: KIL – Approach view (Source: Author's field work)

Figure 2: ABU Zaria, Samaru campus, KIL highlighted in red outline. (Source: Google-imagery, Digital Globe, 20012)

Facilities and Capacity

The distribution of spaces within KIL is as follows:-

a. Ground Floor: Exhibition hall, lounge, periodicals, catalogue, photographic and reproduction, general male and female toilets, bindery, dark room, reference section, and other offices.
b. First Floor: Librarian's office, deputy librarian, staff lounge, conference room, staff offices, two reading areas, audio visual section.
c. Second Floor: Rare books, special collections, and a reading area.

KIL has a capacity of 2,000 readers; this capacity is supported by reading carrels that carry 4 people. There are about 4 major reading sections in the library used regularly by students and staffs of the university. Recent additions or modifications saw the inclusion of a computer centre, additional business centre, and a lounge.

Organizational Structure of KIL Management

The management of KIL is headed by the University Librarian, the deputy Librarian, Administrative Section, and eight departmental heads and their supporting staff. The following is an outline of the various departments/divisions in KIL management.

a. Human resources development.
b. Customer services
c. Resource processing
d. Reference information service
e. Research and bibliographic services
f. Serial management
g. Information and Communication Technology (ICT)

RESEARCH METHODOLOGY

Assessment Criteria

The survey methodology used in the research is based on the qualitative research technique, designed to determine the physical condition of KIL.The condition survey was carried out through:-

a. Field investigations: The condition survey focused on the building elements and finishes, (Openings, floor, walls, and ceiling), the furniture, and fittings. The condition survey was broken down into two separate investigations as follows:
   i. A walk through observation (with broad category of interest), using photographic documentation to record findings was conducted. The results provided a basis for establishing the oral interview questions.
   ii. A structured observation using a checklist was conducted – with a focused analysis of building elements and items.
b. Oral interviews - guided by open and close-ended questions, conducted with staff of KIL, and the Estate department of the university, also shed more light on the inner procedural workings of the maintenance operations in KIL.

Scope and Limitations

The scope of the investigation concentrated on functional spaces with a high frequency of usage, the building element finishes, furniture and fittings of those spaces. As a result the spaces investigated are as follows:

a. Reading rooms 1 to 4.
b. Stair case.
c. Male and female toilets.

A major limitation of this investigation was due to the restriction of access to certain spaces in KIL – as imposed on the author by KIL management. This made it difficult to make a thorough assessment on the facility as well as to take measurements.

Condition Rating Variables

The criteria used in collating the data on the checklist form are categorised under 'Condition rating' and 'Recommendations' for remedial action as follows:-

a. Condition rating: The physical state/appearance of the item under investigation.
   - Good: This implies that the item is not damaged.
   - Fair: The item has suffered minor and easily reversible damages/deteriorations.
   - Bad: The item is extensively damaged.
b. Suggested solution: The appropriate remedial action based on the condition rating.
   - Maintain: This implies that the item does not require any remedial action.
   - Repair: Item requires minor/minimal remedial action.
   - Replace: The item should removed and replaced due to unsalvageable damage.

Using Microsoft Office Excel 2007, the numeric codes of 0 and 1 – representing negative and positive "No" and "YES" responses, are assigned to the variables. The sum total of responses for each variable was collated as percentage distribution and presented in a chart.

Walkthrough Condition Survey

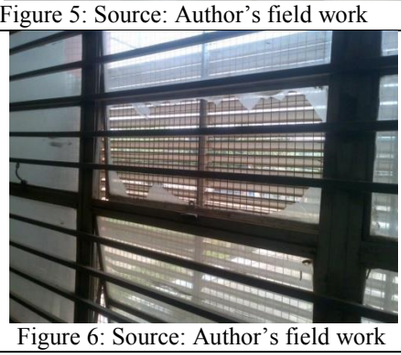
Direct visual observations through field investigations/inspections – aided by checklists, interviews, photographs, instruments and so on, are therefore necessary in the understanding of the physical condition of buildings. The scope of investigations is limited by the purpose of the investigation. As the purpose of this research is to establish an estimated image of the condition of KIL, the scope will be limited to the building fabric in areas of high frequency of use.

FINDINGS

Walkthrough Condition Survey

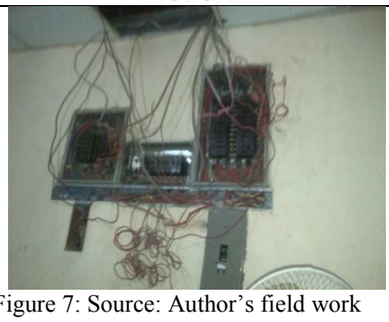
Table 2: Photographic documentation of the walk through condition survey conducted.

DESCRIPTION	FIELD NOTES	PICTURE
Floors	The plastic floor tiles in the reading rooms are peeling off, broken and in most parts completely damaged.	 Figure3: Source: Author's field work
Walls	The walls are stained with dirt, and most of the paint is discoloured	 Figure 4: Source: Author's field work

Ceiling	The acoustic ceiling tiles are loose, fallen off, or have been removed and not replaced in most places.	 Figure 5: Source: Author's field work
Windows	The glass panes to the windows in the reading rooms and toilets are broken or missing.	 Figure 6: Source: Author's field work

Source: Author

Table 3: Photographic documentation of the walk through condition survey conducted.

DESCRIPTION	FIELD NOTES	PICTURE
Electrical Services	Electrical service equipment and fittings are in a state of disarray.	 Figure 7: Source: Author's field work
Toilets	The toilet facilities are in a deplorable condition, characterised by damaged toilets cisterns, and damaged plumbing. The toilets are in a less than hygienic condition throughout the day.	 Figure 8: Source: Author's field work
Toilets	The same deplorable condition obtains in both male and female toilets. The wall tiles are stained, falling away. Leakage from the damaged plumbing leaves the floors wet with water.	 Figure 9: Source: Author's field work

Furniture	Most of the chairs and tables in the reading rooms and offices are in a damaged state, with broken frames and torn upholstery.	 Figure10: Source: Author's field work

Source: Author

Condition Survey Results Using Checklist Form

Figure 11 and 12 show the percentage frequency distribution of the condition and remedial action recommendation ratings. The results reveal that in the spaces, elements, and items investigated, 59% are in a fair condition requiring minor repairs/remedial works, 35% are in a bad condition requiring extensive repairs/remedial works or replacements, while only 6% are in good condition.

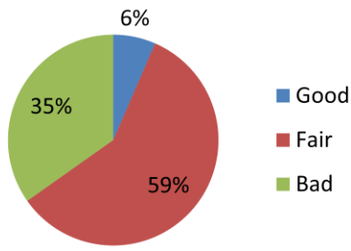


Figure 11: Percentage distribution of condition ratings. Source: Author

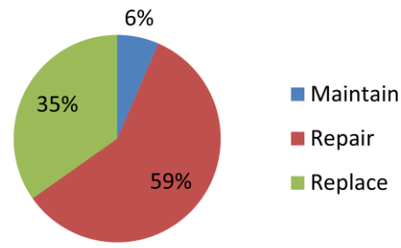


Figure 12: Percentage distribution of remedial action. Source: Author

Table 4 shows the results from the close ended interview with a staff of the ABU Estate department (physical planning unit) in charge of maintaining the infrastructure of the university.

Interview Results

Table 4: Results of Closed Ended Oral interview

	QUESTION	RESPONSE
1	Is there a documented maintenance policy or plan in use for Kashim Ibrahim Library (KIL)?	No
2	Is there an in-house maintenance management department for KIL?	No
3	Is there a work order system in use?	Yes
4	Are regular/periodic inspections carried out in KIL?	No
6	Is there an annual budgetary provision for the maintenance of KIL?	No
7	Is there a maintenance standards policy in use?	No
8	Is there a documented facility inventory for KIL?	No
9	Is there a documented equipment inventory for KIL?	No

Source: Author

Open Ended Oral Interview Results

The information from the respondents revealed that the maintenance management approach used in KIL can be categorized as break down maintenance – in which remedial works and repairs/replacements are carried out only in the event of failure, and this is usually long after the occurrence of the breakdown. There is also no predetermined procedure for any maintenance/repair works.

Maintenance works in KIL are generated through a maintenance officer (not resident in KIL) of the Estate department assigned to KIL – who is to serve as a liaison between KIL management and the Estate department; with the responsibility of carrying out periodic inspections of the facility, generate work requests, and collate and forward work requests to the Estate department - which will then validate the work requests, and apply for an approval from the university management.

Contracts for major repairs, improvements, or modification works are usually initiated by the university management, even without the knowledge of the Estate Department or KIL management. Custodial services – which are done once a day, are carried out by staff of the university under the direct control of the health services department.

DISCUSSION OF RESULTS

The walkthrough condition survey revealed a generally deplorable condition of the building elements, finishes, furniture and fittings. The structured survey using checklist further revealed that KIL is in dire need of repairs due to the high percentage of items with poor quality condition rating requiring repairs or replacements. The lack of direct control over custodial staff by KIL management, and the low frequency of cleaning are responsible for the deplorable condition of the toilets. The generally poor condition of KIL has been due to long time neglect, inadequate and/or poorly executed maintenance works over the years with little or no professional inspection.

The absence of a documented maintenance management policy, maintenance standards, predetermined procedures to tackle problems before or as they arise, and lack of regular/periodic inspections - which would detect problems before they arise, are major contributors to the poor condition of KIL. Also, the absence of budgetary allocation for the upkeep of KIL often constitutes inadequate allocation of resources for much needed works.

The work order system in use has been inefficient and not adhered to over the years (as confessed by the respondents and evidenced by the condition of KIL), due to the lengthy protocols, and further compounded with poor record keeping, and unverifiable verbal communications. As a result, the university librarian will at times directly write or make verbal requests for works to the university management. Applications for repairs are mostly denied or at best delayed by the university management.

RECOMMENDATIONS

This research has revealed a direct connection between the poor quality condition of KIL and the lack of a documented MMP, and inefficient maintenance management strategy and techniques. Therefore the following recommendations are made to address immediate problems and long term solutions:

1. A comprehensive and documented MMP should be developed for KIL. This will define the way and manner in which failures are detected; works are generated, planned, budgeted and executed to maintain the quality of KIL.
2. A schedule of dilapidation report should be prepared following a more thorough and in-depth survey/inspection. This report can be used to formulate necessary works and formulate a bill of quantities for further action.
3. A turn around maintenance should be scheduled and executed based on the schedule of dilapidation and bill of quantities generated.
4. The input of KIL management should be sort – in the form of needs assessment and recommendations, and these should form the basis for the generation/formulation of works contract.
5. Custodial services should be under the direct control and supervision of KIL management.
6. An in-house maintenance department under KIL management should be established so as to eliminate unnecessary and lengthy protocols which inhibit prompt execution of maintenance works.

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INFORMATION TECHNOLOGY AND CONSTRUCTION

IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) FACILITIES DEPLOYMENT ON QUANTITY SURVEYING PRACTICE IN ABUJA

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The world today has become a global village with information being passed on within seconds and jobs made easier through the use of electronic devices. Information and communication (ICT) is in the forefront of championing this course. Most quantity surveying firms face one challenge or the other in adopting ICT in their daily operations. Thus, this research set out to assess the factors influencing ICT facilities deployment on quantity surveying practices in Abuja. The study adopted a survey approach, in which quantitative data were gathered from quantity surveying firms (QSFs) within the study area, through the use of structured questionnaire. Percentage, mean item score, and factor analysis were used in analysing the data gathered. The study reveals that the factors influencing the deployment of ICT in quantity surveying practices are majorly ICT related issues, external related issues, human related issues, legal and change issues, and cost related issues. Crucial factors among them are; high cost of hardware and software needed for ICT deployment, satisfaction with existing method of working, lack of legal support for use of ICT, and high cost of training ICT professionals. It was further revealed that the most significant measures that aid ICT deployment in quantity surveying practices are proper education and trainings on ICT, promoting awareness and use of ICT, and implementing measures to develop and retain skilled human resources in the ICTs sector. The study concluded that high cost of ICT deployment and training among others are the factors influencing it deployment by QSFs. The study recommended that Government should assistance QSFs in the country, particularly with a view to improving their funding and financing capacity. In addition, the need for NIQS to organise regular seminars and workshops to train practicing quantity surveyors on the use of ICT

Keywords: ICT Deployment, Information and Communication Technology, Quantity Surveying Practice, Factors, Abuja

INTRODUCTION

Across the world, new technology is developed daily which is transforming and revolutionizing all, from the basic to the intricate functions of life, and the construction industry is no exception. Halim (2010) postulated that no profession can effectively succeed in solving its 21st century development challenges unless the professional visions, aspiration, mission and strategies are fundamentally anchored in the realm of knowledge creation and strategically driven by technology. Technology is seen as the catalysts for change; changing working conditions, handling and exchanging information, teaching methods, learning approaches, scientific research, and in accessing information (Mikre, 2011; Onyegiri *et al*., 2011). Information and Communication Technology (ICT), a crucial aspect of technology has been described as an aspect that covers any product that will store, retrieve, manipulate, transmit or receive information electronically (Alaghbandrad *et al.*, 2011). In construction, Maqsood Walker and Finegan (2004), opined that a major construction process demands heavy exchange of data and information between project participants on a daily basis. This is made easy through the adoption of ICT.

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Mohamed and Stewart (2003) observed that majority of construction process information, has been through the traditional means of communication, such as face-to-face meetings and the exchange of paper documents in the form of technical drawings, specifications and site instructions. This situation accounts for difficulty in accessing data, and prevalence of out-of-date and incomplete information within the construction industry (Shoesmith, 1995). Thus, there is the need to increase the efficiency of information management by exchanging massive volumes of information at high speed and at relatively low cost through the deployment of ICT in the industry (Deng *et al*., 2001).

One of the major participants in the construction industry, whose role is crucial in the delivery of construction projects, are the Quantity Surveyors (QS). Ashworth *et al.,* (2013) described QS as those responsible for the costing of construction designs and production of procurement and construction documents. Ojo (2011) further stated that QS estimate and manage the cost of construction projects. A practicing QS is mostly found in Quantity Surveying Firms (QSFs) which are service based firms providing consultancy, financial and allied management services to their clients (Abidin *et al.*, 2011). Oyediran and Akintola (2011) view QSFs as knowledge based firm because QS sells knowledge and not physical product when in operation. It is noteworthy that this knowledge is transformed into service that gets delivered to clients eventually. The Royal Institute of Chartered Surveyors (RICS) (1998) therefore stated that for QS, a basic competency in data, information and information technology is required. It has therefore become a tactical necessity for these QSFs to integrate ICT into their service delivery in order to improve the flow of information between them, and also enhance the effectiveness of decision-making and service delivery (Najam et al., 2014).

Tan and Yeoh (2011) highlighted a major benefit of ICT in the delivery of QS service. The study suggested that the use of measurement software applications can help QS to speed up the measurement of designs and also the preparation of the bill of quantities. However, it was further stated that QS ability to avail themselves of these emerging opportunities provided by the advent of ICT, depends on the adoption of new technologies since its impact on professional practice has been mainly in making jobs easier for the professions, facilitating decision-making and savings in operating costs, among others.

Usman et al. (2012) revealed that QS in Nigeria are not taking serious action towards advanced adoption of ICT as QSFs appears to make sluggish progress towards effective ICT implementation for its unique features which distinguish it from other firms within the industry. These firms remain weak and data cannot be exchange efficiently. A similar observation was made by Oyediran and Akintola (2011) when they stated that most software packages used for estimating and tender analysis by QS, still rely on manual data input. This tends to lead to low productivity of these QS and also increases the risks for errors which will eventually give wrong budget estimate (Akinnagbe and Adelakun, 2014). Thus, pertinent issue such as the level of ICT facilities deployment among QSFs requires answers if the use of ICT among these firms is to improve. According the Nigeria Institute of Quantity Surveyors (NIQS) (2012) QS practice faces challenges as a result of the inability of its professionals to adapt to the changing technological environment in which they operate. This problem can prove crucial to the deployment of ICT facilities in quantity surveying practices.

Ibironke *et al*., (2011) evaluated the level of adoption of information technology by QS in Nigeria and its impact in discharging their professional obligations to achieve improved service delivery. The study revealed that although there is the increasing awareness of the importance of information technology in improving service delivery and productivity, QS in Nigeria are still reluctant in using these technologies. Reason for this reluctance was attributed to the high initial cost of acquisition, lack of infrastructures to support its use, and security concerns such as the susceptibility of the system. A similar observation was made by Akinnagbe and Adelakun (2014) who assessed the risk associated with using quantity surveying softwares in QSFs in Lagos. The study discovered that not all QSFs have fully braced up to the acceptance and usage of ICT modalities. It was also discovered that changing trends in technology is the major factor that necessitates the usage of softwares in QSFs in Lagos State.

Halim (2010) carried out a research on the use of ICT in construction with focus on real estate organisations in Lagos. The study revealed that ICT has not yet gained wide range acceptability within the assessed organisations. According to a study on Service Quality Model to evaluate the effect of ICT on the quality of services of QSFs in the Nigerian

Construction Industry, ICT is a suitable tool for improving the quality of quantity surveying services in the country (Musa *et al.,* 2010). If this is the case, QSFs would be better of it when then deploy ICT in the delivery of their services.

It is evident from the above studies that significant literature abounds in the aspect of ICT in the Nigerian construction industry. However, not much has been done in assessing the factors influencing ICT deployment among quantity surveying practices in the study area. Bearing in mind that the socio-economic and physical environment have significant influence on the delivery of professional service within the construction industry (Kazaz and Ulubeyli, 2009; Pamuku and Bhuta, 2004), assessing the factors influencing the deployment of ICT facilities among QSFs specifically in Abuja was deemed necessary. Therefore, the aim of this research is to assess factors influencing ICT facilities deployment in quantity surveying practices in Abuja, with a view to proffering possible measures towards increasing its deployment in QSFs. The specific objectives are to determine the factors influencing the deployment of ICT in Quantity Surveying Practices and to assess the possible measures for increasing ICT deployment in Quantity Surveying firms in Abuja

Thus, it is believed that to a great extent, the findings of the study will set a stage for rapid and a more comprehensive appraisal and utilization of technology in quantity surveying practice. This has become necessary to keep QS abreast with the use and advantages inherent in ICT. Also outcome of this study will educate the decision makers in QSFs in Abuja on the possible impact of ICT deployment on quantity surveying practices. If the suggested measures for increasing ICT deployment in this study are adopted, it is believed that utmost efficiency in quantity surveying practice in Nigeria, through the effective and efficient utilization of ICT can be achieved. By extension, this will lead to better service delivery of QSFs and more satisfaction of their clients.

LITERATURE REVIEW

Evolution of Technology in Quantity Surveying Practice

Musa *et al.* (2010) opined that Quantity Surveying Practice the world-over and in Nigeria in particular is experiencing dramatic but significant changes in scope and service delivery. Researchers in the early twenties attributed these changes to the changing industry's and clients' demands, advances in Information and Communications Technology, increased level of competition both locally and internationally and globalization. Major among these changes is the paradigm shift from paper-based to computer based (digital) cost information production and exchange through the adoption and use of the Information and Communications Technology (ICT). Mores so, the advent of technology has also enhanced quantity surveying practice in Nigeria (Halim, 2010).

Corroborating further, a simple example is the use of mobile phones for communication via text messages which has helped to improve communication in the course of everyday assignments. Field staff can make immediate contact with their office of the principal partner when issues arise while out in the field in the past, such staff would have had to return to base to deal with such issues. The use of computers and the internet has also made it possible for firms to operate several branches apart from their Head offices with more ease than previously was the case. Professional reports may be vetted online and the exchange of documented information has been greatly enhanced. ICT are perfect tools for working with information and can handle and process large amounts of information for various purposes which would otherwise be difficult to manage manually (Halim, 2010).

Information and communication technology has recently started what appears to be a revolution in quantity surveying practice, as practitioners are increasingly investing in technology hardware and software. The increasing adoption and use of the technology in work practices however, necessitated the development of different specialist software packages to carry out quite a number of tasks involved in the practices. These packages include Digitizers, Autocard, Autosketch, Super Project, Master Bill, WinQs, QSlotus, Computer Aided Taking Off (CATO), Estimator Pro.MB 3, QS Cad, RIPAC, EVEREST, Kwikest, Microsoft Navision etc. for processing of operations. These packages introduced new ways of performing quantity surveying tasks.

On the other hand, it is quite disheartening that Quantity surveying practitioners in Nigeria do not seem to be operating at par with their professional counterparts in the industry. As

field reconnaissance revealed that some practitioners have traditionally lagged behind others, when it comes to applying the latest ICT application in quantity surveying practice. As observed in Lofgren (2006), a greater part of the production difficulties in the construction industry has strong relation to the communication and information exchange between the parties involved in the construction project.

ICT Deployment Tools

According to Oladapo (2007) the basic modes of acquisition of computer literacy available to construction professionals are through private lessons, self-taught, in service training given by employer, and continuous professional development training by professional bodies were the major modes, and lastly learning at school. The use of self-taught is most common and this is a reflection of the very low ICT contents of construction education in Nigeria (Oladapo, 2006).

The essential tools for ICT deployment are hardware and softwares. While the hardware comprises majorly of the different types of computerised gadgets, the softwares ranges from word processing softwares to design softwares. The common types of software used in construction include: Word processing; Spreadsheet; CAD (Revit, AutoCAD, ArchiCAD); Internet software; BIM (Building Information Model); RFID (Radio Frequency Identification); Project extranet; Microsoft project etc. These softwares are used for administration, marketing, desktop publishing, presentation and project management (Doherty 1997, Arif and Karam 2001). While architects, engineers and contractors use CAD mostly for design, drawing and presentation, quantity surveyors use it for measurement, preparation of bills of quantities (BOQ), estimating, and presentation.

The Quantity Surveying Firm in Nigeria

Quantity Surveyors (QS) estimate and manage the cost of construction projects. According to Ojo (2011) opines that the responsibilities of QS begin at the planning stage and continue through the construction period. Nigerian quantity surveying firms (QSFs) usually have more than one registered quantity surveyors that have been licensed to practice under the bye-laws of the Nigerian Institute of quantity surveyors, NIQS (Anyadike, 2001). QSF may consist of unlicensed individuals also, but they only work as assistants to the licensed QS in the firm for the purpose of gaining experience and getting licensed. Quantity Surveying Firms like any other firm/company must be registered with Corporate Affairs Commission (CAC) and given certificate of incorporate to operate legally (Odediran *et al.*, 2012). Also, the firm have to register with Quantity Surveyors Registration Board of Nigeria (QSRBN) and the Nigerian Institute of Quantity Surveyors (NIQS), to be recognised as quantity surveying firm (Odediran, *et al.*, 2012).

Factors Influencing ICT Deployment

Oladapo (2007) noted that there is significant positive correlation between the level of ICT use and business of the firm (contracting, consulting or academics), years of computer literacy of the CEO/senior managers, and the attitude of the CEO/senior managers to ICT (whether they see the need for ICT or not). Although these correlations are not very strong, the fact that the attitude of the CEO is the strongest means that the effects of the other factors are largely dependent upon the importance the CEO attaches to ICT. Also, the fact that none of the external factors is significant seems to suggest that the organisational and management characteristics of firms largely determine the level of ICT use by firms.

Oyediran and Odusami (2005) identified the following factors as those that are responsible for the slow acceptance of ICT by quantity surveyors. They are: Operational inhibitors - Rate of virus attack leading to loss of data, and associated problem, the rate at which software becomes outdated and require up dating, the durability of clones (locally assembled computers), and branded computers are not replaceable; Educational problems - QS training institutions are not equipped\positioned to give computer education to their students, there is no tailor-made QS training by private computer school trainers, management of organizations rarely give in-service training to QS staff, software education is poor, capacity of QS educators are low; Return on investment - Inadequate job order to encourage investment in computer, the cost engaging computer literate is high, fees are not paid to justify computerization of PCMS; Management attitude -management is not willing to computerize PCMS, management does not see the need to computerize; Myth factors - It makes other professionals to encroach on QS jobs. QS believes computer training and usage is for the coming generation, and it is capable of creating unemployment for QS.

According to Oladapo (2007), the factors that constraints the acceptance of ICT devices include insufficient/erratic power supply; job sizes and fees not enough for ICT; high cost of hardware/software; fear of virus attack; high rate of obsolescence of software/hardware; inadequate ICT content in construction; scarcity of professional software; high cost of engaging computer staff; lack of management desire and appreciation of ICT; Security; Low return on investment in ICT; personnel abuse; and fear of ICT making professionals redundant. Ibironke *et al.,* (2011) also reported that the major factors that could influence the use of ICT by QSFs include; rate of virus attack leading to loss of data and associated problems, high initial cost of acquisition, fear of ICT making professionals redundant, irregular power supply, few professional software to choose from, inadequate job order to encourage investment in computer, security / privacy fears, the cost of engaging computer literate staff is high/training on use of software, fear of personal abuse, the rate at which software becomes outdated and requires updating

In addition, Rezgui *et al.* (2004) and Pasupathinathan and Pieprzyk (2008) asserted that the reasons for the relatively low adoption of ICT are: issues relating to the legal ramifications of electronic communications, vague security framework, and issue of trust. Also, organizational and human issues were highlighted as the key factors affected the use of technologies in the construction sector (Oyediran and Akintola, 2011).

Measures for Improving ICT Deployment

Mutesi (2009) carried out a research on the possible solutions to the use of ICT. The top three possible solutions to the use of ICT in their organizations are; loans from Government for ICT development in the private sector, Improving and employing professionals with ICT skills and Staff training on job in the use of ICT for work. The ICT sector must be strengthened since it affects operations of all other sectors of the economy (Kundishora 2006). Some of the points he further stressed which helps to strengthen ICT are: loans from government, adequate power supply, lowering cost of PC's by rationalizing ICT's tariff structure, ensure that every department develops and manages a computerized information system, promote awareness and use of ICT and Promote local research and development. These factors can only be implemented by the government and so are to be considered under the roles of the government in improving the use of ICT.

RESEARCH METHOD

This study covered the assessment of the factors influencing ICT facilities deployment in quantity surveying firms (QSFs) in Abuja. The choice of selecting QSFs in Abuja for the study is based on the premise that Abuja is the administrative centre of the country with lots of construction projects being executed on a daily basis. Thus, most construction related firms (QSFs inclusive) have their head office or branches there (Aje et al., 2015).

According to Kothari (2004), population is a collection of elements being studied and about which conclusions are to be drawn. Since this research sets out to assess the impact of ICT deployment on quantity surveying practices in Abuja, the population for this research is therefore quantity surveying firms (QSFs) in Abuja. According to the Nigerian Institute of Quantity surveyors (NIQS) web page there are 82 registered quantity surveying firms in Abuja as at December, 2016. Since the population is defined and fall under a manageable and reachable size, the whole population was considered for the research. However, during sampling it was observed that some of the quantity surveying firms have either moved without a forwarding address or could not be accessed as at the time of visit, thus reducing the number of QSFs accessible to 64. This study adopted census method of sampling, a non-probability sampling since the population for the research falls within a manageable and accessible size; and the researcher is not concern about the representativeness of the sample, and the probability of an element being stated is unknown. Census sampling which is a Non-probability samplings was used since it is the sampling method best suited for this study involving an extensive field work. Furthermore, the study adopted a well-structured questionnaire administered personally to quantity surveying firms in Abuja. One quantity surveyor was assigned to attend to the questionnaire in each of the QSFs assessed. According to Blaxter et al. (2001), questionnaire is one of the most used technique for conducting social research, and it involves the formulation of precise written questions for the respondents, whose opinion is being sort. The questionnaire used was designed in sections with multiple-choice.

The questionnaire used was designed in two sections using information derived from related literatures reviewed Section A of the questionnaire was used to harness data on the background respondent. This was done in order to provide quality check to the data gotten from the other sections of the research instrument. Section B was divided into parts and it addressed the objectives. Part A and B assessed the factors influencing the deployment of ICT and the possible measures of increasing ICT deployment in QSFs. After administering the questionnaire, the respondents were given considerable amount of time to reflect and facilitate giving of valid responses to the items on the

A pilot survey was adopted to test the suitability and appropriateness of the questionnaire to meet the study objectives as suggested by Fellows and Liu (2008). Ten of the draft questionnaire were randomly distributed to the selected experts and based on the feedback a final draft was made. The reliability is an important aspect of research instrument and it must be considered to ensure that accurate results are obtained. One of the most commonly used reliability coefficients is Cronbach's alpha test (α) (Kothari, 2004). This method is used to measure the reliability of the questionnaire between each field and the mean of the whole fields of the questionnaire. The normal range of Cronbach coefficient alpha (α) value between 0.0 and + 1.0, and the higher values reflects a higher degree of internal consistency. According to Pallant (2005) ideally, the Cronbach alpha coefficient of a scale should be above 0.7. The closer the alpha (α) is to 1, the greater the internal consistency of items in the instrument being assumed. The Cronbach alpha value for the factors influencing ICT deployment and possible measures of increasing ICT deployment are 0.860 and 0.720 respectively. Therefore, the questionnaire is credible and has high degree of reliability as confirmed by (Pallant, 2005)

A total of 59 questionnaires were retrieved out of the 64 questionnaires administered to available QSFs. This represent a response rate of 92% which is far above the usual response rate of 20-30% for questionnaire surveys in construction management studies, as suggested by Akintoye (2000). Reason for this high response rate can be attributed to the sampling technique adopted out of which 59 were retrieved and ascertained fit for analysis. The study employed Percentile, Mean Item Score (MIS), and Factor Analysis in the data analysis. Percentile was employed in analysing the background information of the respondents, Mean Item Score was used in assessing the factors influencing ICT deployment and in determining the possible measures for increasing ICT deployment is QSFs, and factor analysis was adopted in order to get a relatively manageable number of factors influencing ICT deployment in quantity surveying practices. Factor analysis is a method used to examine how underlying concepts influence responses in relation to the variables measured. This study employed the use of principal component analysis (PCA) with varimax rotation for factor extraction. According to Field (2005) PCA is concerned mostly with establishing which linear components exist within the data and how a particular variable might contribute to that component. Data analysis was conducted using statistical package for social science (SPSS 17.0).

RESULTS AND DISCUSSION

The analysis of data gathered on the background of respondents is showed that majority of these respondents (42.4%) have worked between 6 to 10 years in their respective QSFs. The average number of years the respondents have spent at their present firm is put at 7.3 years. This implies that these respondents have spent considerable number of years in their present organisations and therefore can give a reasonable insight to the happenings within their firms. In terms of highest amount of construction project handled, 44.1% of them have handled projects worth of 51 to 100 million naira. Result further shows that on the average these assessed firms have handle projects worth of 204 million naira. Also majority of the respondents (44.1%) have between 6 to 10 years working experience.

The average years of working experience of these respondents is calculated to be 10.7 years, while their highest academic qualification is Bachelor of Science/Technology (42.4%), Higher National Diploma (25.4%) and Masters of Science/Technology (15.3%). This result suggest that the respondents are not only equipped in terms of number of years working in these firms, but also in terms of years of experience in the built environment and also academically. Most of these respondents are Senior QS (35.6%) and Assistant QS (33.9%) in their respective firms, while most of them are corporate (37.3%) and probationer (33.9%) members of the Nigerian Institute of Quantity Surveyors. Findings from the background

information of the respondents for this study shows that response gotten from them can be relied upon in making valid conclusion of the subject of the study.

Factors Influencing the Deployment of ICT in Quantity Surveying Practices

The seventeen factors identified from literature were assessed based on the level of significance as the influence the deployment of ICT in Quantity Surveying practices. The ranking of these factors is shown in Table 1. The analysis revealed that the top ranked factor is the high cost of hardware and software needed for ICT deployment (mean = 4.17), next is satisfaction with existing method of working, lack of legal support for use of ICT and high cost of training ICT professionals with a mean value of 3.93, 3.88 and 3.68 respectively. The least significant factor is virus attack, security breach and fear of accuracy with a mean value of 3.07. With an average mean score of above average of 3.0., these factors can be said to exert a considerable influence on the deployment of ICT in quantity surveying practices.

Table 1: Factors influencing the deployment of ICT in quantity surveying practices

Factors	Mean	Std. Deviation	Rank
High cost of hardware and software	4.17	1.248	1
Satisfaction with existing method of working	3.93	1.065	2
Lack of legal support for use of ICT	3.88	1.247	3
High cost of training ICT professionals	3.68	1.432	4
Inadequate knowledge about return on ICT investment	3.58	1.429	5
Inadequate financial resources	3.56	1.263	6
Software and hardware reliability problems	3.56	1.236	6
Inadequate trained ICT professionals	3.53	1.419	8
Fear of job losses /making professionals redundant	3.49	1.165	9
Missing link in the educational training	3.46	1.194	10
Rapid changes in ICT technologies	3.46	1.343	10
Inability to quantify process improvements and uncertainty of benefits of ICT	3.41	1.219	12
Lack of information by professionals on areas of adoption	3.39	1.313	13
Little return on investment	3.37	1.272	14
Security concerns/privacy fears	3.22	1.233	15
Insufficient/Erratic power supply	3.20	1.141	16
Virus attack, security breach and fear of accuracy	3.07	1.701	17

Source: Researcher's analysis, 2017

In order to group the identified factors influencing ICT deployment in quantity surveying practices into more manageable and significant size, factor analysis was employed. This was deemed necessary to reduce these factors into a smaller number of coherent subscales. The suitability of the data gathered for factor analysis was determined firstly by considering the sample size and number of variables under study. Pallant (2005) stated that there had been little agreement amongst authors concerning the size of a sample for factor analysis, but recommended the use of a larger sample. However, studies of factor analysis conducted for smaller sample size has evolved in over the years. Akintoye (2000) conducted factor analysis for a sample size of 84 in a comparative study conducted on UK contractors. Takim and Adnan (2008) also employed factor analysis on 93 respondents in analysing the effectiveness measures of construction project success in Malaysia. Thus it can arguably be stated that a sample size of 59 adopted in this study is suitable for this analysis. Regarding the number of variables, Hair *et al*. (1998) suggested that factor analysis is suitable for 20–50 variables, as the extraction of common factors becomes inaccurate if the number of variables exceeds this range. However, study have shown that less number of variables can be used (Ahadzie *et al.*, 2008). Hence the 17 factors coupled with the sample size is considered adequate for factor analysis.

Kaiser–Meyer–Olkin measure of sampling adequacy (KMO) and Bartlett's test of sphericity were adopted in testing the factorability of the data gathered. According to Sharma (1996) KMO is a measure of homogeneity of variables and has become a popular measure used in testing whether the partial correlations among variables are small. Tabachnick and Fidell (2007) stated that the KMO index ranges from 0 to 1, with 0.6 suggested as the minimum value for a good factor analysis. However, Hair *et al.* (1998) and Stern (2010) suggested that KMO value should be greater than 0.7 if the sample size is adequate for factor analysis. Sample with a KMO value between 0.5 and 0.7 is marginal while lower than 0.5 is considered to be unsuitable for factor analysis. Also Pallant (2005) submitted that Bartlett's test of sphericity shows whether the correlation matrix is an identity matrix. It was further suggested that the Bartlett's test of sphericity should be significant ($p < 0.05$) for the factor

analysis to be considered appropriate. Result in Table 2 shows a KMO value of 0.738 and a significant level of 0.000 for the Bartletts test. This result coupled with the 0.860 result obtained from the reliability test carried out through the use Cronbach's alpha test, shows that the use of factor analysis for the data gathered is appropriate.

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.738
Bartlett's Test of Sphericity	Approx. Chi-Square	391.951
	Df	136
	Sig.	0.000

Source: Researcher's analysis, 2017

Having confirmed the suitability of the data, factor analysis was conducted using principal component analysis (PCA) with varimax rotation. Result in **Table 3** shows that 5 components with eigenvalues greater than 1 were extracted using the factor loading of 0.50 as the cut-off point. The total variance explained by each component extracted is as follows; component 1 with 33.64%, component 2 with 10.28%, component 3 with 7.84%, component 4 with 7.28%, and component 5 with 6.54%. Thus, the final statistics of the PCA and the components extracted accounted for approximately 65.59% of the total cumulative variance. This fulfils the criterion of factors explaining at least 50% of the variation as stated by Stern (2010).

Table 3: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.719	33.641	33.641	5.719	33.641	33.641	2.953	17.369	17.369
2	1.749	10.289	43.931	1.749	10.289	43.931	2.789	16.407	33.775
3	1.333	7.840	51.771	1.333	7.840	51.771	2.467	14.509	48.285
4	1.238	7.283	59.054	1.238	7.283	59.054	1.686	9.918	58.203
5	1.112	6.544	65.598	1.112	6.544	65.598	1.257	7.395	65.598
6	0.918	5.402	71.000						
7	0.877	5.160	76.160						
8	0.767	4.510	80.671						
9	0.612	3.601	84.272						
10	0.599	3.524	87.795						
11	0.447	2.630	90.425						
12	0.435	2.561	92.986						
13	0.339	1.995	94.982						
14	0.269	1.583	96.565						
15	0.243	1.432	97.997						
16	0.209	1.228	99.225						
17	0.132	0.775	100.000						

Source: Researcher's analysis, 2017

Further to the factor extraction with eigenvalues greater than 1, Pallant (2005) suggested a critical look at the scree plot in other to determine which components (factors) to extract or retain. In analysing the scree plot, a change in the shape of the plot is identified and only components above this point are retained. A look at the fig. 1 shows that from the fifth component, the plots tend to flattened; hence only components from this point above are retained. This further confirms the result in **Table 3** which shows only 5 components which eigenvalues greater than 1. Result in **Table 4** shows each of the 5 extracted components and their variables. Spector (1992) stated that a clear component structure is present when a variable has significant factor loading (loading > 0.50) on one component only. Hence only elements with 0.5 and above are considered under each component.

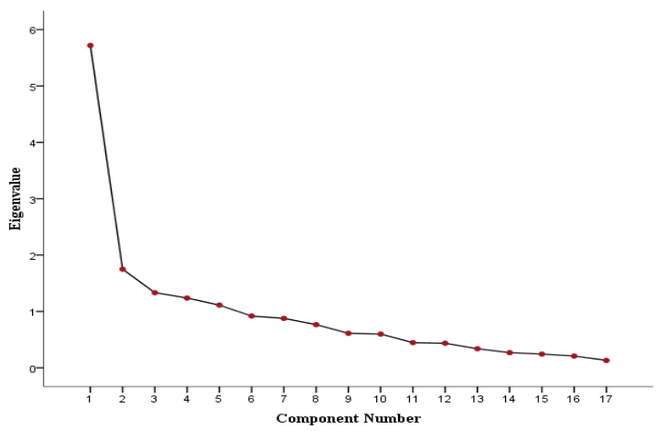

Figure 1: Scree Plot

Table 4: Rotated Components Matrix

	Component				
	1	**2**	**3**	**4**	**5**
Rapid changes in ICT technologies	0.730				
Software and hardware reliability problems	0.728				
Security concerns/privacy fears	0.625				
Missing link in the educational training	0.612				
Inadequate knowledge about return on ICT investment	0.571				
Virus attack, security breach and fear of accuracy	0.568				
Insufficient/Erratic power supply		0.751			
Inadequate financial resources		0.571			
Little return on investment		0.569			
Inability to quantify process improvements and uncertainty of benefits of ICT		0.472			
Fear of job losses /making professionals redundant			0.827		
Lack of information by professionals on areas of adoption			0.723		
Inadequate trained ICT professionals			0.564		
Lack of legal support for use of ICT				0.831	
Satisfaction with existing method of working				0.645	
High cost of hardware and software					0.895
High cost of training ICT professionals					0.572

Source: Researcher's analysis, 2017

Analysis of Results

(i) ICT Related Issues

Result in Table 4 shows that the first principal component has high factor loadings for a group of 6 variables. These variables include; rapid changes in ICT technologies, software and hardware reliability problems, security concerns/privacy fears, missing link in the educational training, inadequate knowledge about return on ICT investment, and virus attack, security breach and fear of accuracy. These factors accounts for 33.6% of the variance explained. After a critical examination of the characteristics of these factors, it was observed that these factors have to do with issues that tends to emanate from ICT usage. Hence, this component was named "ICT related issues".

(ii) External Related Issues

Result also shows that the second principal component accounts for 10.3% of the total variance explained. Factors loading on this component are; insufficient/erratic power supply, inadequate financial resources, and little return on investment. These factors are associated with external environment of the QSFs. Based on this knowing, this component was named "external related issues"

(iii) Human Related Issues

The third principal component accounts for 7.8% of the total variance explained. Three factors are loaded on this component and they include; fear of job losses /making professionals redundant, lack of information by professionals on areas of adoption, and inadequate trained ICT professionals. These factors tend to emanate from the individuals within the industry. Based on this, the component is named "human related issues".

(iv) Legal and Change Issues

Result reveals that the fourth principal component have only two factors loading on it and it accounts for 7.3% of the total variance explained. These two factors are; lack of legal support for use of ICT and satisfaction with existing method of working. Based on the characteristics of these two factors, the component was subsequently named "legal and change issues".

In the adoption of ICT in quantity surveying practices, the absence of legal backing cum implication can go a long way in affecting the deployment of same within QSFs. In similar vein, the inability of the construction industry in general to adapt to changes and adopt

innovative ideas tend to impact negatively on the delivery of the services of the industry. Thus instead of adopting the use of ICT in its holistic form, QSFs tend to rather stick to their old practices base on the fact they appreciable satisfaction is still being derived from the old ways.

(v) Cost Related Issues

The fifth principal component also has two factors loading on it and it accounts for 6.5% of the total variance explained. These factors are; high cost of hardware and software, and high cost of training ICT professionals. Since these factors are cost related, this component was subsequently named "cost related issues". The huge cost of acquiring most of quantity surveying softwares has been a major issue that deters most QSFs from acquiring them. This invariable has its share of influence in the choice of adopting ICT by these firms. In similar vein, training QS on the use of these firms can prove to be expensive, thus, delimiting the use of these softwares within QSFs.

These findings regarding the factor **Influencing the Deployment of ICT in Quantity Surveying Practices** are in line with Oyediran and Odusami (2005) who stated that factors relating to the ICT operations tend to have huge influence in the choice of the adoption of ICT by firms. Findings of this research is also in tandem with Ibironke *et al.* (2011) findings which shows that the high initial cost of acquisition; lack of infrastructures to support its use and security concerns such as the susceptibility of ICT system are some of the major factors influencing the use of this system. However, contrary to Ibironke *et al.* (2011) findings that the rate of virus attack leading to loss of data and associated problems is the major factor affecting the adoption of ICT in QSFs, this study discovered that this factor is actually the least influencing factor. The top factor according to this research is the high cost of hardware and software. This further confirms the result from the crosstab conducted, which shows that QSFs involved in higher budget projects tend to deploy ICT more than those with smaller budget projects. This further corroborates Oladapo (2006) submission that the increased cost of acquiring hardware and softwares for the deployment of ICT in the dwindled economic condition of Nigeria, has made it almost impossible for construction professions to adopt ICT in their daily activities.

Usman *et al*. (2012) categorised the factors influencing the deployment of ICT in QSFs in Nigeria in two; human factors which has to do with individuals, and the organisational culture factors. Findings of this study is in tandem with this submission as it was discovered that human related issues are among the crucial factors influencing the deployment of ICT facilities in QSFs in Abuja, Nigeria. similar to Rezgui *et al.* (2004); Pasupathinathan and Pieprzyk (2008) assertions that the reasons for the relatively low adoption of ICT are: issues relating to the legal ramifications of electronic communications, vague security framework, and issue of trust, this study discovered that legal issues as regards ICT plays a vital role in its deployment by QSFs

Measures for Increasing ICT Deployment in Quantity Surveying firms in Abuja

Result in T**able 5** showed the ranking of the possible measures to increase deployment of ICT among QSFs, identified from literature. The result revealed that the most significant measures are; creating avenues for proper education and trainings on ICT, promoting awareness and use of ICT, implementing measures to develop and retain skilled human resources in the ICTs sector, ensuring easy access to loans from financial institutions to finance ICT development, and top management supports within the organisation, with a mean value of 4.22, 4.17, 4.02, 3.98 and 3.97 respectively. Also, the least ranked measure is promoting local production of ICTs products to ensure relevance of content and use of appropriate technologies that meet international standards with a mean value of 3.07. It is evident that all the identified measures can increase the deployment of ICT with QSFs if considered as they all have a mean value of above average of 3.0. This finding further affirms Mutesi (2009) submission that the top three possible solutions to the use of ICT are; loans from Government for ICT development in the private sector, improving and employing professionals with ICT skills and Staff training on job in the use of ICT for work. The finding is also in line with that of Akinnagbe and Adelakun (2014) who observed that for increased ICT deployment, QS should be trained and given technical and financial support so that they can become first hand software experts. The study observed that ensuring easy access to loans is crucial if ICT deployment is to increase in QSFs. This is in line with Eze *et al.* (2015) submission that Government should extend the hand of assistance to firms in the country, particularly with a view to improving their funding and financing capacity.

Table 5: Measures for Increasing ICT Deployment in QSFs

Measures	Mean	Std. Deviation	Rank
Creating avenues for proper education and training on ICT	4.22	0.892	1
Promoting awareness and use of ICT	4.17	0.931	2
Implementing measures to develop and retain skilled human resources in the ICTs sector	4.02	1.196	3
Ensuring easy access to loans from financial institutions to finance ICT development	3.98	1.106	4
Top management supports within the organisation	3.97	0.830	5
Rationalise the ICTs tariff structure to make ICTs more affordable and accessible	3.64	1.256	6
Promoting local research and development	3.56	1.134	7
Creating a conducive environment for investment in the ICTs sector	3.46	1.104	8
Adequate /Improving power supply by the government	3.46	1.194	9
Promoting local production of ICTs products to ensure relevance of content and use of appropriate technologies that meet international standards	3.07	1.285	10

Source: Researcher's analysis, 2017

CONCLUSION AND RECOMMENDATIONS

This study assessed the factors influencing information and communication technology (ICT) facilities deployment in quantity surveying practice in Abuja with a view to providing possible measures that will ensure the increase in the use of ICT among in the delivery of quantity surveying services within the country. Using a survey design approach the study has been able to ascertain the factors influencing the deployment of ICT in quantity surveying practices, and possible measures for increasing this ICT deployment has been identified.

Based on the findings of the research, the study concludes that the factors influencing the deployment of ICT in quantity surveying practices are majorly ICT related issues, external related issues, human related issues, legal and change issues, and cost related issues. Crucial factors among them are; high cost of hardware and software needed for ICT deployment, satisfaction with existing method of working, lack of legal support for use of ICT, and high cost of training ICT professionals. It was further concluded that the most significant measures that can aid ICT deployment in quantity surveying practices are proper education and trainings on ICT, promoting awareness and use of ICT, and implementing measures to develop and retain skilled human resources in the ICTs sector.

Based on the findings of the research, the following recommendations are made; The Nigeria institute of Quantity Surveyors should also organize seminars, continuing professional development, and workshops, including demonstration of the relevance of ICT applications to quantity surveying practices. This will go a long way in educating the professionals who did not have a chance to learn and also update others who have the basic skills. Also QSFs should endeavour to sponsor their staffs to these workshops and seminars. The Nigeria institute of Quantity Surveyors can also improve ICT deployment within the profession by launching extensive research into the relevance of ICT deployment in quantity surveying practices. This can be achieved through approving of funds for a research committee to carry out educational research. Data gathered from such research will serve as a fundamental base for learning and from where more QS may have insight into the benefits that abound in the use of ICT. The institution should put legislation in place to make it mandatory for QSFs to make use of ICT in their service delivery. This will create a legal base for QSFs to deploy ICT when carrying out their day to day activities.

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INFORMATION TECHNOLOGY AND DESIGN

DESIGN AND IMPLEMENTATION OF A COMPUTERISED BATTERY ANALYSER

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Computerised battery analysers have been used to study the discharge capacity of batteries by both battery manufacturing industries and end users. However, there is no such device manufactured in Nigeria. One of the areas that need urgent research and development (R&D) attention is mobile device battery but R&D in portable battery will be hampered if there are no affordable battery testing devices manufactured in Nigeria. This work reports the design and construction of a computerised battery analyser using Arduino with good measurement accuracy. The design was done such that battery analysis will be carried out using constant load discharge method while measuring the current, voltage, and power consumption at specific intervals of time. The device is microcontroller driven; it interfaces between the battery under test and the battery analysis application that gives a graphical representation of the discharge process. The device was tested by measuring the capacity (amp hour rating) of a zinc carbon AA battery using a load of 5.6 ohms over a period of 5 hours. The capacity measured with the designed computerised battery analyser was similar to the capacity documented in the datasheet of Zinc-Carbon AA battery. This suggests that this design is suitable enough for industry standards and therefore can be a useful tool in the battery R&D.

Keywords: Battery capacity, Analyser, Computerised, Measurement, Battery testing.

INTRODUCTION

Battery analysis is an important factor when manufacturing a new battery. This is because the electrical characteristics of the battery will tell what devices the battery can drive, under what conditions the battery can best operate and other factors like the amount of energy that will be lost from the battery if it is not used (Simpson, 2011). Today, there are many different cell manufacturers that offer a wide variety of battery cells to both corporate and personal customers. Unfortunately, however, reliable information on the physical dimensions and electrical characteristics can be difficult to obtain for many cells. High-end suppliers commonly provide data sheets that contain technical product information including factors such as size, weight, capacity, voltage profile and cycle life, as well as some limited measurement data to support these numbers. (Muenzel, et al., 2015)

Although measurement of battery capacity by method of discharge has proven to not always be the accurate method especially with lead acid batteries, (BU-904) the discharge method is the most widely applied technology in battery analysers today to calculate the capacity of a battery. Battery capacity measurement by discharge method involves three main categories; the constant current discharge, the constant power discharge method and the constant load method. The constant current discharge is the method applied in battery analysis by some researchers in the study of Commercial 18650-Format Lithium-Ion Battery Cells. (Muenzel, et al., 2015)**.** The constant load method used in this design involves putting a load across the battery of constant resistance and measuring the power dissipated as a ratio of the square of battery voltage to the resistance applied at a specific and constant time interval.

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Onwuka, et al., (2018). **DESIGN AND IMPLEMENTATION OF A COMPUTERISED BATTERY ANALYSER.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

The accuracy of the constant load method can be affected by the interval chosen and the measurement accuracy of the voltage across the battery terminals. Although there has been recent studies on new methods to determine battery capacity, one of which is the pulse discharge test (Zoe Carlin & Joern Tinnemeyer, 2008) and another being the two pulse load test (Coleman, Hurley, & Lee, 2008), these do not render the traditional discharge method obsolete since the accuracy of most of these new methods heavily rely on battery history.

During battery analysis various technical specifications are calculated, these include; Cut-off Voltage, Nominal Capacity (Ah for a specific C-rate), Energy (Wh for specific C rate), Cycle Life, Specific Energy (Wh/kg) and Energy Density (Wh/L). The specification usually gotten from battery analysers is the Energy, Cut-off Voltage and Nominal Capacity (MIT Electric Vehicle Team, 2008).

An Arduino board was used in this work to design a battery analyser for testing a locally made rechargeable battery. Arduino is an open-source electronics platform based on easy-to-use hardware and software. It is put together by a computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world (Arduino - Introduction).

The analysis of battery using microcontroller device requires an analogue to digital converter (ADC) to take analogue readings of voltage and current dissipated from the battery for a specific time and calculate the power dissipated in that time period. The cumulative dissipated power over a given period of time gives the basis for a technical specification for the battery. The accuracy is dependent on the resolution (number of bits) of the ADC in the microcontroller device. The Arduino UNO Unit uses the ATmega328/P microcontroller device with an 8-channel and 6-channel 10-bit ADC. A Computerised battery analyser is simply a battery analyser whose readings are computed with a micro computer application after the battery analyser device has taken the required measurements over time. The communication between the battery analyser device and the computer application is made using a protocol known only to the battery analyser manufacturerxc and is embedded in the driver for the analyser hardware. In this work a customized computerised battery analyser with good measurement accuracy was implemented using Arduino.

Materials and Methods

This design was done such that battery analysis will be carried out using constant load discharge method while measuring the current, voltage and power consumption. The main units include, Arduino UNO R3 unit, relay unit comprising four loads of 5.6 ohms, 10 ohms, 20 ohms, and 40 ohms and a display unit that can be used instead of the computer application (i.e., for a manual operation). The complete circuit diagram for the device is shown in Fig 1.

The microcontroller was programmed using the algorithm presented in the flowchart of Fig 2. A desktop application was developed using C# programming language to communicate with the serial interface as that of the microcontroller used at a baud rate of 9600 MHz. The functions of the desktop application are to detect the battery analyser, detect a battery being plugged to the device and also control the measurement time of the device. The desktop application gets readings of current, voltage, power dissipated and temperature and logs the observed values. At the end of data logging the application has an option to compute the rating of the battery measured with regards to the measurement time (if the user desires it). This computation is done internally using equation (1). The application also generates a graph of voltage and current against time and another graph of power against time. Values computed by the application are; milli-Ampere rating of battery, cut-off voltage, Nominal voltage, energy dissipated and maximum temperature observed. All of these are shown in the software interface of Fig 3. These are basic specifications with which a newly made battery can be characterized. These measurements give the battery an identity.

$$\frac{Total\ Power\ Dissipated \times measurement\ interval\ (in\ hours)}{Nominal\ Voltage\ of\ Battery} \quad (1)$$

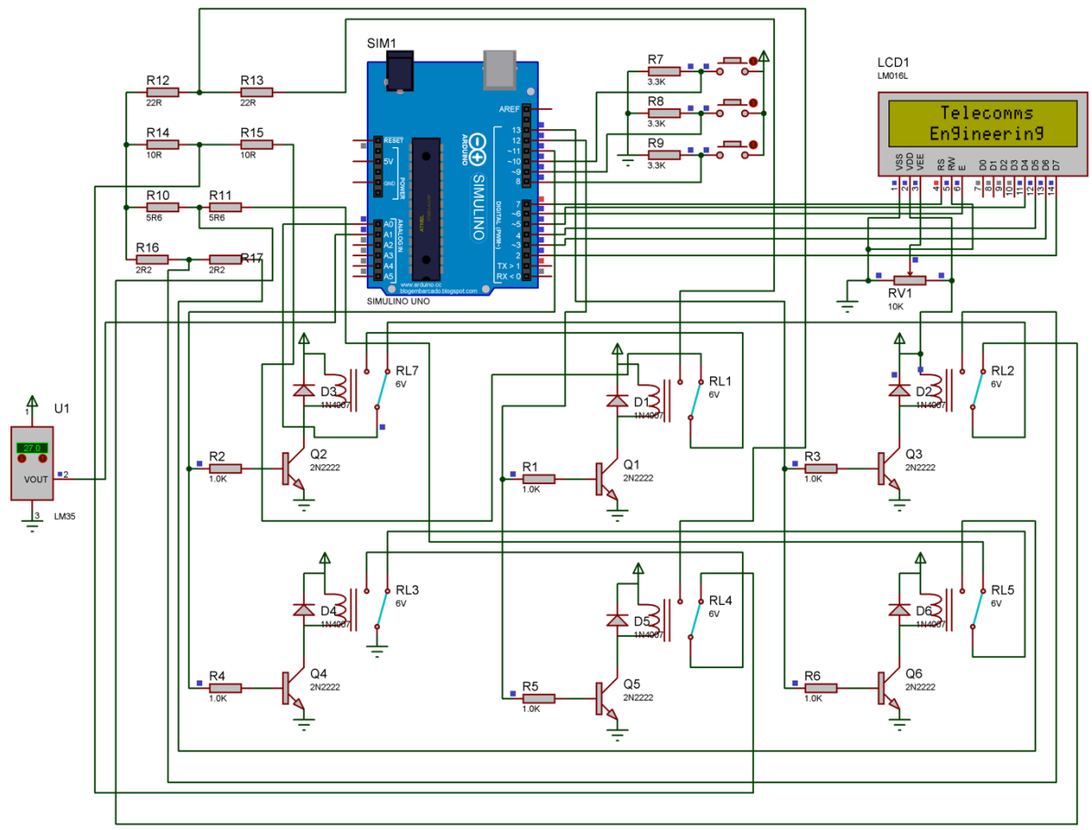

Fig 1: Circuit diagram of the battery analyser

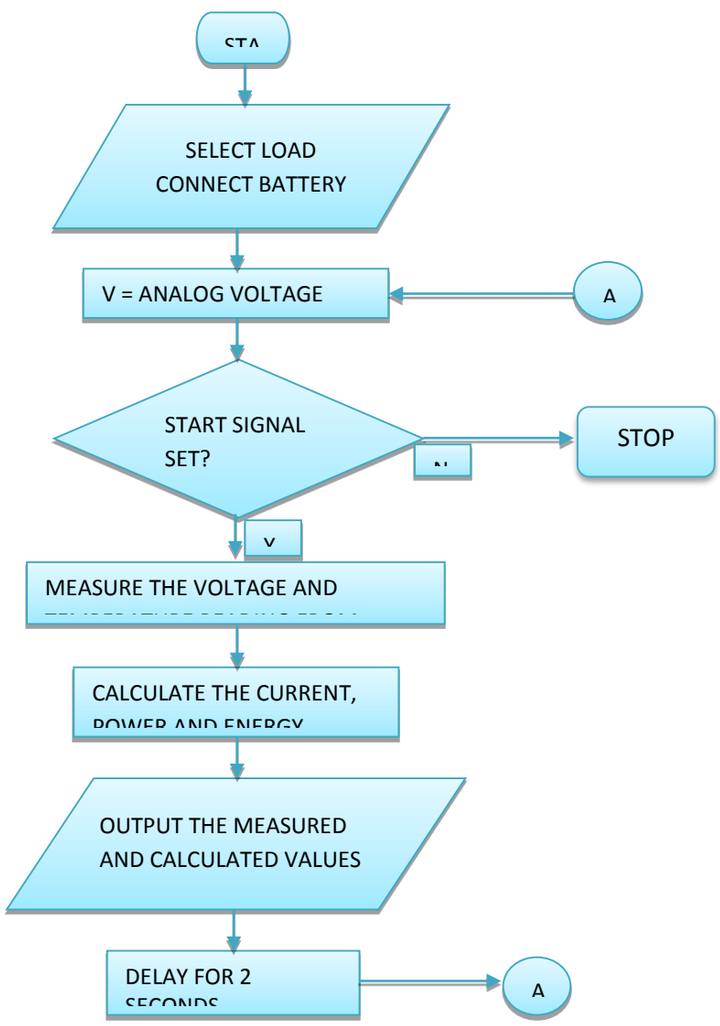

Figure 2: Microcontroller programming algorithm

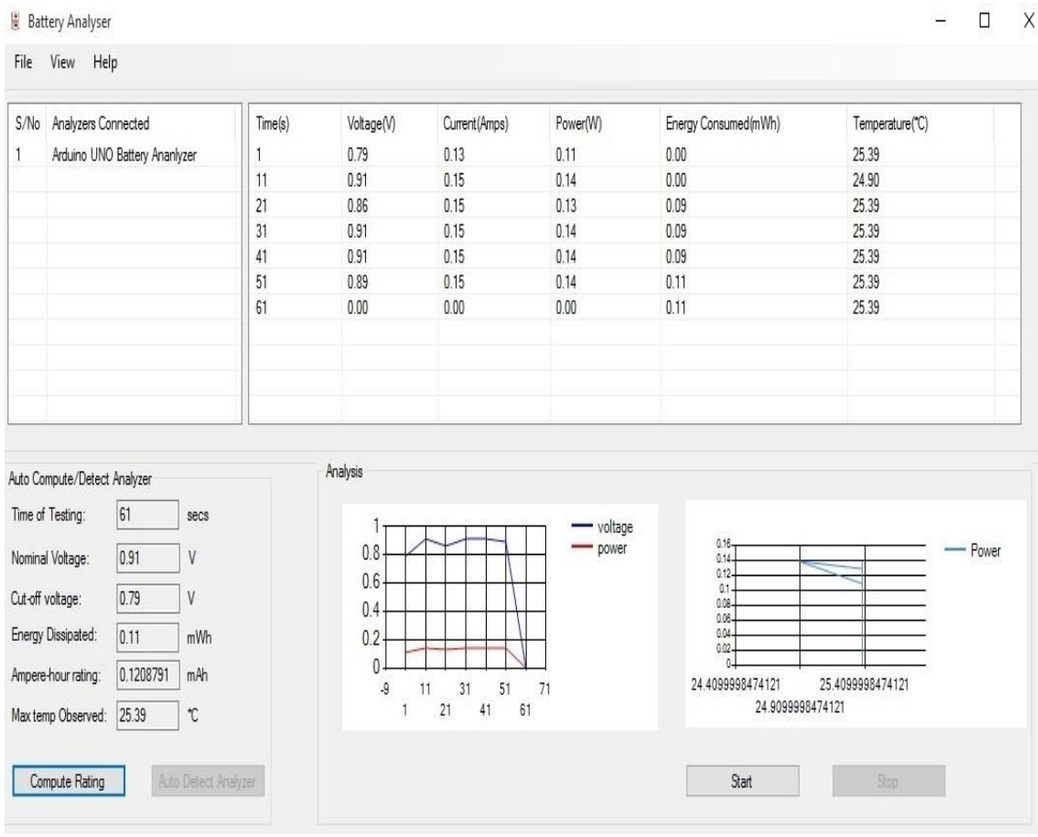

Figure 0: Battery Analyser Software Interface

Results and Discussion

The designed computerised battery analyser was used to analyse a standard Zinc-Carbon AA battery (Tiger Battery, Type R-6 UM-3) with known specifications. Table 1 shows the known characteristics of the Zinc-Carbon AA battery. The open circuit voltage is 1.5volts, the terminal voltage is 1.19 volts, the ampere-hour rating is between 250-900mAh and these values depends on the C-rate or the load connected to the battery.

The results obtained from using the designed computerised battery analyser to analyse the same Zinc-Carbon AA battery is shown in Table 2. The terminal voltage is 1.19volts and the ampere-hour rating gotten was 268mAh at a constant discharge load of 5.6ohms. The discharge curve as obtained from the computerised battery analyser is shown in Figure 4.

Table 1: Known characteristics of the Zinc-Carbon AA battery

Tested (Known) Characteristics	Value
Open circuit voltage	1.5 volts
Terminal voltage	1.19volts
Cut-off voltage (recommended)	Not required for primary cell
Ampere-hour rating	250 – 900mAh
Operating temperature	23ºC – 27ºC
Charging output (recommended)	Non – Rechargeable

Table 2: Characteristics obtained with the constructed battery analyser for the same Zinc-Carbon AA battery

Calculated Characteristics	Value
Open circuit voltage	1.5 volts
Terminal voltage	1.19volts
Cut-off voltage (recommended)	Not required for primary cell
Measurement interval	10seconds
Total discharge time	330 minutes (5.5 hrs)
Total power dissipated	115.1664Watts
Watt hour rating	0.319907Wh
Ampere-hour rating	268mAh

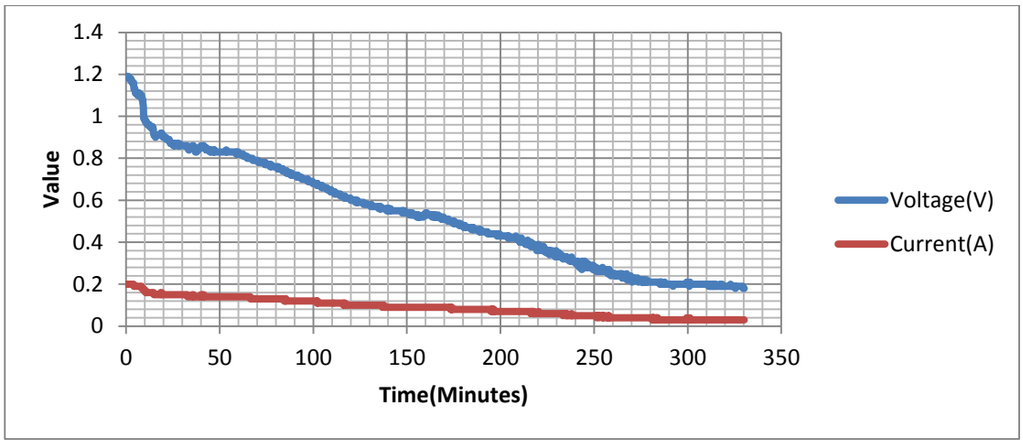

Figure 4: Discharge curve for Zinc-Carbon battery with battery analyser

For the battery whose characteristics is shown above the following calculations were carried out internally by the computerised battery analyser and displayed as the mAh rating of the battery:

$$Total\ power\ dissipated = 115.1664\ Watts$$

$$Watthour\ rating\ of\ cell = \frac{115.1664 \times 10}{3600} = 0.319907Wh$$

$$Amperehour\ rating\ of\ cell = \frac{0.319907}{1.19} = 0.26883Ah = 268.3mAh$$

This result means that the battery analyser presented in this work can be used to characterize any newly manufactured battery to a good degree of accuracy. Moreover, it is very convenient and user friendly since it provides a graphical user interface, which enables a user to observe the measurement process. It does not only perform the calculations to determine the capacity of a battery it also automatically generates the discharge curve via the PC software.

CONCLUSION

In this work, a computerised battery analyser was designed and implemented. The major aim is to design an indigenous, low cost battery testing device that can support battery R&D locally. The battery analyser was designed using the method of discharge with constant load. It takes and logs measurements at very short intervals and was used to characterize a battery of known characteristics with a good level of precision. Thus this design methodology can be further applied to mass produce an affordable computerised battery analyser in Nigeria to aid R&D in the areas of high capacity batteries for mobile devices.

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INNOVATIVE INFRASTRUCTURE DEVELOPMENT

EFFECTS OF INFRASTRUCTURE PROVISION ON RESIDENTS OF SELECTED PRIVATE AND PUBLIC HOUSING ESTATES IN LOKOJA METROPOLIS, NIGERIA

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Provision of adequate infrastructure and housing is one of the most intricate problems facing developing countries. It has been noticed that infrastructure provision in some of the housing estate are done in piecemeal by individual house owners in the study area thereby increasing the cost of housing maintenance and infrastructure provision. This paper assessed Infrastructures provision in Public and Private Housing Estates in Lokoja. Two private's owned housing estates and two housing estates owned by the government were sampled with a total of 877 houses which serves as sample unit and 267 sample size considered. The systematic random technique is employed for data collection at 5 buildings interval using a structured questionnaire to acquire data on the effect of non-provision of infrastructures before construction, condition and maintenance of these infrastructures and user satisfaction. Findings revealed that there is high cost implication of piecemeal provision and maintenance on the part of the occupiers. There should be adequate provision of infrastructures within a neighbourhood to ensure comfortable and convenient living; and construction process should be followed by the developer in order to produce sustainable housing.

Keywords: Infrastructure, housing development

INTRODUCTION

The provision of infrastructures like roads, drainage networks, electricity, potable water supply and good waste management system increases the liveability of the neighbourhood and goes a long way in reducing the cost of housing development and maintenance. The provision of urban housing infrastructure in piecemeal is a major contributor to sub-standard housing development, sprawling and increase housing development and maintenance cost. Holistic provision of infrastructure guides development in more efficient and equitable manner. Hence, help to reduce per capita cost of infrastructure development which is the major constraints to infrastructure development. (Frank, 2003).

Provision of adequate infrastructure and housing is one of the most intricate problems facing developing countries. Adequate provision of infrastructure is the bedrock of housing development, hence should be treated integrally (Otegbulu, et al, 2008). Rapid urbanization and population growth in urban area especially in Lokoja is a major contributor to fast growing housing demand in Nigeria. World Bank (2013) estimated Housing deficit in Nigeria to be about 17million units, which has invariably led to the concerted effort by both the private and public sector effort in housing estate development. In recent time, several housing estates have been developed across Lokoja metropolis in other to make house available for every one by both the public and private sector housing developers. This paper examines the level of infrastructure provision in four housing estates developed by private and public developers in Lokoja metropolis and the social, environmental and economic effects on the inhabitants.

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Urban areas in developing countries have continued to witness rapid growth in population, and despite the importance of infrastructure in socio-economic and physical development of individual and communities as well as the effort of various governments in addressing the issue, the problem is still escalating. Larger percentage of citizens in sub-Saharan Africa, part of Asia and Latin America have no access to basic amenities such as durable roads, education, healthcare, drainage, electricity and potable water supply (DFID, 2004; Ndulu et al., 2005). Infrastructure is regarded as one of the basic facilities and systems that carry a country, city or a neighbourhood as the case may be; it includes the services and facilities necessary for cities to function economically and socially (Frank. 2003). Infrastructure may include roads, bridges, sewer, electricity, water supply, telecommunication, schools and more. Nubi (2003) defined infrastructure as "the physical components of interrelated systems providing commodities and services essential to enable, sustained, or enhanced societal living conditions. According to Pritika and Piyush (2012), housing and basic infrastructure plays a vital role in providing an enabling environment or the overall development and urbanization and all municipal attempts to provide better housing and basic infrastructure for its residents through policies and enabling conditions. Ajibola et al., (2013) identified that where urban infrastructure is adequately provided and efficiently managed, productive and profitable land uses are usually attracted towards such area.

RESEARCH METHOD AND STUDY AREA

The four estates under study are located in Lokoja, Kogi State. Lokoja the study area lies on longitude $7^0$30 and $8^0$00 North and latitude $6^0$30 and $7^0$00 East and bounded by the Federal Capital Territory, Niger State, Plateau State to the North; Benue State to the East; Ondo, Enugu, Edo, Anambra State to the South; and Kwara State to the West.

Dillman and Salant 2007 sample size formulae was adopted

Table 1.0: Selected Housing Estate in Lokoja Metropolis

S/No	Name	Number of Houses	Proportion	Number of Questionnaire
1	500 housing estate	252	28.6%	77
2	Otokiti Housing Estate	253	28.6%	77
3	Civil Defense Housing Estate	100	14.2%	30
4	Flood Housing Estate	272	28.6%	83
	Total	**877**	**100**	**267**

Source: Authors Computation (2017)

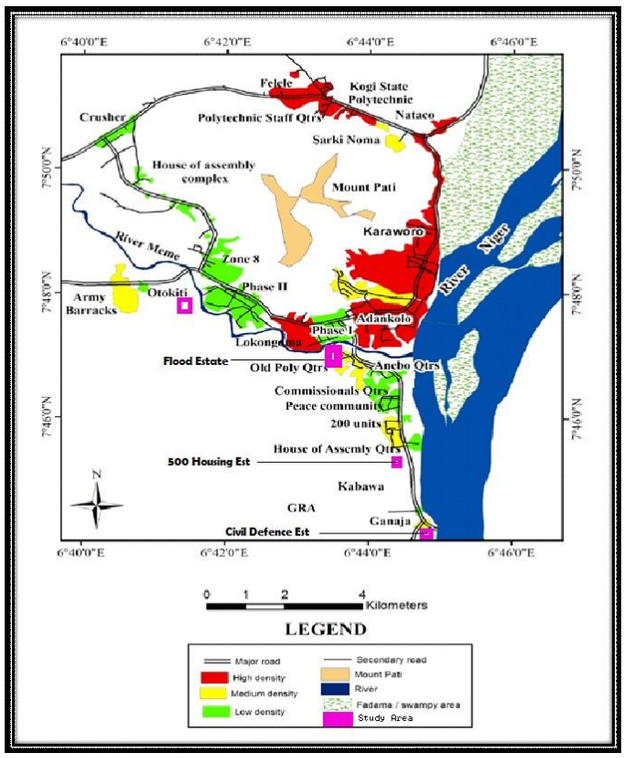

Figure 1. 1 Map of Lokoja showing surrounding settlement and Study area
Source: Pascal (2005)

RESULTS AND DISCUSSION

Availability of Neighbourhood Infrastructure

The neighbourhood facilities provided in the estates were presented in the Table. The findings revealed that water, electricity and access road are available in all the housing estates; all the housing estate are connected to public electricity grid, accessible by either paved or unpaved road, and have access to public water source (pipe borne), except for Civil defence estate which has private bore holes as alternative water supply source.

In the public housing estates, drainage lines are well defined, while in the private housing estate only Civil defence estate has well defined drainage line. Schools are also available within the public housing (Otokiti and 500) estates, while there is no record of schools (Table 1). Street light is only available at Civil defence housing estate; availability of security post is also observed in civil defence and Otokiti housing estate, while others have no record of security (private/public). Primary healthcare facilities or amenities are not available within any of the estate; it is also observed that only Otokiti housing estate has provision for open space and children playground. The infrastructure availability index shows that Otokiti housing estate (Public) performed better (0.78) than other housing estates to rank first. Civil defence housing estate had an availability index of 0.67 to rank second, while 500 housing estate ranked third with availability index of 0.56. Flood housing estate performed poorly with availability index of 0.33 to rank 4th among other estates examined.

Conditions of Available Infrastructures in the Estates

The condition of the available infrastructures in the study area was evaluated and computed for each of the infrastructures across the estates. The condition of the various infrastructures and amenities was evaluated using 5 scale Likert table. Where five implies very good, while one implies very poor. The result is presented in the sections below.

Table 2 shows the condition of road in the estates. The result shows that the general condition of road in all the estates is poor (2.29). This trend is also observed in each of the selected estate. Otokiti recorded the highest condition index of 2.60, which implies that the road condition in Otokiti housing estates is relatively fair. All other estates have poor road condition; 500 housing estate recorded condition index of 2.29, Civil defence 2.20, Flood housing estates 2.07. Generally, the condition of road is better in the public estates (2.44) than the private housing estates (2.14); although the general condition is poor.

Table 1: Available Infrastructures and Amenities in the Estates

Estates	Public Water	Electricity	Drainage	Road	Healthcare	Waste	Street Light	Security	Open Space/Recreation	A.I	Rank
	Private Housing Estate										
Civil Defence	1	1	1	1	0	0	1	1	0	0.67	2nd
Flood Housing	1	1	0	1	0	0	0	0	0	0.33	4th
Sub-Total	**Public Housing Estate**								**Sub-Total**	**0.50**	
Otokiti	1	1	1	1	0	1	0	1	1	0.78	1st
Ganaja 500 Housing	1	1	1	1	0	1	0	0	0	0.56	3rd
									Sub-Total	**0.67**	
									Total	**0.62**	

Source: Authors Fieldwork (2017)

Table 2: Road Condition

Type	Estates	VG	G	F	P	VP	Mean/Rank
Public	Otokiti	0 (0%)	2 (3%)	50 (65%)	17 (22%)	8 (10%)	2.60 (1st)
	500 Housing	0 (0%)	12 (16%)	11 (14%)	41 (53%)	13 (17%)	2.29 (2nd)
	Sub-Total						**2.44**
Private	Civil Defence	0 (0%)	0 (0%)	12 (40%)	12 (40%)	6 (20%)	2.20 (3rd)
	Flood Housing	0 (0%)	0 (0%)	12 (14%)	65 (78%)	6 (7%)	2.07 (4th)
	Sub-Total						**2.14**
Total							**2.29**

Source: Authors Fieldwork (2017)

Key: 0-1.49=Very poor; 1.50-2.49=Poor; 2.50-3.49=Fair; 3.50-4.49=Good; 4.50-500=Very Good

Condition of Water Infrastructure and Amenities in the Estates

Furthermore, the condition of water infrastructures and amenities in the housing estates was also assessed and the result is presented in Table 3. The result as presented in Table 4.8 reveals that 500 housing estate recorded the best condition index of 3.52; this implies that water infrastructures and amenities in the estates is in good condition. This was followed by Flood estate 3.33 and Otokiti housing estate 3.03; the condition of water infrastructures and amenities in the Flood and Otokiti housing estate is fair. The least condition index of water infrastructures and amenities is recorded in Civil defence estate (2.27). The general condition of water infrastructures and amenities in the housing estate is fair (3.04), similar trend is recorded in the private (2.80) and public housing estate (3.27).

Condition of Drainage lines in the Housing Estates

The condition of drainage lines within the estates varies significantly. The conditions of the drainage within the housing estates are presented in Table 4. Otokiti housing estates recorded the highest condition index of 3.01; this implies that the condition of drainage within Otokiti housing estate is fair.

Table 3: Condition of Water Infrastructure and Amenities in the Estates

Type	Estates	**VG**	**G**	**F**	**P**	**VP**	Mean/Rank
Public	Otokiti	8 (10%)	6 (8%)	45 (58%)	12 (16%)	10 (13%)	3.03 (3rd)
	500 Housing	32 (42%)	6 (8%)	18 (23%)	12 (16%)	9 (12%)	3.52 (1st)
	Sub-Total						**3.27**
Private	Civil Defence	1 (3%)	2 (7%)	8 (27%)	12 (40%)	7 (23%)	2.27 (4th)
	Flood Housing	15 (18%)	22 (27%)	30 (36%)	7 (8%)	9 (11%)	3.33 (2nd)
	Sub-Total						**2.80**
Total							**3.04**

Source: Authors Fieldwork (2017)

Key: 0-1.49=Very poor; 1.50-2.49=Poor; 2.50-3.49=Fair; 3.50-4.49=Good; 4.50-500=Very Good

The condition of drainage in Ganaja 500 housing estates is also fair (2.57). However, in Civil defence and Food housing estates (private housing estate), the condition of the drainage is poor as they record condition index of 2.03 and 1.76 respectively. This is also evident in the general condition of the public (2.79) and private (1.90) housing estate. The general condition of drainage in the housing estate is poor (2.36). The poor condition of drainage may be the result of seasonal flood experienced within some of the estates.

Table 4: Condition of Drainage lines in the Housing Estates

Type	Estates	**VG**	**G**	**F**	**P**	**VP**	Mean/Rank
Public	Otokiti	9 (12%)	12 (16%)	33 (43%)	17(22%)	6 (8%)	3.01 (1st)
	500 Housing	9 (12%)	6 (8%)	17 (22%)	33 (43%)	12 (16%)	2.57 (2nd)
	Sub-Total						**2.79**
Private	Civil Defence	0 (0%)	0 (0%)	7 (23%)	17 (57%)	6 (20%)	2.03 (3rd)
	Flood Housing	0 (0%)	0 (0%)	0 (0%)	63 (76%)	20 (24%)	1.76 (4th)
	Sub-Total						**1.90**
Total							**2.35**

Source: Authors Fieldwork (2017)

Key: 0-1.49=Very poor; 1.50-2.49=Poor; 2.50-3.49=Fair; 3.50-4.49=Good; 4.50-500=Very Good

Condition of Waste in the Housing Estates

Table 5 presents the findings for waste collection and disposal infrastructures in the estates, reconnaissance survey was carried out revealed that there is no designated provision for waste collection and disposal in all the four estate studied. Due to the non-provision of waste collection and disposal infrastructures in the study areas, there were indiscriminate disposal of solid waste.

Table 5: School Condition

Type	Estates	**VG**	**G**	**F**	**P**	**VP**	Mean/Rank
Public	Otokiti	19 (25%)	15 (19%)	3 (4%)	33 (43%)	7 (9%)	3.08
	500 Housing	22 (29%)	12 (16%)	7 (9%)	25 (32%)	11 (14%)	3.12
	Sub-Total						**3.10**
Private	Civil Defence	0 (0%)	2 (7%)	0 (0%)	21 (70%)	7 (23%)	1.90
	Flood Housing	0 (0%)	2 (2%)	16 (19%)	22 (27%)	43 (52%)	1.72
	Sub-Total						**1.81**
Total							

Source: Authors Fieldwork (2017)

Key: 0-1.49=Very poor; 1.50-2.49=Poor; 2.50-3.49=Fair; 3.50-4.49=Good; 4.50-500=Very Good

Effects Experienced by Residents in the Estates

Types of impact experienced as a result of inadequate or poor provision of infrastructures were examined. The impacts were classified into three, environmental, economic and social impact. The result as presented in Figure 1 shows that the largest proportion of the respondents from Otokiti (100%) and Flood housing estate (100%) experience economic impact. For economic impact, the largest proportion is recorded in Flood housing estate and Otokiti, while the least proportion of respondents that experience economic impact is recorded in 500 housing estates (67%). Social impact is more experienced at 500 housing estate (93%) and Flood housing estate (100%).

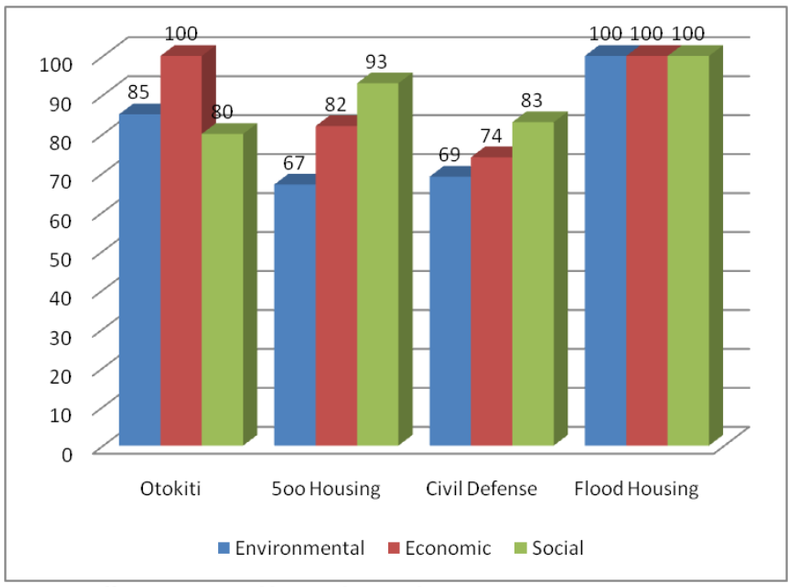

Figure 1: Effects Experienced by Residents in the Estates
Source: Authors Fieldwork (2017)

Extent of Environmental Effect of Inadequate Provision of Infrastructure

Respondents were asked to rate the extent to which inadequate provision of infrastructure and amenities impact on them. The rating was based on a 5 scale likert table; and the result is presented in Table 6. The result shows the mean impact value recorded for each of the identified environmental impact. It was observed that 500 housing estate recorded the highest mean impact value of 3.52; which implies that residents experience high effect of inadequate or lack of provision of basic infrastructures amenity. The environmental effect of inadequate provision of infrastructures experienced by residents from other housing estates is fair; Otokiti 3.28, Flood 3.26, and Civil defence housing estate 3.02. Flood housing estate experience the highest level of environmental pollution, while erosion and flash flood is more experienced in Otokiti housing estate. Flood housing estate had the highest mean impact value for indiscriminate waste disposal (4.05) and open defecation (3.61).

Table 6: Environmental Effect of Inadequate Provision of Infrastructure

Environmental Effect	**Otokiti**	**500**	**Civil**	**Flood**
Environmental –Pollution	3.25	3.46	3.09	3.51
Erosion	3.80	3.56	3.41	3.75
Flood	2.74	3.72	2.20	1.39
Indiscriminate waste disposal	3.95	3.87	3.93	4.05
Open Defecation	2.64	3.00	2.48	3.61
Overall	**3.28**	**3.52**	**3.02**	**3.26**

Source: Authors Field Work (2017)

Extent of Economic Effect of Inadequate Provision of Infrastructure

The study also assesses the extent of economic effects experienced by residents as a result of non-provision or inadequate of provision of basic infrastructures and amenities. The result of the analysis is presented in Table 7. The result shows that residents from Flood housing estate experience more economic effect of inadequate provision of infrastructure than other housing estates. Flood housing estates recorded a mean impact value of 3.77; which implies high economic effects. It was also revealed that residents from Otokiti housing estate and 500 housing estate experience high economic effects of inadequate provision of infrastructures as they record a mean impact value of 3.54 and 3.64 respectively. The economic effect experienced by residents of Civil defence housing estate is fair, with a mean impact value of 3.49. Generally, it can be observed that most residents experience high economic effects as a result of non-provision of infrastructures and amenities. Flood estate has the high mean impact value in all economic effects identified except for increased cost of infrastructure provision; reduced standard of living 4.02, increased cost of living 3.75, and additional cost of maintenance 3.84,

Table 7: Extent of Economic Effect of Inadequate Provision of Infrastructure

Economic Effect	Otokiti	500	Civil	Flood
Reduce Standard of living	3.62	3.71	3.53	4.02
Increased cost of living	3.68	3.65	3.14	3.75
Additional cost for maintenance	3.51	3.72	3.62	3.84
Increase cost of infrastructure provision	3.34	3.48	3.67	3.45
Overall	**3.54**	**3.64**	**3.49**	**3.77**

Extent of Social Effects of Inadequate Provision of Infrastructure

Furthermore, the study also assessed the level and extent of social effects of inadequate or non-provision of infrastructures experienced by residents of the housing estates. The result as presented in Table 8 shows that Flood estate and 500 housing estate experience high social effects of inadequate provision of infrastructures and basic amenities. Flood estates recorded a mean impact value of 3.88, followed by 500 housing Estate with a mean impact value of 3.53. The result also shows that Otokiti and Civil defence housing estate experience a fair social effect of inadequate or lack of provision of infrastructures with a mean impact value of 3.48 and 3.44 respectively. Deterioration of building had the highest mean impact value of 4.21, followed by increased crime rate with a mean impact value of 4.14 in Flood housing estate, while the least is conflict 2.63 recorded in Civil defence housing estate.

Table 8: Social Effects of Inadequate Provision of Infrastructure

Social Effects	Otokiti	500	Civil	Flood
Increase crime rate	3.53	3.57	3.42	4.14
Discourage recreation	3.86	3.74	3.81	3.88
Conflict	2.74	2.85	2.63	3.18
Aesthetics	3.59	3.61	3.74	3.98
Aids deterioration of building	3.67	3.88	3.62	4.21
Overall	**3.48**	**3.53**	**3.44**	**3.88**

Source: Authors Fieldwork (2017)

Analysis of Variance (ANOVA) was employed as analytical tool to test the study hypothesis "There is no statistically significant difference in infrastructure provision between the public and private housing estates". The ANOVA test records an F-statistics of 0.705 and a p-value of 0.490. This implies that there is no statically significant variation in the provision of infrastructures between the public and private housing estates in Lokoja. The p-value recorded is greater than 0.05, hence the null hypothesis is accepted, while the alternative hypothesis is rejected.

Table 4.17: Hypothesis Test

ANOVA

Cases	Sum of Squares	df	Mean Square	F	p
Group	0.029	1	0.029	0.705	0.490
Residual	0.082	2	0.041		

Note. Type III Sum of Squares

Source: Author's Fieldwork (2017)

CONCLUSION

Housing has been noted by many researchers as more than shelter, the diverse function of housing due to diverse components and supporting facilities make it a basket of services. Zubairu (2002) concluded that having a shelter over one's head does not constitute access to adequate housing, rather adequate housing means housing that has the following attributes: decency, security, privacy, spacious, healthy, affordable, legally secured tenure, habitable, accessible, and appropriately located with services and infrastructure.

RECOMMENDATIONS

Infrastructures provisions in the study area were found out to be inadequate, with detrimental effect on the occupants of the estate. The following recommendation were proffered to have rightful turnaround in housing development in Nigeria towards making housing full of goods and services that is worthy of high satisfactory level for the people:

1. Monitoring of developers: The ministry of works, housing and urban development should be empowered to carry out their duties especially monitoring of development activities towards ensuring compliance to standards and best practices in infrastructures provisions in housing development.

2. A viable housing project needs to be based on a clear definition of the target group. They can be workers in the public and private sector or individual people operating in the private sector. The type and density of development are taken into consideration to ensure affordability of the houses to the target clients;
3. Site and services: The design and development of the required infrastructure facilities and services should be carried out ahead of the construction of the houses. In fat each plot should be provided with water, power and telephone sources before the actual construction starts. This is such that as soon as the construction of each house is completed, the house owner can be able to move into it after the utility providing Agencies have connected the house to the mains;

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RESILIENT HOUSING DEVELOPMENT

STUDY OF RESIDENTS' SATISFACTION WITH HOUSING CONDITIONS IN URBAN CENTRES OF SOUTHWEST NIGERIA

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The study examined residents' satisfaction and housing parameters across some urban centres of southwest Nigeria. Three urban centres were selected based on the dialectical composition of the zone as found in the literature. Principal Component Analysis extracted three components from the 38 satisfaction and housing variables used. Component 1, 2 and 3 account for 29%, 23% and 8% respectively. Component 1 represents resident social environment, component 2 represents residents' neighbourhood facilities and component 3 represents the physical characteristics of the housing in the study area.Descriminant analysis was conducted on these variables and the result shows three distinct regions of slightly different housing satisfaction level with south subzone (Abeokuta) highest, Northwest (Ibadan) high and Southeast (Akure) low in the housing satisfaction scale loaded. The study shows that residents' neighbourhood facilities and social environment are the basic and most important factors for determining the success of housing in meeting up with the objectives of the residents in southwest Nigeria. In the light of this neighbourhood planning approach and effective distribution of social facilities, according to socioeconomic status of residents should be given preference in the built environment of this region for urban resilience and satisfactory housing conditions in southwest Nigeria.

Keywords: Housing Condition; Neighbourhood; Resident Satisfaction; Urban centre; Environment

INTRODUCTION

Residentsatisfaction can be described as the degree to which residents feel that their housing meet their desired expectations(Jiboye, 2011).Resident satisfaction is complex, multifaceted and multidimensional measure of quality housing (Berk, 2005; Foley, 1980). Thestudies with housing quality cannot not be exhausted because housing inevitably contributes to the quality of lives and the inhabitants' social and economic needs keep evolving with time(Lepkova, 2016).Housing is a barometer for measuring the standard of living, level of technological advancement, culture and civilisation of a given urban milieu (Abdul and Hashim, 2015). The problem of quantitative and qualitative housing has long been identified with Nigeria urban housing (Fatima and Kawu, 2011; Morenikeji *et al.*, 2017).In recent times, there has been an emerging necessity to improve the degree of urban resident satisfaction through the production of quality housing.The problem of quality housing is more pronounced in urban areas due to a series of deprivations, congestions, poor housing conditions and overcrowding brought about by population growth. Urban population from natural growth, rural-urban and urban-urban migrations have its consequential effects on the housing deficit (Adedayo, 2011). Urbanhousing supply could not meet the demand of the teeming population. This over stresses the existing housing and create deteriorate poor living conditions to the dwellers.

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Several studies on different aspects of resident satisfaction with housing conditions and quality have been conducted (Olotuah and Bobadoye, 2009; Jiboye, 2009; Oduwaye *et al.*, 2011; Olotuah, 2015; Abdul and Hashim, 2015). Most of these studies were focused on sample survey on housing quality at a small area of coverage. Besides, the majority of these studies were directed at public housing where interest is geared toward the absence of user's input in the design of the housing scheme thereby leading to all forms of modifications. Morenikeji *et al,* (2017) conducted a similar study at national scale on spatial distribution of housing quality in Nigeria. The result of the study shows a sharp difference in the quality of housing distribution among the three distinct regions of Nigeria. The study also observed that it is grossly inadequate to use small sample survey for an in-depth understanding of housing quality requirements at larger scale. There is a need for understanding the quality of housing requirements at regional scale. Enough attentions have not been given to residents' satisfaction with privately owned housing at local and regional scale despite its diversity in housing typology and its far reaching contributions to urban housing supply in Nigeria. The study hypothesised that urban centres located in each sub-zones of southwest Nigeria (Northwest, south and southeast) will exhibit similar qualities of housing characteristics and will be distinctly different from the other sub-zones in the region. Therefore, there is a need to examine the residents' satisfaction characteristics with housing conditions in the urban centres of southwest Nigeria with a view to identifying the factors responsible for housing quality variations across the region for both policy makers and all professionals in the building industry in pursuance of housing satisfaction in the urban centres of southwest Nigeria.

LITERATURE REVIEW

The importance of housing to the well-being and general human development underscores the reason for studying different aspects of housing quality. As an important life component, housing provides shelter, safety, dignity and delight in addition to providing a place of rest (Hablemitoglu, *et al.,* 2010; Henilane, 2016). Housing is an essential indicator of living standard of the urban population (Abdul & Hashim 2015).In recent times, housing has to be comfortable, pleasant, economical, maintainable and architecturally expressive in addition to comform with the neighbourhood environment (Henilane, 2015a). This points to the fact that quality housing is far beyond the general assessment of the physical and structural adequacy of the housing units.Housing satisfaction is acomplex, multifaceted and multidimensional measure of Housing quality (Berk, 2005; Foley, 1980). The multidimensional nature of the problem accounts for the interdisciplinary approaches to the housing discussion (Foley, 1980).

The concept of housing satisfaction relates to how a resident reacts to the overall adequacy of housing as it meets their expectations (Waziri *et al*.,2014).Housing satisfaction is the degree to which inhabitants feel that their housing is helping them to achieve their housing goals (Jiboye, 2012). Housing satisfaction examines characteristics of the users and that of the neighbourhood environment (Amerigo and Aragones, 1997).Housing satisfaction could be used toexamine the characteristics of the residents, considersthe satisfaction as a predictor of the residents' reaction to the existing situation towards making changes to the existing house or move to another housing with more facilities that meet their current housing needs and preferences (Mohit and Azim 2010).In addition, it could measure housing quality by examining the physical characteristics of the housing unit, housing facilities, infrastructure and housing neighbourhoodenvironment (Jiboye, 2009; Mohit and Azim, 2012). Housing satisfaction is said to be an equilibrium situation between housing conditions and housing anticipated (Salleh, 2008).

Some studies on housing satisfaction concentrates on physical characteristics of the housing unit. For instance Galster (1987) measured housing well-being using a satisfaction with the housing unitfacilities like number of rooms per occupants, private toilet and kitchen.On the other hand Varady and Carrozza (2000) observe that housing satisfaction is related tothe dwelling unit, services provided, the housing environment, and the location of the facility within the house.Mohit and Azim (2012) studied residential satisfaction with public housing in Hulhumale, Maldives by assessing the level of satisfaction with the public housing unit. The study revealed that the overall levels of satisfaction specific to the Maldives public housing studied are determined by the size and condition of the bedroom, cleanliness of the

surrounding, provision of electrical and mechanical services, conditions of washing and drying areas.

Jiboye (2009) examined tenant satisfaction with public housing in Lagos, Nigeria. The study employed dwelling unit features, housing area environment and the management of housing units. The study discovered that the level of housing satisfaction depends on the physical features of the dwelling units, housing, environment area, and the management of the housing units. The study concluded that the level of satisfaction is also different among the residents of the housing units. In a related study conducted by Jiboye (2014) on determinant of residential quality in Osogbo, Nigeria the study concluded that house-type significantly influence user's perception of residential quality in the study area.

Waziri *et al*., (2014) investigated the influence of socioeconomic status as a predictor of housing satisfaction of the residents in a study conducted on prince and princes housing estate Abuja, Nigeria.The study discovered that employment and income are the major socioeconomic variables predicting housing satisfaction. This findingcorroborates with similar studies by Liu (1999) who observed that household income influence residential satisfaction.This study was also on prototype housing estates designed and constructed for certain categories of users among the urban dwellers.

In a housing survey conducted by Bark (2005) on the occupants' perception of neighbourhood concept in contemporary residential environments, the study discovered among others that concentrations on the physical attributes of dwelling units for housing satisfaction and paying less attention to the neighborhood environment increases feelings of insecurity, social interactions, communal participation and social support of the built environment.Certain types of neighbourhoods are considered more satisfactory than the other due to their physical characteristics(Adriaanse, 2007). The three distinguished residential environment components include neighbourhood, housing unit and the neighbours (Canter and Rees, 1982). The way residents perceive and use their neighbourhood environment is exploited in this study.Empirical studies on quality housing have shown that quality housing due to its complex, multi-faceted and multidimensional is anchored on many factors: housing unit types, housing facilities (toilet, dining and kitchen), the neighbourhood environment(outdoor and parking spaces, security), and the housing area (appearance and size of the building), location of the housing (proximity to transportaion and public facilities) and urban management agency.

This explains why Literature on quality housing abounds and with findings emphasising different objectives and subjective factors of quality housing attributes like physical, social, psychological, management, neighbourhood and demographic characteristic of the residents. These approaches suggest that all subjective and objectiveattributes of quality housing could be used for measuring housing satisfaction depending on the type of data used and the socio-culture of the milieu under investigation.Most of these studies place less emphasis on how residents perceive urban housing management features which is charged with the responsibility of planning, regulating and managing the physical and socioeconomic activities of the urban centres.The urban management aspect of housing quality is the statutory body coordinating all the aforesaid attributes of quality housing without which residents may choose not to comply with any established building standard. Although there seems to be no universally accepted measurement of quality housing characteristics many of the studies have established a basis for measuring quality housing either from subjective or objective parameters.This shows therelevance of a basis for evaluating housing satisfaction of an area as evidenced from these studies examined.

In this regard, little attention has been directed toward the importance of urban management agency in charge of housing administration for ensuring quality housing in a given urban milieu.This study, therefore, focuses on the major quality housing parametersthat variesacross the urban centres ofsouthwest Nigeria for determining acceptable quality housing variables and incorporating these in the urban policyand regulations in the region.

METHODOLOGY

Southwest Nigeria is divided into three sub-zones, namely; Northwest, South, and Southeast (Aremo, 2009). The sub-zone reflects similarity in their dialect (Johnson, 2001). Urban Centre of Ibadan, Abeokuta and Akure respectively, were selected to represent each of the sub-zones of southwest Nigeria. Urban centre selected from each of the sub-zones were

based on population and being an administrative headquarters. The sampled houses were spread across each of the twelve administrative wards in each of the selected urban centres. A questionnaire survey was carried out in these selected urban centres to elicit information on the existing housing conditions in the study area. Two local governments were randomly selected from each of the three selected urban centres. This study employed the use of calculation to arrive at the sample size for the study (Israel,1992). The sample size is presented in Table 1. A total of 784 households were randomly selected out of a total of 313,138 households in the three urban centres. A sample size of 784 households at 95 percent confidence interval with a margin of Error of about ±3. 5% was covered in Southwest Nigeria. A sample size required for population between one million and three hundred million (1 – 300 Million) at 95% confidence interval with a Margin of Error of about ±3. 5% is 784 (Krejcie & Morgan, 1970). Therefore 784 households arrived at as sample size for this study intuitively makes sense.

Table 1: Population and Households Covered in each of the Local Governments.

Urban Centre	Local Govt	2006 Census	2014 Projected Population	Calculated Houses@6 Persons per household	No. of Households Covered	Percentage (%)
Ibadan	Ibadan North	306,795	413,454	68,909	173	22.06
	Ibadan South East	266,046	358,538	59,756	150	19.13
Abeokuta	Abeokuta North	201,329	271,322	45,220	113	14.41
	Abeokuta South	250,278	337,288	56,214	140	17.86
Akure	Akure North	195,200	258,829	43,138	108	13.78
	Akure south	160,081	239,399	39,899	100	12.76
Total		**1,379,729**	**1,878,830**	**313,138**	**784**	**100%**

Source: NPC, 2006 & Author's Projection, 2014

The population in each of the two local government areas was used in the distribution of the 784 questionnaires accordingly. The distribution of the questionnaire shows that 323, 253 and 208 households were covered in Ibadan, Abeokuta and Akure urban centres respectively. A total of 557 was retrieved representing 71% of the sample size. The housing satisfaction variables are grouped into five categories: (a). Physical features of the housing unit; (b). Services within the housing unit; (c). Public facilities in the neighbourhood; (d). Residents' social environment (e). Urban Management Feauture. A five-point Likert scale was used to measure the housing satisfaction on the housing components employed (Table 2.). The data were analysed using both principal components (PCA) and regression analyses of the variables using SPSS version 20.

SN	**Table 2:Housing Quality Constructs Employed in the Study**	Code
	a). Housing unit Physical characteristic	
1	How satisfied are you with the layout of the house?	D1
2	How satisfied are you with the appearance of the house?	D2
3	How satisfied are you with the wall finishes of the house?	D3
4	How satisfied are you with the floor finishes of the house?	D4
5	How satisfied are you with the windows of the house?	D5
6	How satisfied are you with the doors of the house?	D6
7	How satisfied are you with the ceiling material of the house?	D7
8	How satisfied are you with the kitchen conditions of the house?	D8
9	How satisfied are you with the toilet condition of the house?	D9
10	How satisfied are you with the Bedrooms condition of the house?	D10
11	How satisfied are you with the living room conditions of the house	D11
12	How satisfied are you with the Ventilation conditions of the house	D12
13	How satisfied are you with the lightning condition of the house	D13
14	How satisfied are you with the electricity conditions of the house	D14
	b)). Characterstics of services within the housing area	
16	How satisfied are you with the garbage collection conditions of this house	M16
17	How satisfied are you with the staircase condition of the house	M17
18	How satisfied are you with the plumbing work condition of this house	M18
19	How satisfied are you with the corridor/verandah	M19

	c). Public facilities in the neighbourhood	
20	How satisfied are you with the public bus stop in the neighbourhood..	P20
21	How satisfied are you with the open space/playing gound in the neighbourhood.	P21
22	How satisfied are you with the place of worship (mosque/church) in the neighbourhood.	P22
23	How satisfied are you with the schools conditions in the area	P23
24	How satisfied are you with the health centre in the area.	P24
25	How satisfied are you with the markets/shops in in the neighbourhood	P25
26	How satisfied are you with the distance of police station to the housing area	P26
27	How satisfied are you with the location of fire station to the area	P27
	d). Characteristics of residents social environment	
28	How satisfied are you with the familiarisation within the neighbourhood.	E28
29	How satisfied are you with the streets appearance in the neighbourhood	E29
30	How satisfied are you with noise polution in the neighbourhood	E30
31	How satisfied are you with the social composition of the population.	E31
32	How satisfied are you with the level of security within the area	E32
33	How satisfied are you with level of community associations within the area.	E33
	e). Urban Management	
34	How satisfied are you with the level of the neighborhood infrastructure facilities	U34
35	How satisfied are you with the activities of planning and development authority in the area	U35
36	How satisfied are you with the drainage conditions	U36
37	How satisfied are you with the road conditions in the neighbourhood	U37
38	How satisfied are you with the refuse condition in the neighbourhood.	U38

The Study Area

The southwest region lies between Longitude 2º and 6º E and latitudes 6º and 9º N. The region is inhabited traditionally by the Yoruba speaking group of individuals that is made up of Oyo, Osun. Ondo, Ogun, Ekiti and Lagos States (Fig.1.1). The population of the six Yoruba speaking states put together by the 2006 Population census was Twenty Seven Million, Five hundred and Eleven Thousand, nine Hundred and Ninety-two (27,511,992), representing 21% of the country's population.

The Yoruba language in the region has many dialects (Bakare-Yusuf, 2011). The southwest zone has three sub-zones classified according to the major dialects (Aremo, 2009). Figure 1.2 shows the sub-zones, namely; Northwest Yoruba (NWY), South Yoruba (SY) and Southeast Yoruba (SEY) sub-zones. Accordingly, three most populated urban centres, which, also serve as administrative headquarters were selected from each of the sub-zones. Ibadan was selected to represent the Northwest (NWY) sub zone. The Northwest Yoruba (NWY) consists of Oyo, part of Osun and part of Lagos. These are Oyo and Ibolo Yorubas (Johnson, 2001). The South Yoruba (SY) is made of Igbomina, Ekiti, Ijesa, Ife, Akoko in the present day of Osun, Ondo and Ekiti States. The urban centre of Akure was selected for this sub-zone. The Southeast Yoruba (SEY) includes predominantly part of Lagos and Ogun States and Abeokuta was selected from Southeast Yoruba (Fig 1.2). The highest rate of urbanisation is evidenced in the peri-urban neighbourhoods being taken over by major urban centres in the southwest Nigeria.

Figure 1.1: Study Area.
Source: Ministry of Land and Planning, Oyo State (2014).

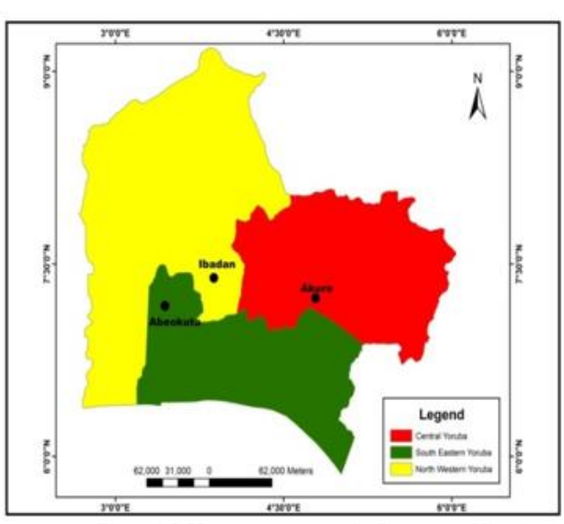

Figure1.2:Yoruba sub-zones in Southwest Nigeria
Source: Aremo, (2009)

Housing characteristics

The assessed housing and neighbourhood environment characteristics employed in the study are shown in Table 2. The quality of housing characteristics employed by Mohit *et al* (2012) and Jiboye (2014) with slight modification to reflect the peculiarity of the study area was adopted. These are: (a). Physical features of the housing unit; (b). Services within the housing unit; (c). Public facilities in the neighbourhood; (d). Facilities in the housing area; (e). Urban Management Agency. A five point Likert scale ranging between '1'= very dissatisfied, '2'=dissatisfied, '3'= Neither satisfied nor dissatisfied, '4'=satisfied and '5'=very satisfied were used to measure the residents' quality housing conditions for southwest Nigeria. Table 2 indicates the list of the housing management and administration characteristics employed in the conduct of the study. The housing management variables are components D1 through D15 and M16 through M19. Housing administration components are P20 through P27, E28 through E33 and U34 through U38.

The suitability or otherwise of the 38 variables of resident satisfaction with the housing conditions survey was carried out. The result is shown in Table 3. The Cronbach's Alpha coefficient of 0.737 indicates that the constructs are a good measure of the study intents. The correlation matrix results revealed strong loading of variables at 0.3 coefficient and above. The correlation of 'how satisfied are you with the layout of the house' with other variables of resident satisfaction with housing conditions was between 0.131 and 0.229. This is low and this was excluded in the further analysis.

Table 3. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.746	.737	38

ANALYSIS AND INTERPRETATIONS OF THE FINDINGS

The result of the field survey was examined by Principal Component Analysis (PCA) with Oblimin rotation. Prior to this operation the suitability of the variables for PCA was verified. The results show that the Kaiser-Meyer-Okin (KMO) value of 0.755 is greater than the recommended value of 0.6 (Pallant, 2013). The Bartlett's Test of Sphericity has the value of chi-squares 1470.832, df, =55; P = 0.000. Which further confirmed the factoribility of the matrix.

Three components with Eigen factor greater than or equal to 1.0 were extracted. Components 1, 2 and 3 account for 29.33%, 23.07% and 8.42% respectively. Table 4 shows the variables that load strongly on each of the components. Components 1 are characterised by items E28 through E31 and E33 in the residents social environment as indicated in bold fonts. Component 2 is characterised by residents' satisfaction with variables P22 through P27 and these variables are the public facilities in the neighbourhood. Component 3 loads on residents' satisfaction with their dwelling places. The first two components account for 52% of the residents' satisfaction characteristics and were adopted for the study analysis. The two components are referred to as ' housing administration' parameters.

The outcome of the PCA described in Table 4 reveal that satisfaction with the social environment and Neighbourhood facilities are the most significant factors in overall housing satisfaction of the southwest zone of Nigeria. Attempt was made to establish which of these two variables dominate the urban centres of the zone. This was done loading the variables of housing satisfaction for each of the urban centres investigated. The result is shown in Table 5. The weighted mean scores for each of the three urban centres revealed that residents' housing satisfaction in the urban centres of southwest region are similar, although it differs slightly in terms of either predominance of social environment or neighbourhood facilities in the urban centres examined.

Table 4: Pattern Matrix of Housing Satisfaction Variables on the Principal Components.

	Component		
	1	2	3
How Satisfied are you with the Layout of the house ?			
How Satisfied are you with the appearance of the house ?			
How Satisfied are you with the wall finishes of the house ?			
How Satisfied are you with the Floor Finishes of the house ?	.320		.441
How Satisfied are you with the windows of the house ?	.335		
How Satisfied are you with the Doors of the house ?			
How Satisfied are you with the ceiling materials of the house ?	.302		
How Satisfied are you with the Kitchen of the house ?			
How Satisfied are you with the Toilet of the house ?			
How Satisfied are you with the Bedroom of the house ?			
How Satisfied are you with the Living room of the house ?			
How Satisfied are you with the Ventilation conditions of the house ?			
How Satisfied are you with the Lightning of the house ?			
How Satisfied are you with the electricity of the house ?	.438		.597
How Satisfied are you with the septic tank of the house ?	.423		.494
How Satisfied are you with the garbage of the house ?	.391	-.322	.423
How Satisfied are you with the staircase of the house ?	.362		
How Satisfied are you with the plumbing of the house ?		.483	
How Satisfied are you with the verandah of the house ?			
How Satisfied are you with the public bus stop?	.606	-.313	
How Satisfied are you with the open/playing ground?	.547		
How Satisfied are you with the place of worship?		**.704**	
How Satisfied are you with the schools conditions in the area?		**.615**	
How Satisfied are you with the healthcare in the area?		**.660**	
How Satisfied are you with the market/shopsin the area?		**.746**	
How Satisfied are you with the police station location?	.312		
How Satisfied are you with the fire station in the house area?		**.724**	
How Satisfied are you with Familiarisations within the neighbourhood of the house ?	**.634**		
How Satisfied are you with the street appearance of the house ?	**.615**		
How Satisfied are you with the Noise pollution of the house ?	**.688**		
How Satisfied are you with the social mix of the house area ?	.560		
How Satisfied are you with the security of the house area?	**.640**		
How Satisfied are you with the community association of the house ?	.559		
How Satisfied are you with the Infrastructure of the house area ?	.416		
How Satisfied are you with the Planning authority in the house area?			
How Satisfied are you with the drainage of the house area ?	.612		
How Satisfied are you with the access roads of the house area ?	.437		
How Satisfied are you with the refuse of the house area?		-.426	

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
a. Rotation converged in 9 iterations.

The results reveal that Abeokuta ranked 1st in residents' satisfaction with Neighbourhood facilities and ranked 3rd in residents' satisfaction with the social environment. Akure ranked 2nd in residents' satisfaction with both neighbourhood facilities and social environment. Ibadan ranked 1st in residents' satisfaction with their social environment and 3rd in Neighbourhood facilities. Generally the result shows a very close similarity in the degree of residents' satisfaction for Neighbourhood facilities and social environment across the urban centres. Ibadan and Abeokuta for instance share slight similarities in residents satisfaction variables explored as they both ranked first and third. The housing satisfaction pattern exhibited by the urban residents of the southwest zone on the two components loaded is relatively similar with insignificance difference that cannot be noticed. This insignificance difference, perhaps explains the reasons for the homogeneity in the urban centres of the southwest zone as expressed in the preference of the residents.

It can also be understood from the outcomes that though the neighbourhood patterns are different among the urban centres of the southwest, the differences reflect high housing quality development. This has influenced concentration of residents around the neighbourhood facilities and consequently this enhanced social environment of the residents in the region. In recent times, most residents have access to quality housing in urban centres of southwest region (Morenikeji *et al,* 2017). This shows that the housing management is progressing steadily in the region.

Table 5 :Loading of the Three Urban Centres on the Two Components

Urban Centre	Component 1	Rank 1	Component 2	Rank 2

Ibadan	4.513	3	4.851	1
Abeokuta	4.713	1	4.485	3
Akure	4.646	2	4.805	2

Attention therefore has shifted to other aspects of the residents' housing environment as revealed by this study. This other aspect is housing administration in southwest Nigeria. The result shows a high degree of homogeneity in the residents' housing satisfaction pattern due to concentration of certain groups of residents in a neighbourhood due to similarity in socioeconomic factors. Southwest region is known for its high degree of socioeconomic factors (Ayeni, 2002).

Housing Conditions Pattern

The homogeneity exhibit in the above result is further investigated using discriminant analysis as each of the sub-zones are represented by an urban centre. The essence is to identify homogeneous pattern among the three geographical sub-zones of southwest Nigeria and the difference among each of the geographical sub-zone interms of housing conditions.

Figure 4 shows the clustering of the residents' satisfaction housing variables of the three urban centres around their group centroid. The Ibadan and Abeokuta show very close cluster pattern.

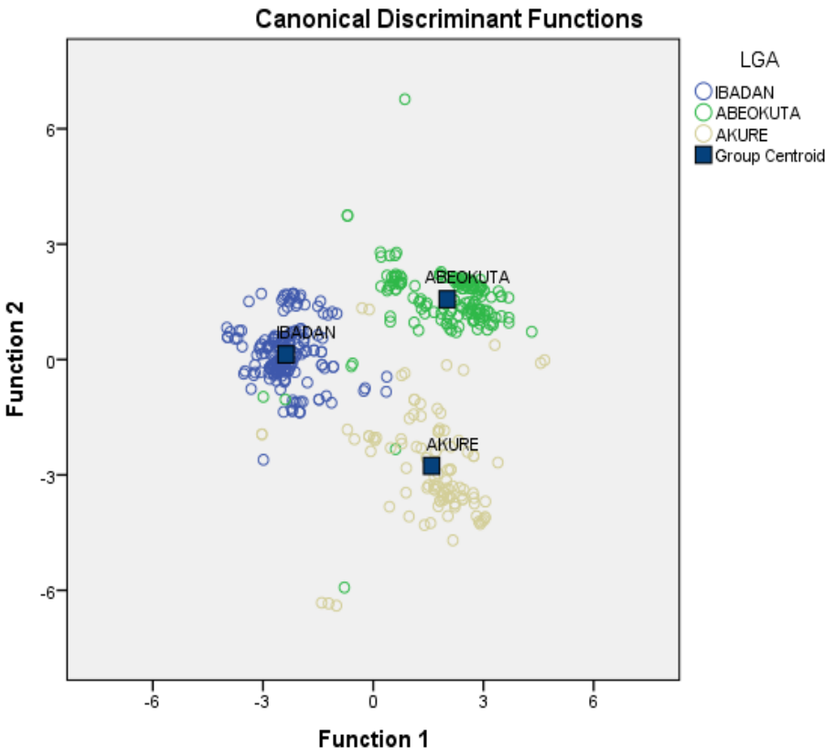

Figure 4. Distribution of the Variables around Group Centroid of the three Geographical Sub-zones

However, Akure exhibits a relatively loose clustering pattern. Ibadan and Abeokuta are similar in residents' satisfaction housing conditions but slight diiferent compared with Akure. The similarity exhibits by Ibadan and Abeokuta could be understood as they both share similar socioeconomic characteristics and population rising. The population growth of Abeokuta could be due to its proximity to Lagos that keep expanding toward the sub-zone. The urban centre of Ibadan is known for its populace, economic and long history of administrative position in the southwest zone.

The extracted canonical discriminant function in Table 4 shows that the first function explains 63.7% of the between-class variations among the three sub-zones and the second function explain 36.3%. The significance of the extracted functions is presented in Table 5. The chi-square value of 1340.104, df = 76; and P = .000 supports the significance of both functions.

Table 4: Canonical Discriminant Functions

Eigenvalues				
Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	4.441[a]	63.7	63.7	.903
2	2.529[a]	36.3	100.0	.847

a. First 2 Canonical Discriminant Functions were used in the Analysis.

Table 5: Wilks' Lambda Significance of the Functions

Wilks' Lambda				
Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.052	1340.104	76	.000
2	.283	571.859	37	.000

CONCLUSION

The study examined the residents' satisfaction with housing conditions in urban centres of southwest Nigeria based on the evaluation of residents' satisfaction with physical housing unit characteristics, services within the housing units, public facilities provided within the neighbourhood and residents' social environment. The objectives of the study were to examine the residents' satisfaction characteristics with housing conditions in the urban centres of southwest Nigeria and to identify the factor responsible for housing quality variations across the region. The major parameters that account for residents' satisfaction with their housing conditions as discovered by the study are neighbourhood facilities and social environments of the residents. These factors, as loaded by the PCA and further confirmed by discriminant analysis cut across the urban centres studied and accounts not only for housing satisfaction variations, but also responsible for the homogeneity pattern of housing conditions exhibit across the study area as evident in the discriminant function pattern of the variables in figure 4. The similarity in the housing quality across the sub-zones could be linked to high concentration of socioeconomic characteristic among the urban residents of the region. Ibadan (Northwest) and Abeokut (south) are two sub-zones with high socioeconomic activities when compared with Akure (southeast sub-zone). The rate of urbanisation in these two sub-zones are higher and due to the rapid expansion of Lagos, the entire urban centres in the south sub-zone is experiencing rapid socioeconomic development at a higher rate than the other sub-zones in the region. The study has evolved three sub-zones within southwest region and Southeast sub-zone represented by Akure shows a unique resident satisfaction with their housing conditions by exhibits a balance in the residents' satisfaction with both neighbourhood facilities and social environment (Table 3.). This reveals that the population growth of southeast sub-zones is not as rapid as in the other two sub-zones of the southwest region. The study also shows that residents' satisfaction with their housing condition depend on the degree of their socioeconomic background and this factor varies among the urban centres investigated.

In conclusion the study has further established the uniqueness of southwest Nigeria for good housing management and relatively week housing administration. The basic indication of housing management is expressed in the individual resident for quality housing in the area while the housing administration is expressed in the output of a gamut of institutions like land use control, policy formulation and provision of social facilities. The major indicators of poor housing administration are lack of good accessibility, close proximity of the adjacent housing in the neighbourhood, lack of open space, park, poor directional drainage and green areas. These aspects require more attention for better and organised, built environment of quality housing in southwest Nigeria.

RECOMMENDATION

The resident housing satisfaction in southwest Nigeria is primarily anchored by neighbourhood facilities and social environment of the housing area among the private housingdvelopment. This shows that residents' satisfaction and housing conditions are subjective and is influenced by the predominant socioeconomic variables of a given urban milieu. Measures aimed at promoting these characteristics require good housing administration. This is because housing in a safe environment with socioeconomic facilities are source of comfort and delight to the urban residents. In the light of this provision of housing neighbourhood and social facilities should be taken into considerations in the planning and land development control in the study area. The neighbourhood concept of

urban housing growth is recommended for this region. This will ensure provision of neighbourhood facilities at significant distances and grouping of urban residents according to their socioeconomic status. This is because in deciding a housing, location, resident socioeconomic status for a period is critical to the choice of residing in an urban centre. Urban residents associate with their perceived standard and facilities as well. In the light of this a participatory neighbourhood planning approach for effective distribution of social facilities, according to socioeconomic status of residents should be given preference in the built environment of this region for urban resilience and satisfactory housing conditions in southwest Nigeria

This will enable the various urban housing administration agencies and customary landowners to be involved in key decisions to avoid duplication of function that may embolden the residents instead of giving the urban residents relief and comfort. Besides, the urban physical development and land control for effective distribution of neighbourhood and social facilities, according to the population and socioeconomic status of the urban residents should not be left at the discretion of customary landowners and the individual developers among the urban residents. This will enable provision to be made for future developments without overstressing the existing facilities and for proper monitoring of the urban physical development.

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MICRO-HOUSING DEVELOPMENT AS FEATURE OF CLASS STRATIFICATION IN THE JOS METROPOLIS OF PLATEAU STATE, NIGERIA

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In every human society social classes exist and most often identified by the kind of food they eat, the clothes they wear, their means of transportation, and the kind of houses in which they live. This paper identifies housing as one of the commonest features by which social classes in the Jos metropolis can be identified. In this direction, attempt is made to link micro-housing with low and middle-income groups in the Jos metropolis. In this process, the metropolis was divided into ten clusters, using road networks as boundary lines, after which, one neighbourhood was selected at random in each of the clusters and a systematic sampling method was used to decide the number of questionnaires to be administered in each neighbourhood depending on the number of micro-housing in each of the selected neighbourhoods. A total of 244 questionnaires were administered to household heads who happen to be the owners of the micro houses. This was followed by data cleaning and compilation through the use of Statistical Package for the Social Sciences (SPSS) and frequencies and percentages were used for descriptive statistical results which were presented in tables and charts. Findings show that the micro housing occupants are predominantly the low and middle income groups. The majority of the houses are compound type and multiple row housing which are characterized by shared kitchens, bathrooms and toilets. Some of the houses are developed without building plans and building permits or approvals by the urban development authorities. It is recommended that government or housing authorities concerned can help solve this problem by reviewing these procedures and as well reduce the fees payable for the approval of building plans and other related documents. Standards too should be reviewed to incorporate micro housing design elements into the overall set of building standards. Finally the improvement in technological ideas of manufacturing building materials like locally made burnt bricks will also reduce cost of production and increase quality and durability of micro housing.

Key words: Housing, Micro-Housing, Household, Socio-Economic Characteristics

INTRODUCTION

Rapid urbanization and population growth have caused many problems in developing cities in Nigeria. Cities grow too rapidly; infrastructures are not able to keep up with the swelling population. Housing is one of the major problems these cities are facing today. The continuous influx of people from rural to urban areas has drastically increased urban population. Hence, these migrants who cannot afford proper housing resolve to build micro-housing without adequate basic utilities and services. With a population of over 160 million people, Nigeria is Africa's most populous nation and the leading oil and gas producers in Africa (Maren, 2011). With a combination of push and pull factors, urban migration to these developing cities within Nigeria economy as the case may be, accounts for over 55% of population growth (World Bank, 2013). This has led to a serious shortage of proper housing. Nigeria's housing deficit is estimated around 16 million units and it requires more than N56 trillion to provide the 16 million housing units to bridge the housing deficit at a conservation cost of N3.5 million per unit in the country (World Bank, 2013).

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Sulyman & Kudu, (2018). **MICRO-HOUSING DEVELOPMENT AS FEATURE OF CLASS STRATIFICATION IN THE JOS METROPOLIS OF PLATEAU STATE, NIGERIA.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

The population figures above, points to the degree of housing shortfall in the country, and because of the desire of the large population to live in cities, they have little or no option but to reside in some form of the overcrowded neighbourhoods. Some of the open spaces within these neighbourhoods have been sold out by landlords and small units of houses have been built on them most of which are informal and without proper title to such lands. In Nigeria, the low income people are identified as wage earners or self-employed people whose income is below the maximum annual income of the highest salary grade level within the civil services structure (Federal Ministry of Works and Housing, 2012). Several housing programmes have been carried out in Nigeria with the principle of low income housing. For instance, the Civil Service Homeownership Scheme, the Prototype and Mass Housing Schemes. have all been targeted to the low income. However, one basic reality is that units produced under these schemes are often not accessible to the low income groups due to stiff competition for the available houses among the low and medium income groups. Where the so called low income houses are available in the market, they are often not affordable since the average housing price ratio to average household annual income is generally low in Nigeria (Omole, 2001).

One may ask the question - What exactly qualifies as a micro-housing? According to Urban Land Institute of the United States of America (2014), micro-housing might be 300 square feet in New York City or 500 square feet in Dallas. They conducted a study to evaluate from camultiple perspectives, the market performance and market acceptance of micro and small units and the learnt that no standard definition exists for the subject.

Cavallary (2012) as cited in Bello (2014), established that no official definition exist, though most homes that are smaller than 500 square feet (approximately 45.5 square meters) are considered to fall into this category. He discussed the issue further noting that a micro house is usually suitable as a living space for two people, and construction of such house can be much lower than that of a full-size house. Micro houses are designed to be minimal structures, but they are not lacking in normal features such as bedrooms and bathrooms.

For the purpose of this research, micro-housing is defined as development of housing at an incremental bases, that is housing been built on a piece meal basis – the foundation may be done completely but the entire structure might not be raised all at once. A section of the building is being built, roofed and occupied by the household while the rest of the structure is built incrementally.

Conceptual Clarification and Literature Review

Concept of Housing

In order to understand the concept of housing, it is necessary to distinguish between shelter, house and housing. Shelter is a physical structure with a covering which originally is meant for protection from harsh elements of climate such as rain, wind and sun. It is a physical space enclosed for the protection of man from elements of whether. Shelter was provided in pre-historic ages under trees, in caves and later in tents made from animal skin (Sulyman, 2015). However, there is a concept of shelter which was defined by Habitat Agenda (2003) to mean more than a roof over one's head. It also means adequate security, security of tenure, structural stability and durability, adequate lighting, heating and ventilation; adequate basic infrastructure, such as water-supply, sanitation and waste-management facilities, suitable environmental quality and health related factors and adequate and accessible location with regard to work and basic facilities all of which should be available at an affordable cost.

Housing all over the world has remained a phenomenon that affects every facet of mankind. Its importance is so pronounced that it reflects the social, physical and mental wellbeing of man irrespective of his socio-economic status, color or creed. It represents the most basic human needs and has no doubt considerable impact on the health, welfare and productivity of the individual (Ademiluyi, 2010).

Housing literally is defined as Buildings or shelters in which people live, a place to live, a dwelling. and to Nations a critical component in social and economic fabric. As a unit of the environment, it has a profound influence on the health, efficiency, social behavior, satisfaction and general welfare of the community (Onibokun 1985). To most groups housing means shelter but to others it means more as it serves as one of the best indicators of a person's standard of living and his or her place in the society (Nubi, 2008).

The totality of ideas and views expressed about what housing entails brought about two clear definitional dimensions of the term housing. First, housing is seen as an economic process and product. Second, it is also seen as a social symbol. As an economic product, housing represents a commodity traded in the housing market. It is a product of investment and a means of income generation, (Jinadu, 2007). As an economic process, housing is described as the ways and means by which housing goods and services are produced through the interactive construction processes of land acquisition, housing finance mobilization, material assemblage and actual construction Tuner, (1992).

The Housing sector can be considered in the context of production of housing goods and services for consumption by various classes of consumers ranging from individuals, families, corporate bodies, etc. The housing sector is the buyer of intermediate goods such as brick, cement, iron etc. from other sectors of the economy, and uses other forms of labour (both skilled and unskilled) for the production of housing goods and services. There is a strong relationship between the construction sector and broader economy, and the sector supports stronger multiplier effects than many other sectors. In addition to the above case, the housing sector is also a supplying sector. Thus, from this stand, the housing sector makes inputs of various forms, from preliminary stages of project initiation, drawing of building plans, construction of buildings and so on, which in the long run brings forth considerable value in terms of output (Jinadu, 2007).

Adequacy should be determined together with the people concerned, bearing in mind the prospects for gradual development. On the other hand, a house is a physical structure which human beings use for shelter. It has all the facilities, equipment, services and devices needed or desired for healthy living. Therefore it can be concluded that all houses are shelter but not all shelters are houses. This is because shelter which does not have all the facilities, equipment, services and devices needed for healthy living is not a house but mere shelter (Sulyman, 2015).

The Concept of Micro-Housing

It is generally accepted that no standard definition exists regarding the term – micro-housin. A micro unit is a somewhat ambiguous term that covers anything from a relatively small studio or one-bedroom apartment to a short-term lease, Single Room Occupancy (SRO) unit with communal kitchen and common room areas. In fact, many in the industry are moving away from branding their units as micro because the term has begun to arouse negative connotations associated with higher density, overcrowding, and transient populations (Keivani, 2008).

In New York City and Philadelphia, the minimum size requirement for a new dwelling unit is 400 square feet. However, former New York City mayor Bloomberg waived this requirement for the adapt NYC competition, which defined micro apartments as studio apartments that range between 275 and 300 square feet and include fully functioning kitchens and accessible bathrooms (Turner 1992). In the city of San Francisco, new legislation was passed allowing apartments as small as 220 square feet, so long as 70 square feet of this space is allocated to a bathroom and kitchen (Turner 1992). In the District of Columbia, the minimum size for an apartment is also 220 square feet but with no prescription regarding allocation of space within the unit. In Boston, the minimum size for a dwelling unit is 450 square feet within one mile of public transit, but again this requirement was waived for a demonstration project in the Innovation District to allow development of smaller units. In some Midwestern and Texas housing markets, units ranging between 400 and 500 square feet are described as micro units. Seattle and Portland have no minimum size requirements for their markets, which probably explain why their markets are two of the best examples of cities demonstrating a tremendous amount of experimentation with very small units, including a wide range of communities offering SROs and micro units (Gbadeyan, 2011).

Thus, the concept of micro units is to some degree relative to the market in which they exist. For the purposes of this research effort, a distinction was made between SRO units and micro-unit apartments with fully functioning kitchens and bathrooms. Although some trading range probably exists in the square footage depending upon the market, a good definition of a micro unit is a purpose-built, typically urban, small studio or one-bedroom using efficient design to appear larger than it is and ranging in size from as little as 280 square feet up to as much as 450 square feet (which roughly equates to 20 percent to 30 percent smaller than conventional studios in a given market). Many micro units under 350

square feet feature built-in storage units and flexible furniture systems (e.g., Murphy beds, hideaway kitchen modules, convertible tables, and so on) to make these smaller spaces work. To put the size of a micro unit into perspective, a 300-square-foot micro-unit studio apartment is slightly larger than a one-car garage but considerably smaller than a two-car garage (Keivani, 2008).

Study Area

Plateau State lies between Latitudes 6ºN and 14ºN and Longitudes 3ºE and 10ºE. Plateau State has been known for its heterogeneity with respect to ethnicity, cultural backgrounds and social groupings. The largest concentration of these ethnic groups are found in Jos the capital city of Plateau State.

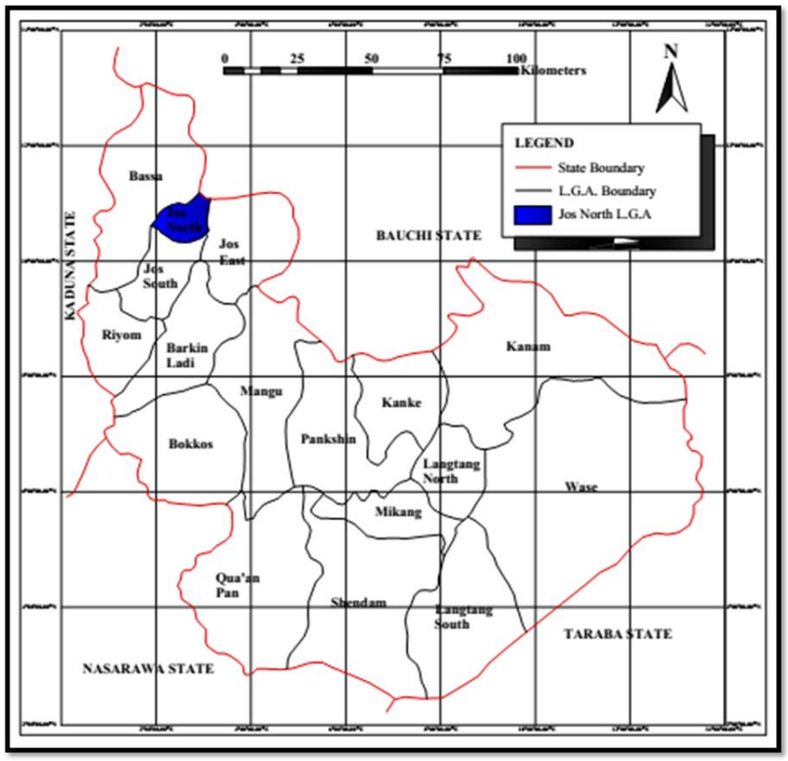

Figure 1.1 Location of Jos North Local Government Area.
Source: Plateau State Ministry of Lands, Survey and Town Planning, Jos (2016)

Jos metropolis is the capital of Plateau state, Nigeria. It lies between latitudes 9051'30''N to 10002'00''N and longitudes 8048'00''E to 9059'00''E. Its headquarters lies in the city centre of Jos. It has an area of 291km2 and a population of 821,718 as at the 2006 census. The city is located on the Jos Plateau at an elevation of about 1,238 metres or 4,062 feet high above sea level.The Jos Plateau is located almost at the centre of Nigeria. It is probably the home of the largest number of ethnic groups, with the largest concentration in the Jos town, capital of Plateau State. Here, almost every ethnic group in Nigeria is represented.The growth and development of the Jos town can be attributed to several factors, pulling populations of different socio-cultural, linguistic and religious backgrounds, creating a unique diversity in the social configuration of the area. This diversity has added beauty to the God-given attractiveness of the physical environment (Kudu, 2017).

The area known as Jos today was inhabited by indigenous ethnic groups who were mostly farmers. The British colonialists used direct rule for the indigenous ethnic groups on the Jos plateau since they were not under the Fulani emirates where indirect rule was used. The Fulani empire controlled most of northern Nigeria, except the Plateau province and the Berom, Mwaghavul, Ngas, Tiv, Jukun and Idoma ethnic groups. It was the discovery of tin by the British that led to the influx of other ethnic groups such as the Hausa, Igbo, Yoruba, thus making Jos a cosmopolitan city (Wikipedia).Generally speaking, the formation of the Jos Town is traceable to as far back as the pre-colonial period. This period witnessed waves of migrations from both outside and within the area to the Jos area. However, the traditions identify the earliest settlers at the area as the Du section of Berom, the Kishi village of Rukuba and the Anambi clan of Anaguta (Kudu, 2017).

The emergence of Jos as a modern city is associated with colonialism and its attendant economic policy, tin mining, Christian Missionaries, Hausa traders and Fulani cattle rearers. Although the Fulani did not live in the urban centre of Jos, the selling of their cattle for meat

gradually acquainted them with the city life, and some of them eventually abandoned their cattle for the city. Among them where those who acted as middle men in the cattle trade, the proceed of which some of them enrolled in the literacy classes, after which they secured employment in the colonial administration asmessengers (Kudu, 2017).Probably of all the factors which pulled population from across the Nigerian area to the Jos Plateau, the tin mining industry was the strongest. During the early stages of its exploitation, from 1903 to 1906, the local population remained the only source of labour, which was even supplied on casual basis in the tin fields (Maren, 2011).

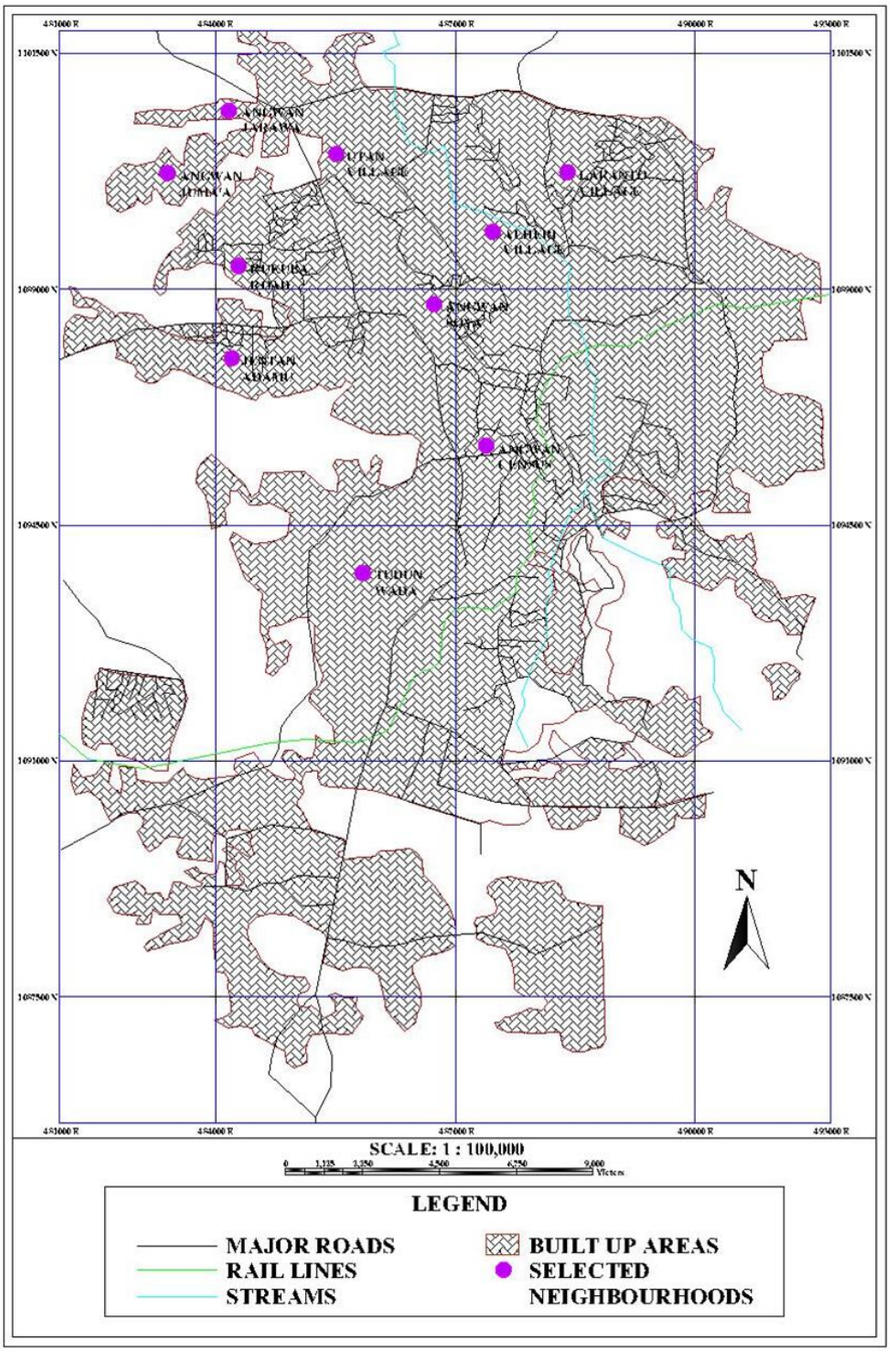

Figure 1.2 Jos Metropolis in State Setting
Source: Plateau State Ministry of Lands, Survey and Town Planning, Jos (2016)

RESEARCH METHODS

Questionnaires were directed to household heads. On the other hand secondary data was obtained from journals, textbooks, maps, internet and other relevant documents. Information gathered were analysed using descriptive statistics such as frequency count and percentages which was used to explain the factors responsible for micro-housing development in Jos metropolis. According to the 2006 National census exercise, Jos metropolis had a population of 900,000.Thus, with a population census figure of 900,000 in 2006, the projection to 2017 is 1,021,395. Hence, from the recommended sample size for interview in the Table 4.1below, 4% of the total micro-housing occupants will be used as sample size.

Recommended Standard for Sample Size

Population	Recommended Sample Size for Interview	
	Maximum %	Minimum %
Under 50,000	20	10
50,001 – 150,000	12	5
150,001 – 300,000	10	3
300,001 – 500,000	7	2
500,001 – 1,000,000	5	1
Over 1,000,000	4	1

Source: Adopted from Wells (1975)

The Jos metropolis was divided into ten clusters to enhance considerable level of inclusion of all areas. From the delineation of the metropolis into ten clusters, the population of micro-housing in the selected nieghbourhoods and the number of questionnaires to be administered in each neighbourhood is shown in Table 4.2 below.

Table 4.2 Distribution of Questionnaires among the Selected Neighbourhoods

S/N	Neighbourhoods	Population (Number of Micro Houses)	Number of Questionnaires to be Administered
1	Utan Village	822	33
2	AngwanJarawa	453	18
3	Sabongari	621	25
4	Angwan Census	779	31
5	Rukuba Road	523	21
6	JentanAdamu	652	26
7	Alheri Village	724	29
8	Angwan Soya	401	16
9	AngwanJumma'a	673	27
10	Laranto Village	456	18
Total		**6104**	**244**

Source: Authors Field Survey, 2017.

The target population of the study is the total number of micro housing occupants in the selected neighbourhoods. The metropolis was divided into ten clusters using road networks as boundary lines, after which, one neighbourhood was selected in each of the clusters and a systematic sampling method was used to decide the number of questionnaires to be administered in each neighbourhood depending on the number of micro-housing in each of the selected neighbourhoods. The ten clusters are shown in figure 3.1 below.

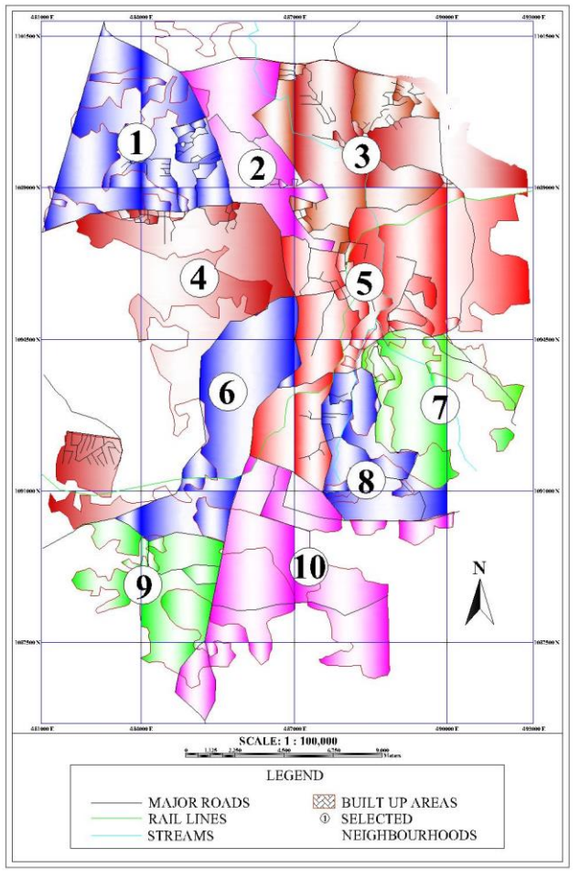

Figure 1.3 Delineated Zones for Systematic Sampling.

Primary data was gathered by means of personal observation, interviews and questionnaire administration. The questionnaire was designedin such a way as to facilitate information regarding socio-economic characteristics such as sex, marital status, level of education, occupation and income level. Information on the characteristics of micro-housing was also collected that is, building type, type of building materials used (walls, roofing sheets, foundation, windows, doors, floor finishing and ceiling finishing), plot sizes, building sizes, duration of construction work and sources of housing finance. Data on the strategies adopted by residents in the construction of micro-housing was also collected some of these strategies included self-help, hired builders, joint efforts from family or joint efforts from friends.

RESULTS AND DISCUSSIONS

Socio-Economic Characteristics of Respondents

The survey conducted reveals that 88.1% of the respondents are males, while 11.9% are females. This shows that house ownership is higher on the side of males than females. 69.9% of the respondents are married while 23.8% of the respondents are single, thus presenting a fact that family size determines the need for housing. 42.6% of the respondents have attended tertiary institutions, 25.1% have primary school certificates, 21.7% have secondary school certificates while adult education and other forms of education have 5.3% percent each. It was also deduced that traders constituted 14.3% of the total respondents, civil servants and students had 12.7% of the total respondents, students constitute 12.3% of the total respondents, farmers are 5.8% while other forms of occupations comprised 54.9% of the respondents. With regards to the income level of the micro housing occupants it was deduced that 42.6% of the respondents earn above N20,000, 30.4% earn between N5,000 and N10,000. 21.7% earn between N15,001 and N20,000 and 5.3% earn between N10,001 and N15,000.

Table 5.1Socio-Economic Characteristics of Respondents

Variables	**Frequency**	**Percentage**
Sex		
Male	215	88.1
Female	29	11.9
Total	244	100
Marital Status		
Single		23.8
Married		68.9
Divorced		0.8
Widow		4.9
Widower		1.6
Total	244	100
Educational Status		
Tertiary		42.6
Secondary		21.7
Primary		25.1
Adult Education		5.3
Others		5.3
Total	244	100
Occupation		
Farming	14	5.8
Trading	35	14.3
Civil Servant	134	54.9
Student	30	12.3
Others	31	12.7
Total	244	100
Income (₦)		
N5,000 – N10,000		30.4
N10,001 – N15,000		5.3
N15,001 – N20,000		21.7
Above N20,000		42.6
Total	244	100

Source: Field Survey, 2017.

Housing Characteristics

The survey conducted reveals that 49.6% of the houses are compound types of housing, while flats constitutes 25.3% of the total micro houses, multiple row housing constitutes 25.1% of the total micro houses. 60.7% of the walls are constructed with sandcrete blocks, while 39.3% are constructed with mud blocks; this shows that quite a good number of this micro houses will be durable and thus have a longer life span. 90.2% of the micro houses are roofed with zinc, while 9.8% are roofed with aluminium; this is a reflection of the income of the micro housing occupants. 59.8% of the micro houses are built on sandcrete block foundation, 25.9% of the micro houses are built on stone foundation while 14.3% of the total micro houses are built on concrete foundation. These micro housing developers find the cement blocks cheaper than stones and pure concrete foundation. 61.5% of the micro houses have steel frame windows with louvers, 27.0% of the micro houses have wooden swing windows, and despite the cost of aluminium sliding windows some of the micro housing occupants could still afford them, they account for 11.5% of the total micro houses. 88.9% of the total micro houses have metal or steel doors while only 11.1% of the total micro houses have wooden doors. Results showed that 94.3% of the houses had sand/cement screed floor finishing while only 5.6% of the micro housing had floor tile finishing. 66.4% of the ceiling finishing are with Saw-dust board, 18.0% are with asbestos ceiling sheets and 15.6% are with P.V.C. The survey conducted reveals that micro-houses on plot sizes of 101 – 150m2 comprise 36.9% of the houses interviewed while plot sizes of between 51 – 100 m2 constitute 32.8% of the total houses. Plot sizes of 151 – 200 m2 plot sizes account for 19.7% and < 50 m2 sized plots account for 10.6%. Some of the plots that falls under Less than 50m2 were plots which either had no definite size or no demarcations at all.

The inventory collected on the sizes of the micro houses reveals that 31.6% of the houses have an average size of less than 50 m2, 27.5% of the sampled houses have average size of between 61 - 65m2, 22.5% of the houses have an average size of between 51 - 55m2, while 18.4% of the total houses have an average size of between 56 - 60m2. Findings on the duration of time used in building these micro houses reveals that 49.2% of the respondents took more than 6 years to build their houses, 30.7% of the respondents took less than 1 year to build their houses, 11.1% of the respondents took 4 to 6 years to build their houses while 9.0% of the respondents took 1 to 3 years to build their houses.

Table 5.2Housing Characteristics

Variables	Frequency	Percentage
Building Type		
Flat		25.3
Multiple Row Housing		25.1
Compound Housing		49.6
Total	244	100
Wall Materials		
Sand Crete Blocks	148	60.7
Mud Blocks	96	39.3
Total	244	100
Roofing Materials		
Zinc		90.2
Aluminum		9.8
Total	244	100
Foundation Materials		
Stone		25.9
Sand Crete Block		59.8
Concrete		14.3
Total	244	100
Type of Windows		
Wooden (Swing)	66	27.0
Steel Frame With Louver	150	61.5
Aluminum Slides	28	11.5
Total	244	100
Type of Doors		
Wooden (Swing)		11.1
Metal (Swing)		88.9
Total	244	100
Type of Floor Finishing		
Tiles		5.7
Sand/Cement Screed		94.3
Total	244	100
Type of Ceiling Finishing		
Asbestos	44	18.0
PVC	38	15.6
Saw-dust Ceiling Board	162	66.4

Total	244	100
Average Plot Size		
Less Than 50m^2		10.6
51 – 100m^2		32.8
101 – 150m^2		36.9
151 – 200m^2		19.7
Total	244	100
Duration of Construction Work		
Less Than 1 year	76	30.7
1 year – 3 years	22	9.0
4 years – 6 years	27	11.1
More Than 6 years	120	49.2
Total	244	100
Sources of Housing Finance		
Own Savings		74.2
Cooperative Society		14.3
Family members and Friends		11.5
Total	244	100
Mode of Construction		
Self-Built	40	16.4
Hired Builder	33	13.5
Family Members and Friends	171	70.1
Total	244	100

Source: Field Survey, 2017.

Facilities and Services within the House

The survey conducted reveals that all respondents have kitchens, however some occupants who don't use the shared kitchens prefer to cook outside or in their living rooms. All respondents claim to have toilets. All respondents have bathrooms to take their bath. 35.7% of the respondents have in-built stores to store either food stuff or any other valuable properties, but 64.3% of the total respondents do not have in-built stores, this implies that the either use the kitchen or empty passages to keep their food stuff or other valuable things. The survey conducted reveals that 79.9% of the respondents do not have dining areas or dedicated space for eating, they eat their food either in the living room, bedrooms or even outside. l respondents.

Facilities and Services within the House

Availability of Facilities									
Kitchen		Toilet		Bathroom		Store		Dining	
Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
100%	0%	94.3%	5.7%	94.3%	5.7%	35.7%	64.3%	20.1%	79.9%

Source: Field Survey, 2017.

Location of Facilities and Services

59.0% of the respondents have their bathrooms outside the house within the compound while 35.3% have their bathrooms within the house others claimed they don't take their bath in the house rather the bath either in their friends' houses or neighbouring compound, they account for 5.7% of the total respondents. 64.8% of the respondents have their toilets located outside the house while 29.5% have their toilets located inside the house. However, others claimed they do not use the toilets in the house rather they use the toilets in the neighbouring compound, accounting for 5.7% of the total respondents. Respondents who have their kitchens located within the house and those who have their kitchens located outside the house both constitute 47.1% of the total respondents, while those who use other forms of kitchen facilities constitute 5.8% of the total respondents.

Table 5.4Location of Facilities and Services

Bathroom		**Toilet**		**Kitchen**	
Inside the House	35.3 %	Inside the House	29.5%	Inside the House	47.1%
Outside the House	59.0%	Outside the House	64.8%	Outside the House	47.1%
Others	5.7%	Others	5.7%	Others	5.8%

Source: Field Survey, 2017.

RECOMMENDATIONS

A general improvement in housing provision for the ever increasing population will definitely improve the standard of living in the Jos metropolis. Housing being one of the most basic needs of man must be a subject of utmost concern to the government. However

when the citizens begin to improvise certain measures to meet this need, the government should also play a vital role which will help in the successful development of this houses and at the same time ensure that acceptable standardsare adhered to in the course of development which will in the long-run improve health and safety of its occupants. The following recommendations are geared towards improving micro-housing development in this study areaand on a larger scale, to make housing affordable and accessible to all.

1. Standards – this study found out that most of these houses have been erected without following the conventional procedures for development. Some of the houses are built without building plans, without building permits or approvals by the authorities. This is because of the financial implications and cumbersome procedures of obtaining all these documents. The government or housing authorities concerned can help solve this problem by reviewing these procedures and reducing the fees payable for the approval of building plans and other related documents. Standards should be relaxed instead of being too rigid so as to incorporate micro housing designs elements into the overall set of building standards.
2. Loan facilities – the study shows that developers of micro housing hardly rely on mortgage institutions and other financial institutions for loans. This is simply because of the stringent conditions as well as the high interest attached to accessing loans for housing development. Financial institutions can play a very significant role in this regard by reducing the interest rates on loan facilities as well as eliminating some of the stringent conditions that a prospective developer must meet before gaining access to loans.
3. Building materials subsidy – the housing market that is saddled with either the production or importation of building materials should be supervised by the housing authorities in order to check the costs of building materials, this is because greedy manufacturers and importers of building materials have high tendencies of inflating prices of building materials and housing goods. Another measure that can be taken by the government can do with this regard is to also involve in partnership with manufacturers of building materials to buy these products directly from the manufacturers and make them available to developers at subsidized rates.
4. Technological improvements – locally made building materials will be able to perform as well as the foreign materials if the technology involved in their production is improved. Houses built with burnt bricks have the capacity to withstand very harsh weather conditions even when not plastered. Therefore the locally manufactured clay when subjected to heat will also serve the same purpose. Well treated and polished wood can also serve as materials for floor finishing as well as ceiling finishing. Doors and windows too can be made from hard wood in an aesthetic way to look good and serve the purpose of security at the same time.

CONCLUSION

Micro units have generated considerable interest and some controversy in the minds of people as well as in the housing industry in the past several years. Research has shown that the migration toward smaller average unit size housing such as one-bedroom units and rental of small apartment with shared facilities and common kitchens, bathrooms and toilets within communities are a growing trend. Whether this turns out to be a lasting phenomenon or a passing fad, micro units have renewed the focus on efficient layouts and innovative design solutions. Many of these smaller units are designed and configured to feel larger to potential renters than older conventional units by virtue of higher ceiling heights, larger windows, built-in storage, and in some cases, shared toilets and bathrooms. Evidence from the housing markets indicates that smaller units tend to outperform conventional units as far as low and middle income earners are concerned.

Micro units are not for everyone and micro units may not be the solution for every location, hence there is need for the housing authorities and agencies concerned to integrate designs of micro housing units in their housing programmes especially low-income housing schemes. There should be some degree of adjustments and review of housing standards to create opportunity for development on smaller plot sizes for housing. Micro housing units should not be seen only from the negative point of view but from a more positive angle.

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ASSESSMENT OF USER SATISFACTION AS A BASIS FOR SUSTAINABLE HOUSING PROVISION IN NIGERIA

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Human development and wellbeing have been attached to the availability of sustainable shelter provision. Alas, there exist a host of challenges with respect to providing housing for the populace. Studies have shown that one critical challenge of housing provided under mass housing schemes is failure to reflect the user specifics of housing provision. This study focuses on the failure of housing provision schemes to reflect the preference of the targeted end users. The study was conducted in the 200-mass housing unit Lokoja, Kogi State. Primary data was gathered by the distribution of questionnaire to respondents asking questions related to what their desired houses should be and juxtaposing these data with the status quo. Findings therefrom show that housing scheme has to a large extent not reflected what the occupants want their houses to be as a result of lack of beneficiaries' participation in the policies targeted at providing housing for the populace. The study therefore, suggests that the people should be carried along in decision making for the provision of housing if a sustainable housing provision is desired.

Keywords: Housing Provision, User Satisfaction

INTRODUCTION

Housing or shelter is one of the three most important basic necessities of humankind which has an enormous effect on human health and wellbeing, Adeoye, (2015). It is a showpiece of host of goods and services that ensures good livelihood and an essential piece for, neighborhood quality and preservation, Eldredge, (1967) as cited by Adeoye, (2015). Agbola also asserted that housing is a blend of physical characteristics that provides a suitable home within any habitable environment; it is an arrangement of socioeconomic and psychological entity. Therefore, housing may be defined as a multifaceted package of goods and services including but not limited to shelter. It is a very important and fundamental accept of individual welfare, survival and health; hence the international concern for growing deterioration of housing conditions in urban areas of developing nations, Central and Eastern Europe (UN 1996) as cited by Aribigbola, (2011). It is globally agreed that adequate housing is intrinsic for good life, is a key requirement for an efficient and satisfied labour force and the foundation of satisfactory community life. Sustainability as it relates to housing provision refers to parameters of housing such as affordability, housing quality and issues of social equity and justice in terms of accessibility. This perspective requires the enumeration of provision over the life cycle of housing. Aribigbola, (2011). The concept of housing assistance is to improve housing affordability for those receiving the assistance (AHURI 2004). Andrews (1998) as cited by Aribigbola A, (2011).

Opined that the term "affordable housing" refers to the housing provision that does not consume up to 30 percent of the income of the targeted beneficiaries. This definition is generally agreed upon as that suiting the concept of affordability. The two also agree that severe housing burden is that provided within 50 percent or more of the income of the targeted populace.

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Therefore, households that spend more than 30 percent of their earnings on housing are considered to be burdened by housing provision. This may pose threat to sponsorship of other aspect of their basic need for existence such as health, education, food, clothing and transportation (HUD 2005). 'Affordability' is the provision of housing based on some given standards such that their prices do not posed undue burden on income of the targeted occupants. Maclennan and Williams (1990) saw affordability as broadly assessed by the ratio of a chosen definition of household expenses to a selected standard of household income at a particular point in time. A more succinct opinion is given by AHURI, (2004) where 'housing affordability" is summarised as the capacity of households to carter for their housing need without jeopardizing their ability to meet the cost of other basic needs.

Housing Quality

According to Onion as cited in Adeoye, (2015), quality is a psychological characteristic of things which may be used to describe its nature or condition. It is a product of subjective judgment which stem from a holistic perspective that an individual hold towards what is perceived as overall perception which individual holds towards what is seen as the most important elements at a material time, Olayiwola et al and Anantharajan, (2006). Ebong, (1983) identified certain criteria as measures for assessing quality in residential development; these includes; aesthetics, ornamentation, sanitation, drainage, age of building, access to basic housing facilities, burglary, spatial adequacy, noise and other forms of pollution and ease of movement among others. However, Neilson, (2004) narrowed these criteria to five indicators of quality in housing, these include; housing must be in compliance with the minimum standard, devoid of serious disrepair, it must be energy efficient and must be provided with modern facilities and services; and that it must be healthy, safe and secure. The quality of housing within any habitable environment should provide the minimum health and living standard while being affordable to all categories of households as observed by Okewole, (2006) and Aribigbola, (2006).

Studies have shown that the urban housing in Nigeria is in a deplorable condition. Almost 75% of the dwelling units in Nigeria's urban centers are substandard and the dwellings are sited in slums (Onibokun, (Ed.); Wahab et al. (1990); Olotuah, (n.d). These result from combined effects of natural ageing of the buildings, lack of maintenance and neglect, wrong use of the buildings, poor sanitation in the disposal of sewage and solid waste, wrong development of land, and increasing deterioration of the natural landscape.

User Based Housing

This is an aspect of housing that suffered neglect in policies and practices. User based housing refers to housing provision based on owners' desired need and aspirations. It comes in various faces ranging from neglect of occupants desired kind of design to completion of housing construction/erection. According to Folaranmi, (2012) design in mass housing schemes in Nigeria is a function of architects training, devoid of owner preferences and specifications. This singular action attests the notion by architects that the bureaucracy in providing user-based houses is tiresome, resulting in the production of prototype mass housing designs around the country. This in turn gave rise to persistent modification of houses in mass housing schemes. Haven identified that the Nigerian society is a multicultural nation with differences in acts of marriage and even building requirement due to climatic differences, two questions that stakeholders are required to answer is "what is the differences between ownership of houses under the mass housing schemes and individually built houses and whether the beneficiaries of mass housing scheme should get their desired houses. The second question is in the affirmative "the owners of mass houses are also potential individual house owners". The need to customise client brief regardless of the associative housing provision category (i.e. mass housing scheme) is pertinent, (Folaranmi, 2012). The forgoing assertion by Folaranmi, (2012) is in line with the aim of this study which seeks to unravel users' preferred housing type.

The Study Area

The study area is the 200-unit mass housing estate in Lokoja, Kogi State, Nigeria built in 2004, it comprises of 100 units of two-bedroom semidetached bungalow and 100 units of three bed room fully detached flats. Background information revealed that it was a state government housing initiative, but individuals were given prototype housing plans to effect the construction. Presently, the estate is an owner occupier arrangement. Sand-Crete hollow blocks formed the chief building materials, rendered in sand-cement mortar and roofed in

various colours of long span aluminium roofing sheets., see plate I, for an aerial view of the estate as captured by google map.

Plate I: google map of. 200 Unit Mass Housing Estate
Source: google earth (2016)

METHODOLOGY

The research paper was conducted to measure the desirability of owners of mass housing scheme to be carried along in the style of and form of building that will be built under a scheme for targeted at providing housing for the urban populace hence, both primary gotten from field survey by administering questionnaires to extract data from form respondents.

There are 200 housing units under the mass housing scheme. Fifty percent (50%) of this number was put under survey for the purpose of this study amounting to a total of 100 units studied (50 units of two (2) bedroom semi-detached prototype housing and 50 units of three (3) bedroom detached prototype houses). 100 questionnaires were distributed to residents of the sampled houses and 95 filled questionnaires representing 95% of the shared questionnaires were retrieved. 87 representing 91.56% of the 95 returned questionnaires were correctly filled; hence formed the valid number upon which analysis was be made.

Analysis of Socio-Economic Survey

From the survey result presented in table1 and figures 1-3; it is evident that majority of the residents in the estate are married and Igala by ethnicity; they hold tertiary educational qualification (91%) and have lived in the estate between 0 and 20 years.

Table 1: Socio-Economic Survey of Respondents

Occupation		No. of Families/Household			Length of stay		Marital Status	
Trading	**5**	**(a)**	**1**	**87**	**<10yrs**	**22**	**Single**	**9**
Civil Servant	**78**	**(b)**	**2**	**0**	**<11-20yrs**	**65**		
							Married	**78**
Student	**4**	**(c)**	**3**	**0**	**21-30yrs**	**0**		

Source: Author

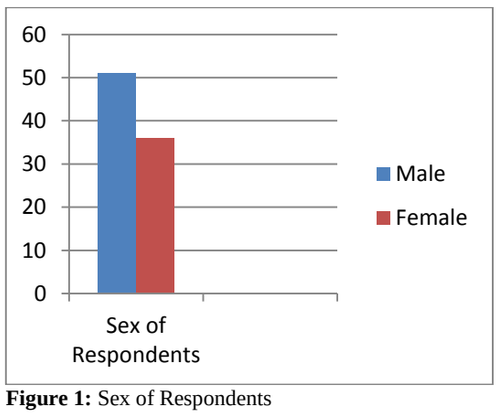

Figure 1: Sex of Respondents

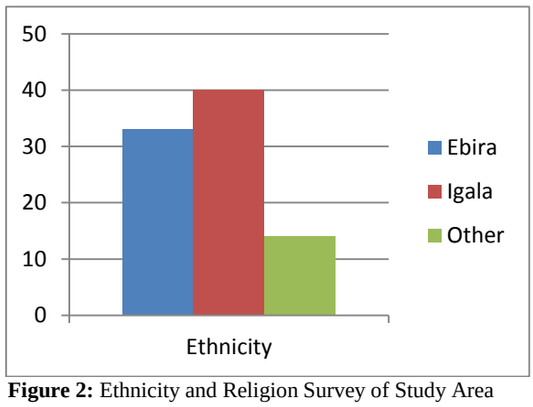

Figure 2: Ethnicity and Religion Survey of Study Area

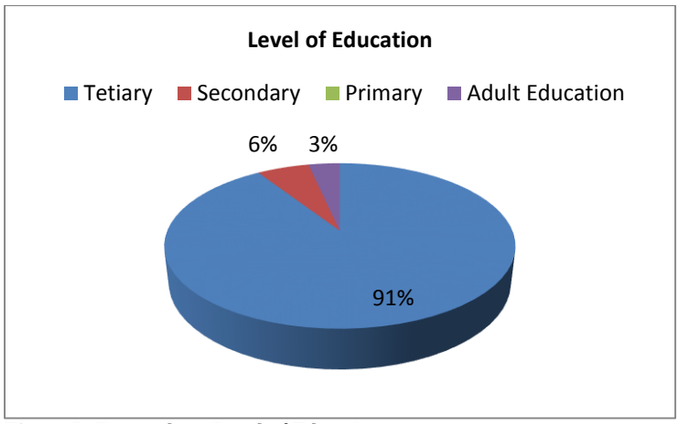

Figure 3: Respondents Level of Education
Source: Author

Analysis of Housing Survey

The above representation shows that 65% of the houses under study area are owner occupied as the houses were either bought from government (33%), or from previous owners (22%) or through mortgage (45%). This shows that the estate was not built for tenament system of house ownership.62

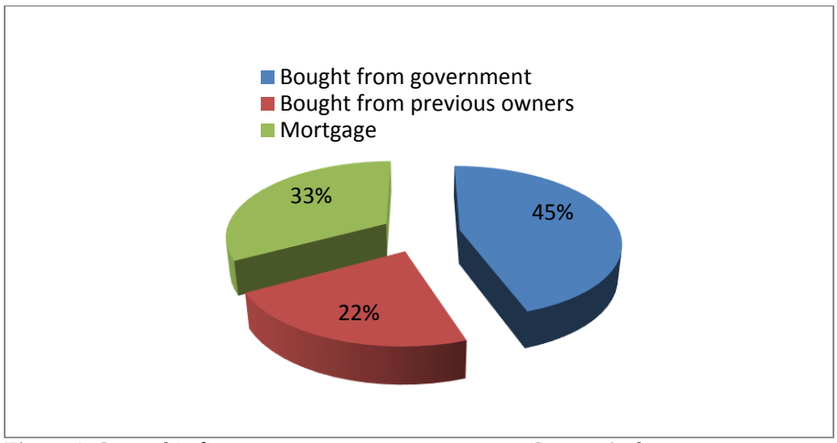

Figure 4: Ownership finance Source: Author

House Type Survey

Here, 87% of the occupants in the estate are currently occupying a bungalow house. From figure 6, it is evident that the number of persons per room out scores the number of habitable rooms which indicates that most of the houses investigated are over-populated with more of young and productive age inhabitants. The result also entails that there is need for the provision of an alternative dwelling space to care for future housing needs by the households.

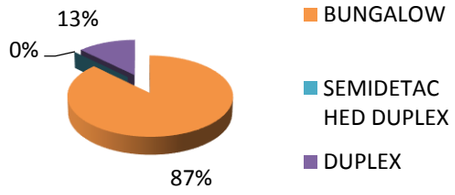

Figure 5: House type

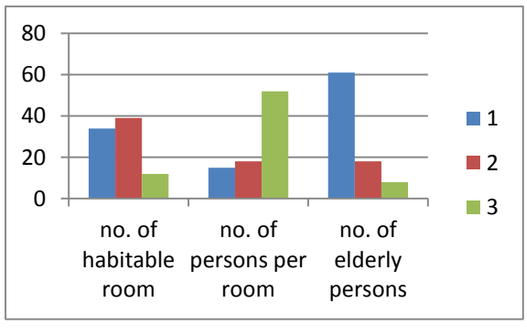

Figure 6: Number of rooms and persons per room

Plot Size and Density Survey

The statistics in figure 7, shows that 74% of the residents occupy a standard plot size of 100x50fts which ensures standard building line and ample setbacks in the estate. All the respondents have only one building units on their plot indicating a comfortable external environment and sufficient room for proper ventilation amidst other advantages.

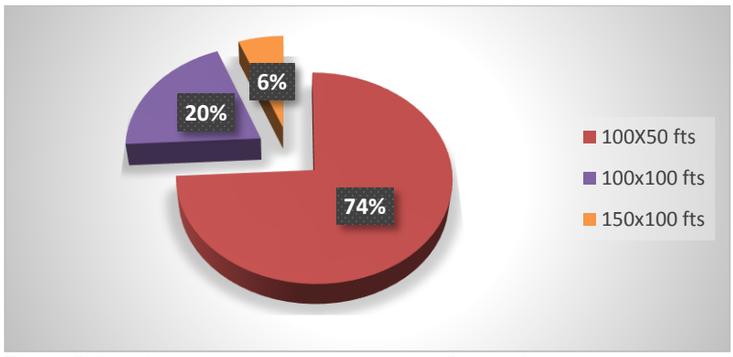

Figure 7: Plot sizes Source: Author

The table 4 shows that there is need to improve the security outfit within the estate while figure 8, shows that most of the respondents are dissatisfied with their current dwelling spaces or housing units. The result is a clear in indication that the housing units can no longer support their housing needs.

Table 4: Security Outfit Available in the Estate.

Security Type	Uniform Personnel	None
Number of Respondents	**3**	**82**

Source: Author

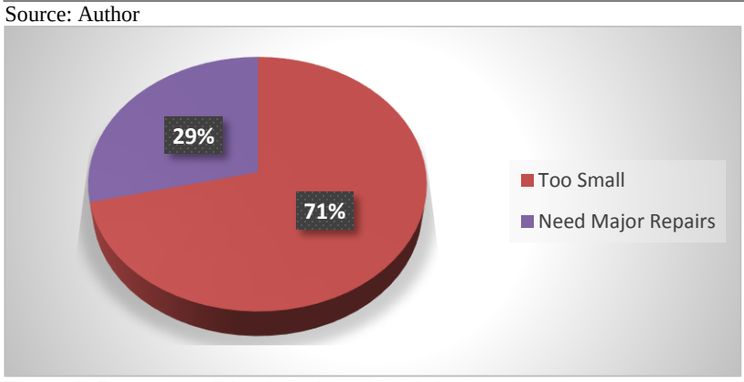

Figure 8: Respondents Dissatisfaction with existing housing types
Source: Author

Survey on House Type Provision for Future Schemes

In figure 9, 59% show preference for large family house as it offers more room for family expansion in future. It also elevates the status of the occupants and enhances the overall presentation of the neighbourhood. 34%, an appreciable chunk of the sample size opted for a small family house which reflects the juvenile nature of populace while 4% and 3% of the respondents showed preference for bungalow and town houses respectively.

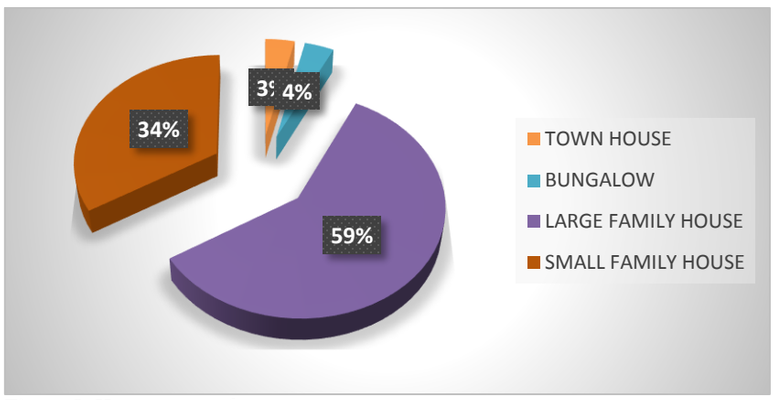

Figure 9: House type preference

Survey on Adequacy of Existing Building and Site Components

A greater size of the respondents showed preference for large building components such as bedrooms and living areas which the current scheme does not offer. Also, they indicated interested for ancillary spaces like study area that are not presently provided on their homes.

Table 5: Building Components Sizes Survey

	NUMBER OF RESPODENTS	
BUILDING COMPONENTS	**YES**	**NO**
Large Bedrooms	58	19
Large Living Rooms	75	12
Large Toilet Space	58	29
Equipped/Large Kitchen	79	8
Large Store Space	71	16
Need for Study Area	50	37
Need for Ramp	12	75
Door Positioning	63	24
Preference for High Roof	52	35
Need for Leisure Facilities	63	24

Source: Author

Again, this survey reveals respondents lack of satisfaction with the status-quo. They have shown their desire for privacy and the need for alternative power source.

Table 6: Building Infrastructure and Additional Site Components Survey.

BUILDING INFRASTRUCTURE/SITE COMPONENTS	**NUMBER OF RESPODENTS**	
	YES	NO
Need for Private Plot	80	7
Need for Private Garden	73	14
On-Site Garage	24	61
Alternative Power Source	81	4

Source: Author

RECOMMENDATIONS

For effective housing delivery and supply that will meet the growing housing need and preference (desired); the following way out is hereby suggested:

1. An easy-to-access and ready housing database should be developed by all level of government i.e. federal, state and local governments.
2. There should be an inclusive housing provision approach whereby potential user's opinion(s) is sort and considered in the design/planning stage.
3. Identifying and getting land for affordable housing should be made easier and documented.

CONCLUSION

The foregoing data analysis indicate a very low performance of the housing scheme in terms of end user satisfaction due to a short fall in meeting the users need and response to occupant's preferences in housing accommodation. This to a large extent may describe a level failure of the housing scheme. The onus is therefore on the government and all stake holders in the housing sector to provide houses that reflect the culture and preference of potential occupants of houses that are being provided. The consideration of developing a potential annual or biennial housing database by all tiers of government is therefore recommended to help achieve a sustainable housing delivery in Nigeria.

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INTEGRATED APPROACH: A SUSTAINABLE STRATEGY TO ADEQUATE HOUSING PROVISION BY THE URBAN POOR IN LOKOJA, NIGERIA

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The housing sector in Nigeria have always adopted single sectored or multi-sectored approaches to address the plaguing issue of housing deficit which have proven ineffective and partial. The most affected are the low income earners due to their inability to afford the rental values as well as other factors that impedes their access to adequate housing. This study is aimed at adopting strategies that will reduce the problem of poverty and aid affordability so as to ensure a sustainable provision of adequate housing. In achieving this, the study examined the provisions made by previous strategies in the study area that have been represented in sixteen (16) neighbourhoods made up of 1,836 housing units. 318 questionnaires were administered and 309 retrieved and analysed using SPSS. On another hand, focus group discussion was held to research the potency of integrated approach through participation over other strategies. A transcript was generated and subjected to analysis using Nvivo. With a highest representation of 33.3% of responses being related to local economic development followed by a 22.2% of responses related to urban governance, the study revealed that participation of people from all areas of life in the housing delivery process and related governance issues as well as engagement of the government in programmes that will improve the livelihoods of the urban poor will result in a more sustainable journey to adequate housing provision than the previously used strategy in the study area which reflects a mean index of 2.73 of the provision as fair, that is, not good enough. Therefore, better involvement in the governance as well as a concurrent improvement in the lives of the people will help every government achieve their prerogative of adequate housing provision not just for the urban poor but for all.

Keywords: Adequate housing, integrated approach, public participation, livelihood, urban poor.

INTRODUCTION

Every living being is entitled to certain basic rights one of which is adequate housing. This right is recognized by the international human rights law as part of a right to adequate standard of living. Despite the central place of this right within the global legal system, well over a billion people are not adequately housed (United Nations Habitat, 2014). This happens as a result of a constant, yet unprecedented rise in population especially in developing countries, consequently making access to adequate and affordable housing by a majority of the population an issue until appropriate intervening measures are taken to achieve this provision at a sustainable level. (Jacqueline and Danielle, 2017). Olotuah and Bobadoye (2009) observed that lack of adequate housing in Nigeria, is a manifestation of poverty; the main reason why significant proportion of the urban dwellers live in high density housing and areas where environmental conditions which constitute serious health hazard and threat to their general productivity exists. In the context of Nigerian cities, there have been interventions (examples include the site and service scheme, low-cost housing scheme, direct built by government in the form of staff quarters) in the housing sector in a bid to accommodate the rising population. These interventions have been in the form of programmes and policies that have guided housing developments, but these have proven not to be sufficient. (Enisan and Ogundiran, 2013).

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As against the recommended strategy by the UN Habitat (2014), in using a participatory approach that ensures social inclusion and environmental viability, the study area, Lokoja, has maintained a pattern of housing provision that has not satisfactorily served the end users and has sidelined the urban poor in the area. This is so because the provisions made so far have been direct built by government and purposely for civil servants except for the flood victim estate. A distribution of these provisions is shown in the table below. It is on this premise that this paper aims to promote integrated approach through participation at all levels as a strategy for the sustainable provision of adequate housing to the urban poor. This is going to be achieved by first, examining the level of satisfaction of the end users of housing provision made through implementation of other strategies and then secondly, examine the resources that can be harnessed in improving this provision through integrated approach in the study area.

Table 1.1 Public Housing Provision in Lokoja, Nigeria.

S/NO	NAME OF ESTATE	HOUSING TYPE	No. OF UNITS	CADRES
1.	Lokongoma Phase I	32 block of 8-man quarter of 2-bedroom bungalow	248	Intermediate Staff
82	Adankolo Housing Estate	1, 2 and 4 bedroom bungalows	74	Junior and Intermediate
3.	Lokongoma Phase II	3 bedroom bungalow	150	Senior
4.	Salau Attimah Estate	1 and 2 bedroom bungalows	70	Junior and Intermediate
5.	4th Republic Legislators' Quarters	3 and 4 bedroom bungalows	35	Senior
6.	Workers' Village	24 blocks of 2 bedroom bungalow	96	Intermediate
7.	Former Commissioners' Quarters (G.R.A.)	4 bedroom bungalow	25	Senior
8.	Danladi Zakare Housing Estate (Ganaja Road)	1 bedroom bungalow	50	Junior
9.	Oba Micheal Olobayo Housing Estate, Ganaja Road	3 bedroom bungalow	226	Senior
10.	Former D.G.'s Quarters, G.R.A.	4 bedroom bungalow	15	Senior
11.	New Commissioners' Quarters, Ganaja Road	6 bedroom duplex	30	Senior
12	Old Poly Quarters, Ganaja Road	3 bedroom bungalow	10	Senior
13.	Otokiti Housing Estate, Barrack Road	1, 2 and 3 bedroom bungalows	253	Junior, Intermediate and Senior
14	Ganaja Housing Estate, Ganaja Road	1, 2 and 3 bedroom bungalows	252	Junior, Intermediate and Senior
15	New Permanent Quarters, Ganaja Road	5 bedroom duplex	30	Senior
16	Flood Victims Estate	1 and 2 bedroom bungalows	272	Flood Victims
			1,836	

Source: Author, 2017

The Concept of Housing

The concept of housing varies from place to place. It is basically seen as a shelter that protects one from the harsh effect of weather elements (Jinadu, 2007). By this definition, huts, tents, canopies and even caves can be regarded as housing. In a case where adequacy is paramount, all these are inappropriate, hence they must fulfill certain functions that only the entirety of adequate and sustainable housing can fulfill (NASA, 2007). Housing is therefore not just a structure with a roof but also the features within the environment provided to support the functionality of the structure. Housing also goes further to portray the social status of a person or family, a source of prestige, a symbol of one's personality or a means of one's identity. It is above all a basic human right (United Nations, 2014)

The Concept and Characteristics of Adequate Housing

United Nations (1991) defined adequacy in housing as a case which is determined in part by social, economic, cultural, climatic, ecological and other factors. For housing to be adequate, the occupants should have a degree of tenure security which guarantees legal protection against forced evictions, harassment and other threats. This security should be available for both property owners and those renting houses. The availability of services, materials, facilities and infrastructure is also a determining factor for housing to be regarded as adequate. Certain features should be put in place such as safe drinking water, adequate sanitation, energy for cooking, heating, lighting, food storage or refuse disposal. There also has to be a degree of affordability as housing is not adequate if its cost threatens or compromises the occupants' enjoyment of other human rights. People should be able to

demand for housing with the corresponding willingness and backing to afford housing according to one's taste and within not more than 30% of a person's income. Other than secure tenure, affordability and availability of infrastructure and services, for housing to be totally adequate, according to UN Habitat (1991), it has to be habitable, accessible, well located and culturally adequate.

Housing and the Urban Poor

The urban poor are those found in areas referred to as slums or informal settlements which in most cases lack tenure, adequate infrastructure and structurally sound and safe houses (Adedayo, 2015). These people are made up of migrants from rural areas to urban areas that relocate to the cities to get a better source of livelihood. They constitute the vast majority of urban dwellers and they are in a disadvantaged economic position to build for themselves and are generally unable to make effective demand of existing housing (Olotuah and Taiwo, 2013).

Nigeria, like most of other developing countries, have made attempts at providing adequate housing for their urban poor through various approaches such as provision of low cost housing, site and service scheme, staff quarters for civil servants among others. All of these approaches have shown very little success as the deficit is still on the increase. At some other points when approach adopted involves renewal or redevelopment of the already existing slums, forced evictions without alternative accommodation or adequate compensations usually take place. This further displaces the urban poor and makes them believe less in the government's ability to salvage the situation of homelessness and housing inadequacy (Afolabi and Olumide, 2012).

The Concept of Integrated Approach

Integrated approach, as defined by Rossiter (2000) is a process where a multi-sector approach is co-ordinated to be mutually supportive, with all the different sectors operating in such a way that results in one are reinforced by achievements in another. This school of thought by Rossiter is been globally concurred with and adopted as seen in the report at a workshop by the UN Department of Economic and Social Affairs and the UN Division for Sustainable Development (2015). The participants at this workshop described the post-2015 development agenda and sustainable development goals as a 'global, national and local social contract where communication, participation and partnership are its keywords.' They also stated that in adopting integrated approach as the way forward, the proposed social cohesion which is the a key aspect of the driving forces to achieve this, demands attention to governance, where national, regional as well as local levels are completely interconnected, where multi-stakeholder and multi-dimensional approaches and collaborations are the norm.

Sustainable Livelihood Framework: A Tool to Achieving Integrated Approach

The Sustainable Livelihood Framework according to Majale (2003), seeks to improve housing (physical capital) through the use of alternative building materials in urban areas which involves building human capital through skills upgrading, strengthening community based groups (social capital) and facilitating access to credit (financial capital), as well as reviewing regulatory frameworks. The concept of livelihood is relevant here because it is an important defining factor in the ability of an individual to provide housing for himself. Majale purports that livelihood connotes assets, entitlements, means and activities by which people make a living. This therefore sums up sustainable livelihood to be a function of how members of a society utilize these assets to meet their needs without compromising those of future generations. This is affirmed in the definition of livelihood by UN Habitat Factsheet (2014) as activities that allow people to secure the basic necessities of live, for example, food, clothing, water and shelter, which is, housing.

The above framework therefore supports the expected outcomes of employment generation and poverty reduction as an important area that the UN Habitat Global Housing Strategy Framework seeks to achieve as part of the forces that will ensure the achievement of sustainable provision of adequate housing. Integrated approach was adopted in Nakuru, Kenya in tackling the issue of providing adequate housing to the urban poor. This they did through participation and improvements of livelihood at the community level. Efforts were concentrated on developing medium scale enterprises to increase the income-earning capacity of community based organizations, especially women's groups. Skills and business

training, and knowledge sharing and information exchange were other project elements that became of great import (Majale, 2003).

RESEARCH METHODOLOGY

Lokoja is a town with an estimated population of 60, 585 people. Responses were drawn with the use of questionnaires that were randomly sampled in the sixteen (16) neighbourhoods made up of 1,836 housing units that represented provisions made through the implemented strategy in the study area to ascertain the success or otherwise of the strategy. The findings from the 309 questionnaires retrieved out of the 318 administered were analysed using descriptive analysis to generate frequency tables (as this can be used for straightforward description of continuous and categorical variables) on SPSS and results are presented in tables. A concurrent finding using the focus group discussion (FGD) method was done across two (2) groups of people (9 and 8 in number) made up of professionals, workers of the informal sector of the economy, members of non-governmental organizations and some youths to find out what resources are available as well as platforms that can and are being leveraged upon to make integrated approach a more appropriate and sustainable strategy for adequate housing provision for the urban poor in the study area. Results from the FGDs were transcribed and analysed using Nvivo. Results are shown in the outlined codings and categories within respective themes and also discussed.

RESULT FINDINGS AND DISCUSSIONS

Level of satisfaction in the implementation and usage of the strategies identified

The level of satisfaction of the inhabitants of the housing provision from previously implemented strategy in the study area is examined using yardsticks which includes;

i. Condition of the buildings: this includes components such as walls, floors, roofs, doors and windows.

ii. Characteristics of the dwelling units: this includes the number of rooms in each unit, their sizes as well as the sizes of the kitchens and toilets and the extent of natural lighting and ventilation in each unit.

iii. Condition of infrastructure and environmental quality.

The levels of satisfaction of each component as presented in the derived Mean Condition index is scaled in ranges from 0 – 5 and represented as follows; 0 – 1.49 (Very Satisfactory); 1.50 – 2.49 (Satisfactory); 2.50 – 3.49 (Fair); 3.50 – 4.49 (Dissatisfactory); 4.50 – 5 (Very Dissatisfactory)

Table 1.2Condition of Building, Characteristics of Dwelling Units and Condition of Infrastructure/Environmental Quality

S/No.	ITEM	Mean index of condition	Remark
1.	Condition of the walls	3.47	F
2.	Condition of the roof	3.41	F
3.	Condition of the floor	2.88	F
4.	Condition of the doors	2.09	S
5.	Condition of the windows	2.22	S
6.	Number of rooms	2.37	S
7.	Size of rooms	2.29	S
8.	Ventilation	1.96	S
9.	Natural Lighting	1	V.S
10.	Number of Toilet/ Bathroom	2.39	S
11.	Size of Toilet/ Bathroom	2.51	F
12.	Size of Kitchen	2.51	F
13.	Efficiency of solid waste disposal system	2.88	F
14.	Condition of drainage	2.76	F
15.	Condition of access road	3.45	F
16.	Regularity of water supply	3.69	D
17.	Regularity of power supply	3.53	D
18.	Level of Security	3.67	D
Mean index of entire public housing provision		**2.73**	**F**

Source: Author, 2017

From the table 4.5 above, the condition of the buildings provided by the previously implemented strategies in the study area is outlined thus; the condition of the walls, roof and floor were considered fair with mean index of 3.47, 3.41 and 2.88 respectively. Those of doors and windows were satisfactory also with mean indices of 2.09 and 2.22. The characteristics of the dwelling units had the size of the toilets and windows considered fair with mean indices of 2.51 each. All other characteristics were considered satisfactory as indicated in the table above.

On the other hand, the condition of infrastructure and environmental quality had a vote of dissatisfaction in the regularity of power and water supply as well as the level of security. This is seen in their mean indices of 3.53, 3.69 and 3.67 respectively. The conditions of the access road and the drainages as well as the effectiveness of the solid waste disposal system were considered fair, having mean indices of 3.45, 2.76 and 2.88 respectively.

Resources Available for Implementation of Integrated Approach in Lokoja

A focus group discussion was carried out involving representatives of selected group of people to have a fair hearing of housing and environmental issues. These people were drawn from workers in the informal sector of the economy, those living in disadvantaged neighbourhoods as well as civil servants.

The questions asked were based on the components of adequate housing as well as factors that determines access to adequate housing, which have been summarized into thematic areas such as basic urban services, environment, urban safety, urban disaster risk, land, urban governance and local economic development. These themes were further categorized under the various aspects of resource capitals that make up the sustainable livelihood framework (natural resources, social resources, human resources, physical resources and financial resources). These attributes and themes and their categories brought about the following findings;

Natural Resources

Natural resources are made up of natural resource stock from which resource flows useful for livelihoods are derived. Examples are land, water, bio-diversity and environmental resources. The thematic areas that contain natural resources that are being and can be harnessed to improve the livelihood of the urban poor or create a platform for such possibility include Environment and Land

Findings for Environment

Environment here refers to the immediate surrounding as well as the entire ecological setting of the study area.

> *'... the variety of river fish and some historic features and sites like the mount patti, the confluence of river Niger and Benue, ... All of these places will be very good for tourism purpose.'* (Government, Community, Cooperative or Individual Driven)

> *'Efforts are being made by the government to better the environment of the people and help improve their livelihood. For example in the Kabawa area, the reclaimed land opposite Kabawa by the river itself is being planned for a recreational garden.'* (Government driven)

Findings for Land

Land here refers to undeveloped plots available for agricultural purposes.

> *'.... Ponds are actually encouraged by the government as well as farming of rice and cassava. Loans are given if you have sufficient land space land and are ready to dive into this initiative. I believe these things can translate into higher income.'* (Government driven)

> *'... the reclaimed land opposite Kabawa by the river itself is being planned for a recreational garden.'* (Government driven)

Discussion

Responses have shown that the environment of the study area can be harnessed to create a platform for improved livelihood. Some of the activities and ideas are government driven, while others are individual or community driven. The ownership of undeveloped land can

as well be an asset for those interested in agricultural activities. When these resources are put into good use, an increased income is ensured as well as support from the government.

Social Resources

This comprises of the social resources (relationships of trust, membership of groups, networks, access to wider institutions) upon which people draw in pursuit of livelihoods. The study area possesses these resources as seen in thematic areas such as local economic development and urban governance as follows;

Findings in Local Economic Development

Local economic development here involves economic activities of the informal sector (such as carpentry, tailoring, and hair dressing) as well as government efforts towards improving these activities.

> *'... the government has helped the unemployed youths and women by engaging them in menial jobs and paying them a token every month. .... What they do is basically engage some of them in cleaning of the streets of Lokoja and others are trained in various vocations ... get paid and then given soft loans to start business at the end of their training. '*

> *'Cooperatives and associations give business loans to members who regularly contribute financially to enhance their businesses. ... daily contribution, for the petty traders, they save a certain amount of money daily and are granted loan after some time,...'*

Findings in Urban Governance

This thematic area involves the activities undertaken by the government as well as methods or initiatives used to improve the wellbeing of the people.

> *'... That is why most of the soft loans given are given to those who apply at cooperative level just to try to show them how cooperative work can bring result.'*

Discussion

It is evident that affiliations with various associations has helped to boost the livelihood of its members either by directly financing their businesses through loan issuances or by giving members a credible platform through which they can obtain financial help from the government for improvements of livelihood activities. These associations and relationship networks have therefore proven to play important roles in making the lives of its members better.

Physical Resources

This includes infrastructure such as water supply, electric power supply, waste disposal system/sanitation, road/transportation, housing and means of equipment of production. The thematic areas that have shown alignment with this resource area are the basic urban services and local economic development.

Findings from Basic Urban Services

Basic urban services include infrastructure and services such as water supply, electric power supply, waste disposal sanitation as well as road/transportation.

> *'Since 1991, it has been the old water works, until Alhaji Ibrahim Idris constructed the new water board at Ganaja producing up to seven million gallons per day which supplies Crusher, Barracks, Ganaja, Phase I and II.'*

With respect to power supply;

> *'Apart from the communities in the town that are geographically in other local governments, the old Lokoja town still suffers more of black out all day.'*

> *'... As regards basic services like power supply, Kabawa have very regular light and they are not being billed.'*

As regards waste disposal practices;

> *'..... the Geemony sanitation company, a private company which works for the government and in turn employs so many youths in cleaning the environment of*

government owned organizations and some public housing estates like the legislative quarters and the commissioners' quarters.'

The road and transport sector has also been regarded as bad as well as expensive to get people and goods around. Not much has been done on the roads, but other areas of transport are being explored.

'..., only the road that was constructed at Adankolo and Kabawa we can call improvement. '

Discussion

Having all physical resources available at their optimum level will have a direct positive impact on other activities both economic and domestic in nature. Cost of creating alternatives can be reduced due to a boost in the provision of these services.

Human Resources

This comprise of knowledge, skill, ability to labour, information and good health. Thematic areas that fall into this category include local economic development and urban safety.

Findings from Local Economic Development

Local economic development here refers to development and improvement of skills that are essential to starting a viable economic activity.

... others are trained in various vocations like carpentry, tailoring, hairdressing, get paid and then given soft loans to start business at the end of their training.

'.... They are as well working on a semi-jetty because of the fishermen since they know that most of the men engage in fishing business.'

Findings on Urban Safety

Urban safety sees to the security of the environment. This thematic area refers to skills as well as willingness to carry out activities that ensure such security.

'The state government has a body of vigilantes trained by the state and assigned to work in collaboration with the police force. They are dispatched to various locations for security purposes and are paid by the government.'

Discussions

Local economic development in the study area has been a target area by the government of the study area in various ways that has and still can literally boost the income of the urban poor. This is evident through initiatives that has helped train people in various vocations as well as finance their businesses to help translate their trainings into money making activities. The willingness of the people to labour has also yielded positive results in earning them security through the vigilante scheme sponsored by the state. Through this, people are getting employed and security of the study area is beefed up as well.

Financial Resources

This includes savings, credits, regular remittances or pensions available to kick start or boost income. The thematic areas relevant to this resource type are local economic development and urban governance.

Findings on Local Economic Development

Local economic development here involves the institutions and initiatives that financially drive and improve economic activities in the study area.

'There is the Mortgage bank from the government and the Agric bank also which also gives soft loan to those who are interested…'

'*Cooperatives and associations give business loans to members who regularly contribute financially to enhance their businesses.'*

Findings on Urban Governance

This refers to the willingness of the government to make financial aid available to the people through various loan schemes.

'The state also offers soft loans to improve businesses of small scale business men and women and traders.'

'The current programs sponsored by the state government are the Best Brain Project, also dealing with vocational training and sponsoring of small businesses;…'

Discussions

Financial resources are key to every other resource and it is evident in the study area that its governance activities are making as much financial aid as possible available to the people. This has helped to improve their economic activities hence, a rise in their income and livelihoods.

SUMMARY OF FINDINGS

The housing interventions from previous strategies in the study area suffer poor structural conditions as expressed by the high level of dissatisfaction of the respondents. While the characteristics of the dwelling units are generally satisfactory and the approach ensured the provision of some basic infrastructure; the efficiency, condition and regularity of these infrastructure turned out to be poor.

The study area is endowed with the necessary resources it requires to improve the livelihoods of the urban poor if put to good use. This can be done if among other thematic areas, a major attention is given to local economic development and good urban governance.

Participatory approach to planning is not in itself a provision of access to adequate housing by the urban poor in the study area but is a very strong entry point to the basis on which every other factor of access to adequate housing is hinged, which is an improved income or financial base.

CONCLUSION

The approach adopted in housing provision in the study area has shown not to have successfully addressed the need for the provision of adequate housing. This is obvious from the various levels of dissatisfaction as expressed by the respondents in the course of carrying out the research. On the other hand, the focus group discussion revealed that the attempts that are being made to improve the livelihoods of the people have been yielding positive results. The level of participation of the participants of the FGD also goes to prove that this can be a very useful tool in knowing the mind of the people with respect to housing. This therefore means that integrated approach, if fully adopted with a focus on improving the livelihoods of the people, will yield a more sustainable result where adequacy in all its ramifications is met and the urban poor are being actually housed or given the platform for an easy self-provision of adequate housing.

RECOMMENDATION

The government needs to see to the implementation of policies and programmes that will have the urban poor as their target with respect to housing provision. This is achievable by putting in place mechanisms for proper monitoring during implementation of housing programmes as well as evaluations at regular intervals as well as creating an enabling environment for the development of local businesses which should be consistently encouraged by the government.

The institutions and organizations in the field of housing provision should create a work frame that allows the participation and input of the urban dwellers of all levels in planning processes especially those that concern housing provision.

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ASSESSMENT OF HOUSING STANDARDS COMPLIANCE AND BUILDING REGULATIONS IN MINNA, NIGER STATE, NIGERIA

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It is well-known fact that the world is fast becoming urbanised and this process is unfortunately rife with the challenge of poor urban development mechanism by the planning authorities. This has led to problems such as slum development, housing deterioration and congestion. Thus, the quality of housing units, especially in the urban areas of developing countries, has continued to evoke considerable concern. Consequently, this study assessed housing standards and building regulations compliance in some selected residential neighbourhoods of Minna in Niger State, Nigeria. The study carried out reconnaissance survey to ascertain the level of compliance with housing standards and building regulations in Minna. A total of 378 questionnaires on household heads in the six randomly selected neighbourhoods of Minna, using simple random sampling techniques. The collated data were analysed with the aid of descriptive and inferential statistical tools which were adopted to summarize the data using of tables, charts and Chi-square. The result of the analysis revealed that there is no significant difference in the level of compliance with housing standards and building regulations in the low, medium and high densities residential neighbourhoods of Minna. It also revealed that the level of compliance to the housing standards and building regulations was very low in the study area, even with the existence of some planning schemes and approved building plans. This, as was observed, is due to lack of proper inspections and monitoring of construction activities by the Urban Board. Finally, the study recommended that the Niger State Urban Development Board (NSUDB) should be more alive to its responsibilities by enforcing building standards and regulations in order to have decent housing environment that is good for human habitation. Also, regular public sensitization and awareness programmes should be organized in order to enlighten the residents on the need and importance of adherence to building standards, especially in terms of securing plan approval and permits before starting any construction activities.

Keywords: Compliance Housing Regulations, Standards.

INTRODUCTION

The term housing is viewed and conceptualized in various ways by different authors (Usman, 2013). Hence, Jinadu (2007) opined that it is more than just a shelter, because a house may transcend the basic functionality of providing a roof over one's head. On the other hand, Agbola and Adeniji (2009) viewed it as a "process" or as a "product". In their view, it is a "product" because it is a finished entity that can be seen and touched, but a "process" because it involves the provision of functional shelter in a proper setting in form of a neighbourhood supported by sustainable maintenance of the built environment for the day to day living and activities of the individuals and families within the community. This therefore goes to show the importance of the availability of neighbourhood facilities and services in the built environment. However, the high rate of urbanization in Nigeria has, according to Onu and Onu (2012), led to an unprecedented increase in its urban population on the one hand, and results in the high demand for housing units on the other. Nigeria as a Nation is faced with the problem of housing deficit, the effects of which have manifested in the form of poor housing quality, congestions, the development of slums and squatter settlements, amongst others.

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Thus, owing to these problems, Onibokun (1990) asserted that both the governments and individuals have made concerted efforts in the provision of quantitative and qualitative housing to meet the demand of the ever increasing population in Nigerian cities. However, Israel and Bashiru *(*2008) stated that these efforts by the government at all levels (Federal, State and Local) and individuals are yet to be fruitful. In the Nigerian construction industry, it is generally believed that putting up a structure is beyond the capacity of the low income earners who form the bulk of the population. In view of this, Israel and Bashir *(*2008) stated that the issues of the quality of the building materials and inaccessibility to funds amongst others are the major constraints that led to price increases of housing and housing construction.

It is worthy of mention to note that housing units occupy geographical space, which makes them entities of the neighbourhood and the entire settlements. Hence, aside the issues of housing satisfaction and liveability (which are both relative), the development of housing units must also satisfy the issues of functionality and compatibility (Atebije, 2016). This functionality, according to Chana (2011), is considered in terms of the design and availability of its component (ancillary) parts and their compatibility with the adjoining land uses. The attainment of these is of paramount importance because they are what physical planning and standards seek to achieve. Physical planning, according to Keeble (1973) is an art and science of ordering the use of land, citing of buildings and other communication routes so as to achieve maximum degree of economy, convenient and beauty. On the other hand, Olujimi (2008) described planning standards as technical devices that states the maximum and minimum percentage of building variables such as coverage, setbacks, and density of housing (and all other forms of development). Thus, this study set out to assess the variations in housing standards compliance across neighbourhoods in the selected neighbourhoods of Minna.

The Study Setting and Methodology

Minna has a land area of about 885 hectares and it covers the whole of Chanchaga Local Government Area in the south and some part to Bosso in the North. It has a distance of 16km which spanned through and lies between latitude 6° to 9° N and longitude 37° to 33°E on the geographical base of undifferentiated basement complex of mainly gneiss and magmatite. To the North-East of the town, a more or less continuous steep outcrop of grain occurs limiting any urban development in that direction (Max Lock 1979). Figure 1 is a street map of the town and it also showed the randomly selected neighbourhoods of the town.

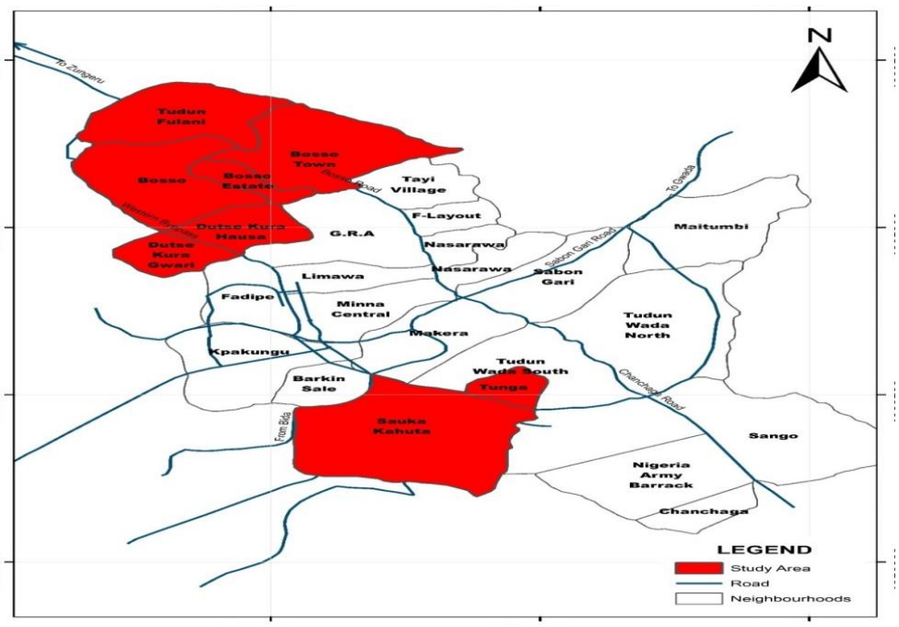

Figure 1: Minna and Selected Neighbourhoods
Sources: Niger State Ministry of Lands and Housing, 2017

RESEARCH METHODOLOGY

The study used data from primary sources. The primary data collected include housing tenure types, land titles, availability of building plans, permits and level off compliance with the standards. These data were collected from 378 households sampled randomly from six neighbourhoods. The neighbourhoods were sampled from a cluster of 24 High, Medium and Low residential areas in Minna.The randomly selected high density neighbourhoods are Tudun Fulani and Sauka Kahuta, the medium densities are Tayi and Dusten Kura, while the low densities area F-Layout and Bosso Estate. Thereafter, the questionnaires were proportionally distributed among the neighbourhoods, while the

systematic random sampling technique was employed in the distribution of the questionnaires to the household heads or their representatives.

The data collected for this research were analysed and presented using both the descriptive and inferential statistical tools .The household compliance Index (HCI) was calculated using the Excel platform while the variation in Neighbourhoods Compliance Index (NCI) was calculated using the chi-square analysis. The results of analysis were presented in frequency tables and charts.

RESULTS AND DISCUSSION

The discussions in this section are based on the results of data analysis on compliance with housing standards and building regulations across the low, medium and high density areas. Also variables obtained from the observations was analysed and discussed.

Housing Types by Neighbourhoods

The basic types of residential properties occupied by households in the study area as shown in Figure 2 were the face-to-face, semi-detached and detached bungalow. It is also important to note that the face-to-face type were mainly either single rooms or a room and parlour (sitting room) type, while the semi-detached and detached bungalows were majorly 1, 2 or 3 bedrooms flat. The data shown in Figure 2 revealed that 61.9% and 79% of the residential units in Dutsen-Kura and Sauka Kahuta respectively were face-to-face housing type, while F-layout (82.9%), Bosso estate (79.3%), Tudun-Fulani (64.3%) and Tayi (61.1%) have higher concentration of detached bungalows. The outcome of this therefore revealed that there were more face-to-face or row housing type in high density areas while the semi-detached and detached bungalows were the dominant housing type in the medium and low density areas of the city.

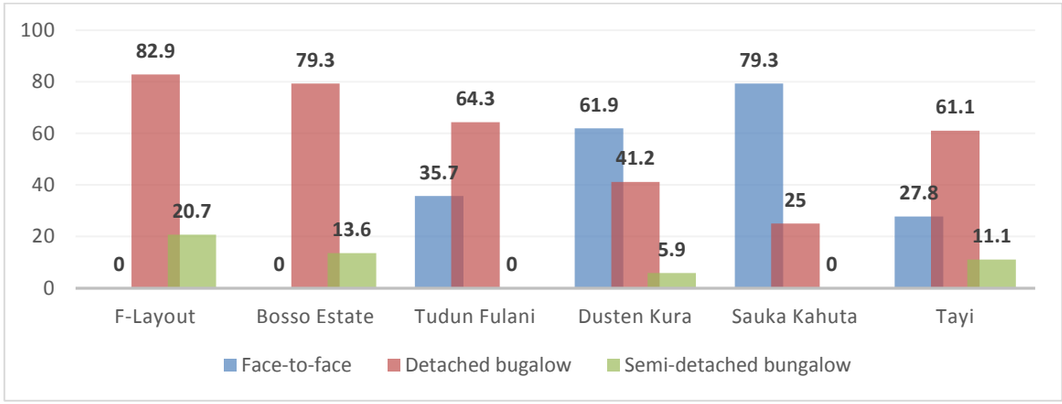

Fig. 2: Housing Types on Neighbourhoods Basis
Source: Author's Field Survey, 2017

Type of Land Title in the Neighbourhoods

The data presented in Figure 3 revealed that 100% of lands in F-layout and Bosso estate had statutory title while 83.3% in Tayi and 63.9% in Dutsen-Kura had customary title of land. The figure also showed that 90.9% of the plots of land in Tudun-Fulani and Sauka-Kahuta respectively had customary title of land, with 5.8% of the plots of land in Dutsen-Kura having no land title. It is discernible from the result only plots of land in the low density areas of F-Layout and Bosso Estate had statutory deeds while medium and high density areas mostly had customary deeds of title.

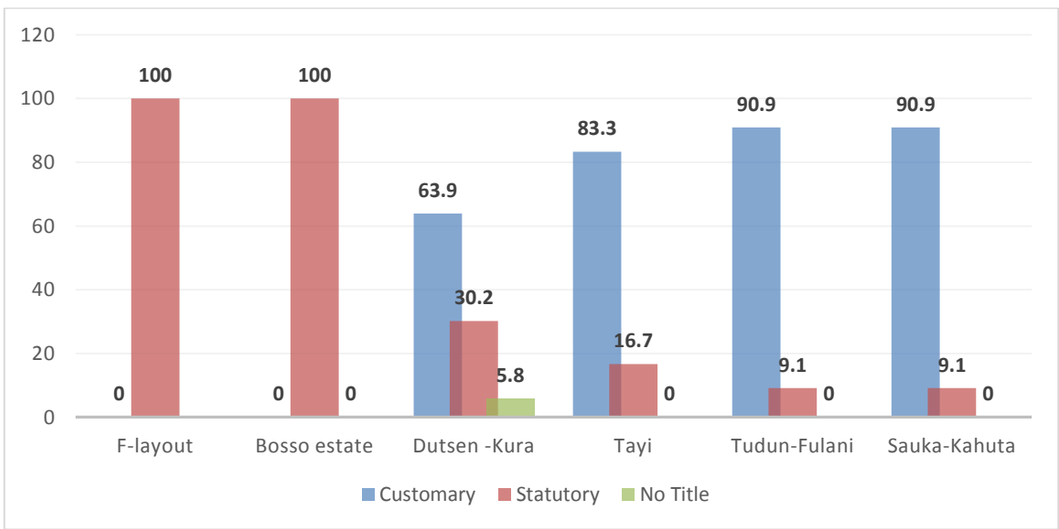

Fig. 3: Type of Land Title of respondents in the study area

Source: Author's Field Survey, 2017

Availability of Building Plans and Development Permit

The level of housing standards and building regulation compliance in the area were examine using variables of building plan availability and development permit from Planning Authority

According to the results shown on Figure 4, all the houses in F-layout and Bosso estate had approved building plans from the Planning Authority. Thus, most of the houses in the areas meet up with the minimum building standards and regulations. However, all the houses in Sauka-Kahuta, 80.2% in Dutsen-Kura, 69.7% in Tudun-Fulani and 55.6% in Tayi do not have building plans. This has therefore affected housing quality in the medium and high density areas of Minna.

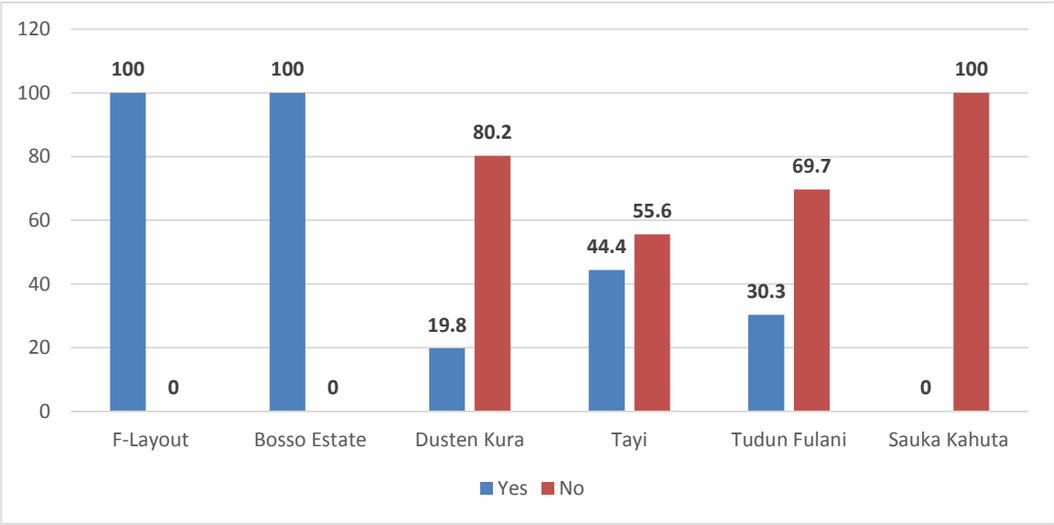

Fig. 4: Approval of Building Plan in the study area
Source: Author's Field Survey, 2017

Building permits are usually granted by the relevant planning authorities upon the fulfilment of some conditions by the prospective developers.industry.The results presented in Figure 5, revealed that all the houses in F-layout and Bosso estate have building permits, while all the houses in Sauka-Kahuta do not had building permits. It was also foundout that 80.2% and 69.7% of houses in Tayi and Tudun-Fulani respectively had no building permits at the time of the survey. Hence, the findings showed that there were higher proportions of illegal structures and buildings in the medium and high density areas than in the low density areas of Minna.

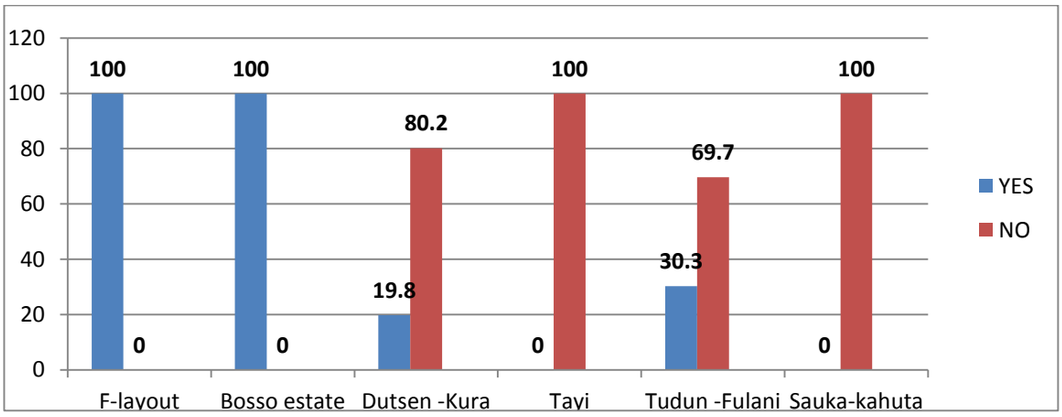

Fig. 5: Building Permits in the study area
Source: Author's Field Survey, 2017

The level of housing standards and regulations compliance is function of development control and inspection activities of the Planning Authority. The results shown in Figure 6 revealed that all the sampled houses in F-layout and Bosso estate were inspected by officials of the NSUDB during their respective construction activities. These, the officials said, were made easy due to the fact that the areas are government approved layouts. The Figure also revealed that 88.8% of the respondents in Tayi, 57.7% in Sauka-Kahuta and 83.8 % in Tudun-Fulani confirmed their buildings were not inspected during construction. As a result of this, the neighbourhoods were characterized by the presence of many illegal and substandard buildings.

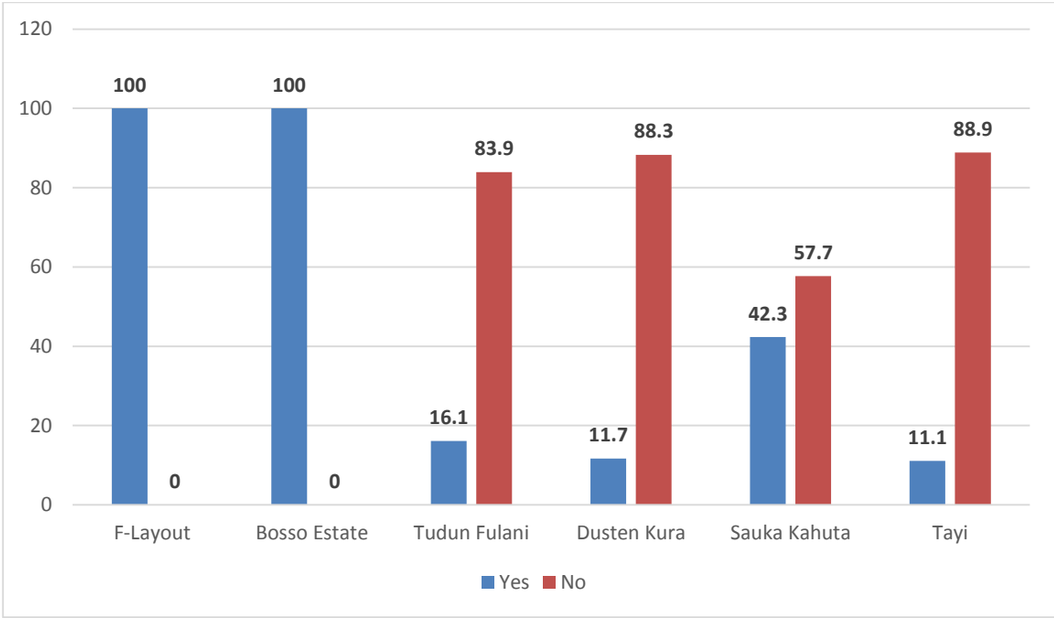

Fig. 6: Inspection of Construction activities by the Planning authority
Sources: Author's Field Survey, 2017

Analysis of the Level of Compliance with Building Standards

In order to determine the general level of compliance with building standards and regulations across the neighbourhoods , measurement on the variables that make up building components of the sampled houses were taken and analysed. The variables measured are building set back, plot coverage, density, building height, size of rooms, ceiling height, external windows, airspaces and height of fence. The outcome of the assessment of the aforementioned is shown in Table 1 which shows the respective minimum standards of the assessed building components of the low, medium and high density neighbourhoods.

Table 1: General Analysis on the Percentage Level of Compliance with Standards across the selected Neighbourhoods

Variables	Minimum Standard L M H	F-Layout	Bosso Estate	Dusten Kura	Tayi	Tudun Fulani	Sauka Kahuta
Set back	8m 5m 3m	58	73	43	43	30	20
Plot coverage	35 45 60	70	79	40	25	25	15
Density	1:00 2:00	80	70	45	35	40	28
Building hgt.	3m	100	100	45	40	45	40
Size of Rm	3600mm	100	100	30	20	30	40
Ceiling hgt.	2.7m	90	100	35	15	35	61
Ext. windows	1400mm	90	100	40	42	25	15
Airspace	3m	100	100	35	45	20	10
Height of fence	2.5m	60	65	45	67	68	35

Sources: Author's Field Survey, 2017

As shown in Table 1, all the sampled houses in F-Layout and Bosso Estate met the minimum standards of building heights, size of rooms and airspaces, while only 40% of the houses in Tayi and Sauka Kahuta, 20% of houses in Tayi and 10% of houses in Sauka Kahuta met the minimum standards of building height, size of rooms and airspaces respectively. On the whole, it was found out that although there were instances of non-compliance with some building standards in the low density neighbourhoods of F-Layout and Bosso Estate, they generally performed better than the medium and high density areas respectively. In other words, the medium density (Tayi and Dusten-Kura) and high density areas of Minna (Tudun-Fulani and Sauka-Kahuta), had comparatively lower compliance level in all the assessed variables. This is because, most of the houses in these neighbourhoods were without approved building plans and permits. In the same vein, the lack of compliance with building regulations in these neighbourhoods is also as a result of poor monitoring and inspection by the concerned public agency (NUDB) as well as low level of awareness of some of these regulations and standards by the residents. In general, it was observed that the poor level of compliance with housing standards and building regulations in Minna is also as a result of the lack of planning schemes in most of these neighbourhoods.

Analysis of Variation in Housing Standards Compliance across the Neighbourhoods

In order to statistically determine the level of variation of housing standards compliance and building regulations across the six selected neighbourhoods, the Household Compliance Index (HCI) of each of the sampled houses was calculated by computing the observed values from the field work in an excel platform. This allowed for the calculation of the Neighbourhoods Compliance Index (NCI) of the households which was used to run the chi-square test. Thus, the analysis of the NCI showed that there is no statistically significant variation across the selected neighbourhoods because there is no much difference in the values obtained from the analysis (Table 2).

Table 2: Neighbourhoods Compliance Index

Neighbourhoods	Neighbourhood Compliance Index (NCI)	Level of Compliance (%)
F-Layout	0.90000	90
Bosso Estate	0.86667	87
Tayi	0.82623	83
Dusten Kura	0.84048	84
Tudun Fulani	0.82121	82
Sauka Kahuta	0.80364	82

Source: Author's Field Survey, 2017

The result of the Chi Square, P = 0.224, which is not significant at 0.05 with 95% confidence level as presented in Table 3.This revealed that there is no significant difference in the level of housing standards compliance and building regulations across the six selected neighbourhoods of low, medium and high densities .

Table 3: Chi-Square Tests for Level of Variation across Neighbourhoods

	Value	Df	P
X^2	30.00	25	**0.224**
N	6		

Source: Author's Field Survey, 2017

CONCLUSION AND RECOMMENDATIONS

The importance of having healthy and functional housing units can never be overemphasized, especially owing to their roles of protecting their inhabitants as well as ensuring their comfort. But these functions of a housing unit are defeated if it did not meet the minimum required standards and regulations. It is important to note that improved quality of housing and it components will bring about healthy human habitation. In view of the findings of this study, there is therefore, the need for developers to provide and improve on the quality of housing and its components by effectively adhering to building standards and regulations.

Based on the research findings, the following recommendations have been put forward in order to ensure effective compliance with building standards and regulations in the study area in particular and the State in general.

i. The NUDB should be more alive to its responsibilities by monitoring and enforcing building standards and regulations in order to have decent housing environment that is good for human habitation;

ii. The NSUB should embark on regular public sensitization and awareness programmes in order to enlighten the residents on the need and importance of adherence to building standards and regulations and;

iii. Incentives should be given to any would be developer that regularised his/her land documents as well as secured plan approval and permits before starting any construction activities.

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SMART CITIES DEVELOPMENT

PROSPECTS AND CHALLENGES OF SMART CITY DEVELOPMENT IN NIGERIA

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Information and Communication Technology (ICT) has become an integral part of every sphere of human interaction. Forces that shape cities are now influenced by ICT, further engaging urban planners, managers and stakeholders in the built environment. This paper assessed the prospects and challenges of smart cities development in Nigeria. To achieve this, the study reviewed the concept of smart city development, current situation of cities in developing countries with reference to Nigeria and the challenges and prospects of smart city development. Through the use of secondary data from relevant literatures, the study revealed that poor electricity, weak stakeholder's collaboration among others are the major challenge to smart cities development in Nigeria.

Keywords; *Built environment, city development, challenges of smart cities, ICT,*

INTRODUCTION

Cities are the main spots of human and economic activity. They hold the potential to create synergies that makes room for great development opportunities to their inhabitants. However, they also generate a wide range of problems that can be challenging to tackle as they grow in size and complexity. Globalization, with trade liberalization measures and fast technological changes are altering the relations of production, distribution and consumption, and has very substantial effects on city development, (Andres 2015).

The concept of the smart city emerged during the last decade as a fusion of ideas about how information and communications technologies might improve the functioning of cities, enhancing their efficiency, improving their competitiveness, and providing new ways in which problems of poverty, social deprivation, and poor environment might be addressed (Batty and Axhausen, 2012) . The smart city approach is emerging as a way to solve complex problems associated with this rapid urbanization. The smart city is an integrated and comprehensive vision of all components of urban life including: the economy, government, transport, green areas, health care and culture (Hajduk, 2015). It is projected that over 26 Global Cities will be Smart Cities in 2025, with more than half of them from Europe and North America. By 2025, it is also expected that around 58% of the world's population or 4.6 billion people will reside in urban areas. This will pose serious challenges for city planners and managers, who will have to re-think how they provide basic city services to residents in a sustainable manner. Smart cities is a global trend of urban schemes which is aimed at restoring the quality of city dwellers leveraging on innovation and high technologies to provide solutions to the challenges confronting the city due to high-population density. It is a remedy for issues of urbanization, especially, land use, environmental pollution, urban sprawl, transport congestion, energy needs, and difficulties in accessing public services.

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However, countries that have adopted the idea of smart cities are mostly in the developed region. They are characterized by high level adoption of technology and the sufficient infrastructure that supports the development of smart cities. In the developing region, Nigeria inclusive, urbanization and infrastructural development are not commensurate. Smart city concept holds the key to an efficient urban system the will tackle the challenges of rapid urbanization in Nigeria. The study intends to provide answers to the following critical question

1. What is the concept and idea of Smart City development?
2. What are the challenges that militate against its development in Nigeria?

Conceptual Issues on Smart Cities

Across literature, the subject of smart cities carries different terminologies; however, a clear-cut definition of the concept does not exist. Some of the terms used that are similar to 'smart' communities appeared as 'wired' communities, ''digital' communities, 'networked' communities, and 'intelligent' communities; but all imply communities that are making 'a conscious effort to understand and engage in a world that is increasingly connected' (Albert, 2009). Even though there are variations in the way the above terms are used by the various researchers, three key aspects stand out in the definitions, they are: the communication mean (network infrastructure , ICTs); the process (networking of various actors); and the goal pursued (public involvement) (Stratigea, 2012).

Defining 'Smart' Cities

There are various definitions that have been given by various researchers and organization on smart cities. A review of these definitions shows that in most cases, these definitions have different perspectives and emphasis. This implies that one definition may not be sufficient enough to drive the idea home, hence a review of different definitions.

Smart cities as an innovation driven by ICT

World Foundation for 'smart' communities defined 'intelligent' cities as 'smart' cities which, based on the adoption and use of ICTs, are paving a 'smart' development. This implies a conscious effort to use ICTs to transform life and work within a certain region, California Institute for Smart Communities (CISC 2001). 'Smart cities were also defined as intelligent environments with embedded ICTs, targeting the creation of interactive spaces that bring computation into the physical world. From this perspective, 'intelligent' cities (or more generally 'intelligent' spaces) refer to physical environments in which ICTs and sensor systems disappear as they become embedded into physical objects and the surroundings in which we live, travel, and work (Stevenson and Wright 2006).

Smart city is a city that monitors and integrates the state of all of its critical Infrastructures" It is also a city "linking the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city." Taewoo (2011)

It is also a city that combines ICT with other organizational, design and planning efforts to de-materialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, to improve sustainability and livability". The goal behind 'smart' city development is the provision of qualitative and innovative services to the public, to the economic activities, and to the visitors of a city, together with the production of a safe, pleasant and inclusive urban environment. To this end, the development of a 'smart city' presupposes the proper integration of three layers (Komninos, 2006). The first is the physical layer, incorporating human capabilities and knowledge-intensive activities; secondly is the institutional layer that incorporates proper institutional mechanisms for social co-operation towards knowledge and innovation development. This involves institutions and mechanisms for information diffusion, transfer of technology, cooperative new product development. While the third is digital infrastructure layer that incorporates a range of ICT infrastructure, tools, applications and content in support of both individual and collective action.

Smart Cities and Infrastructure

Smart infrastructure delivers the foundation for all of the crucial themes related to a smart city, comprising smart people, smart mobility, smart economy, smart living, smart governance, smart buildings, smart energy, smart health, smart solid waste management and

smart environment. The core characteristic that underlies most of these components is that they are connected and that they generate data, which may be used intelligently to ensure the optimal use of resources and improve performance.
A smart building integrates the different physical systems present in an intelligent way to ensure that all the systems act together in an optimized and efficient manner, (Honeywell and Ernest 2015) Smart mobility is best described as approaches that reduce congestion and foster faster, greener and cheaper transportation options. Most smart mobility systems use data collected from a variety of sources about mobility patterns in order to help optimize traffic conditions in a holistic manner. Smart energy management systems use sensors, advanced meters, renewable energy sources, digital controls and analytic tools to automate, monitor and optimize energy distribution and usage.
Cities are constantly trying to solve water scarcity problems with innovative technologies and the better management of water. Improved metering and flow management are key to a good water distribution system. Smart waste management systems reduce waste and categorize the type of waste at the source, and develop methods for the proper handling of waste. Such systems may be used to convert waste into a resource and create closed-loop economies. Their primary benefits are in improving the efficiency of waste collection, pick up, separation, reuse and recycling. Smart cities can develop the capacity to use technology such as big data to develop predictions or identify hotspots of population health (such as epidemics or health impacts during extreme weather events) Hoornweg and Bhada (2012). Smart health-care management converts health-related data into clinical and business insights, which include digital health records, home health services and remote diagnoses, treatment and patient monitoring systems. Jayasinghe, (2015)

Some Example of Smart Cities

Looking closely, there are array of attempts at smart city formation and member-ship. Singapore's intelligent nation project, Songdo, South Korea's purpose built, globally competitive, high-tech, environmentally sustainable, business city, or Guangzhou Knowledge City in China are designed to attract talent, skilled manpower and knowledge-based industries. Masdar City, in the UAE, is currently being designed as an 'oasis of the future' (quite literally as it is built in the desert) and intended to become the world's first sustainable, renewable, energy-powered clean tech cluster (Kingsley, 2013). In Scandinavia and Europe, Helsinki and 'Intelligent' Thessaloniki (Greece) are held up as examples of encouraging the development of new mobile applications utilizing open data and using IT to increase competitiveness and sustainability, respectively (Komninos *et al.*, 2013). In Europe, Barcelona, continues to be renowned for its Smart City Model and in November 2014 hosted its fourth Smart City Expo World Congress in as many years while the Amsterdam Smart City initiative is held up as the example of how to retrofit a city to improve living and economic conditions and reduce carbon emissions (Hollands, 2015; Kirby, 2013)

Going 'Smart': Critical Factors

The Intelligent Community Forum (ICF), a think tank that studies the economic and social developments of 21stCentury communities, defines five critical success factors for the creation of 'smart/intelligent communities', which are also used as evaluation criteria for assessing and rewarding the efforts undertaken by various cities towards 'going smart'. (ICF 2008; Bell et al. 2008; Passerini and Wu 2008; Komninos 2009): one of the major critical factors is the deployment of broadband communication infrastructure, used for the evaluation of the local capacity for digital communication. It should be noted that connectivity choices made by a 'smart' city need to be evaluated through both the prism of that city's local vision, and the affordability of costs incurred for the users (Passerini and Wu 2008). Effective education and training of local labour force, strengthening high rates of adoption of ICT infrastructure. This results in increasing the capacity of this workforce to perform knowledge-intensive activities, and enhancing the potential of participation in knowledge creation processes.

Policies and programs that promote 'digital democracy' by bridging the digital divide among different groups of society, ensuring that everyone will reap the benefits of the broadband revolution (i.e. digital inclusion) is another factor. Innovation capacity, assessing the level of creation of an innovation-friendly environment that attracts highly creative people and businesses. Marketing of 'smart' communities as advantageous places for living, working and running a business, which leverages the community's potential to attract talented

employment and investments. These critical factors are required to be in place before success can be achieved in the development of smart cities.

RESEARCH METHODOLOGY

The study made use of qualitative data which consist mainly of review of relevant literature on the subject of smart cities. This implies that the study made use of secondary data which was sourced from published previous studies on smart cities both in Nigeria and other regions of the world.

The State of Nigerian cities

According to the Nigerian census of 1952, an urban center was an area with the population of more than 5,000. By contrast, the 1963 census in Nigeria fixed 20,000 people and above for an urban center. The economy of the country in which urbanization is taking place has been described as stagnant and the growth of industrialization is negligible (Salau, 1992). The implications of rapid growth of cities in Nigeria on employment, human and food security, economy, waste management, infrastructural facilities and services inter alia are alarming.

Projections suggest that the number of people living in Nigerian urban centers will reach 100 million by 2020, (Oyeleye, 2013). The significant growth in population has implication the management of land for housing, business premises and the environment and infrastructure. Inadequacy in the provision of housing has led to the emergence of slums, spatial inequity in access to land and infrastructure, unplanned land development, decay in infrastructure, persistent flooding, widespread poverty, and unemployment. The management of urban Municipal Solid Waste (MSW) is another big issue in Nigerian cities due to the lack of sufficient equipment for collection of waste. This situation is similar in all the major cities of Nigeria. Muhammed *et al* (2015). This therefore brings to bare the need for the adoption of smart cities technology to mitigate the challenges of urbanization in the country.

CASE STUDY; ATTEMPTS AT SMART CITIES DEVELOPMENT IN LAGOS STATE, NIGERIA

In line with strategies to make Lagos a smart and mega city in the 21 Century, the government has begun the setting up of free WiFi connectivity across public places in the state, Ndubuisi kanu Park in Alausa, Ikeja are already completed (www.thisdaylive.com). The Lagos government and the state of Dubai signed an MOU that would among others lead to the deployment of 13000 CCTV cameras and unified communication system. The Lagos state government has also started the implementation of Lagos enterprise Geographic Information System upgrade and the integrated Land Administration Automation system, which will adopt technology in ensuring proper monitoring of public infrastructure for optimum benefits, fast-track the ease of doing business and improve government citizen relationship. Part of the project will include installation of information highway metro fiber and deployment of 4G LTE networks across Lagos to support the complete implementation of e-services like e-health and e-agric among several others, (www.vanguardngr.com)

Prospects for the Development of Smart Cities in Nigeria

Nigeria already has a significant number of its population having access to internet facilities, even though it is not very strong but with the growth in the provision of internet of services across the country, there is a prospect for the development of smart cities in the near future. Some traces of smart concept currently practiced in Nigerian include; Smart banking, which has been adopted by most of the major commercial banks in the country. With this initiative a number of transactions are carried out outside the banking hall and also beyond banking hours (24 hours banking). Smart registration of services and applications such as jobs application, online company registration, tax payment, educational application (JAMB) etc, Smart meters for energy reading among others.

The concept of smart cities is already being mentioned by the various arms of Government in Nigeria; already the federal government is planning a summit on smart cities which is to be conveyed in Lagos Hence, the idea in not entirely strange in the land.

Challenges of Smart Cities Development in Nigeria

Collaboration among Different Stakeholders

Successful smart city has to guarantee the collaboration among different stakeholders (Federal Ministry of Science and Technology, Federal Ministry of Communication, National Information Technology Development Agency (NITDA), Nigerian Communications Commission (NCC), Nigeria Communication Satellite Limited (NIGCOMSAT). The challenge in the Smart City development is for all the participants involved to evolve towards the same objective. Stakeholder collaboration has been a challenge in urban planning and management in Nigeria, what is obtained is the battle of supremacy amongst department and agencies. The various security outfit (Military, police, civil defense etc.) of the country have experience clashes over the years as to issues of jurisdiction. Such battles of supremacy also exist between planning boards and other agencies responsible for the provision of infrastructure such as the water board, housing agencies etc. Abubakar, (2015)

Data and Research

A smart city has all its mechanisms interwoven and this is only possible with the gathering and application of data gathered way over time from the people. Structures cannot be efficient and fluid as envisioned in a Smart City if basic data of the citizens are not on record. This difficulty is only peculiar to smart cities development areas where data is not readily available or totally non-existent. This is the situation in Nigeria where data culture is not very active, even though it is picking up slowly although slowly, too slow for a fast growing economy to get answers and data across various platforms and really understand how its systems work, (Victor 2016)

Inadequate penetration of broadband for major cities in the country

Abubakar, (2015) identified that A fundamental challenge for smart city initiatives is when digital equipment, such as mobile phones (smart) and internet connections are unequally distributed amongst the Nigerian urban populace? Although mobile infiltration may be high in the country, the cost of mobile communication and data is still high for a significant part of the population. The cost of broadband data is also high in Nigeria. There is a wide social disparity in Nigeria between the rich and the poor which pose a challenge to the development of smart cities as it relates to digital inclusion. Nigerian, cities rarely manage to create inclusive dynamics that involve residents, public and private actors in a shared ecosystem of innovation.

Inadequate power for driving cities and Digital Technology

Electricity is a necessary infrastructure for powering the smart city concept; it is required to power the digital technology aspect of any smart city project. However, electricity supply in Nigeria has been an enduring challenge over the years. In May of this year 2016, the Ministry of Power released figures that showed power output dived from a highest 4,500 MW to 2,500 MW; which is almost half of the original amount. The situation seems to be worsening as compounded by rise in the activities of vandals recently this has reflected in daily electricity available in homes, businesses and institutions. How then can the technology of smart city be driven?

These challenges are however not insurmountable if those concerned are willing to address them. However, if these challenges persist, the idea of a smart city in Nigeria will be far from being achieved.

RECOMMENDATION

The study therefore makes the following recommendations based on the challenges identified

1. Stakeholder's collaboration should be integrated in every aspect of the city and should be legalized. This is key to the achievement of a smart city, relevant agencies such as; Federal Ministry of Science and Technology, Federal Ministry of Communication, National Information Technology Development Agency (NITDA), Nigerian Communications Commission (NCC), Nigeria Communication Satellite Limited (NIGCOMSAT) and the citizens need to collaborate. This could mean government organizations and departments working together on larger projects, it could mean

reviewing and adapting regulation already in place to ensure there's much more collaboration between businesses, governments and its agencies.

2. Solar energy as a source of power should be explored to its full potential. Wind and water energy can also be harnessed along with biodiesel and other renewable energy sources. It makes complete sense for a futuristic project like a smart city to tap into alternative sources of energy to power it especially in Nigeria.
3. A restructuring of the institutions responsible for gathering relevant data in Nigeria will be necessary to successful develop a smart city especially socioeconomic data. These institutions have to be empowered to constant collect new data and update old once on all aspect of the city. The country can also tap into sourcing data from the citizens themselves with surveys, reliable computing systems in places where public data us collated.

CONCLUSION

The Smart City model can lead to a better city planning and management and thus, to the achievement of a sustainable model of urban growth. The study reviewed the concept of smart cities and looked at some examples of smart cities which were found to be mostly in the developed world. The state of the Nigerian cities was reviewed with the aim of identifying the challenges and prospects of smart cities development that are peculiar to the state of the Nigerian cities. Smart city concept has the potential to bring efficiency in the activities of the Nigerian cities there by making it more viable and attractive to investors, but this can only be achieved if the challenges identified are addressed and the prospects built upon.

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EXPLORING FACTORS THAT CONTRIBUTES TO RESIDENTIAL ENVIRONMENT LIVEABILITY IN MINNA, NIGER STATE

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Creating a liveable residential environment has been given prominence globally, and of particular concern is the residents' and neighbourhood satisfaction relationship. The increasing reports of slum situation in many urban areas spur the greater concern about liveability of mass housing projects around the globe. This paper explored the factors that contribute to the residential environment liveability through grounded theory approach. Extant literature provides factors such as dwelling unit features, neighbourhood facilities, economic vitality and safety. Based on this, a questionnaire survey was developed to obtain views from the residents' of housing estates in Minna, Niger State of Nigeria. Residents' views collected consisted of seventeen indicators of liveability of their residential environment. Analyses of data for this study include regression analysis, ANOVA and relative importance index (RII). The analysis of variance (ANOVA) result showed that all the four factors with $F(4, 361) = 92.442$, $p<0.05$ significantly predict the dependent variable liveability. The regression analysis result revealed neighbourhood facilities (34.8%) as the most significant predictor of the liveability of residential environment. The results appear to be relevant globally; however this study recommends an upgrading of neighbourhood facilities and other key factors of liveability in the study area by the relevant authorities.

Keywords: residential environment, liveability, grounded theory and regression analysis.

INTRODUCTION

One of the earliest studies to identify the key factors that contributed to residential environment liveability was by Sanoff and Sawhney (1972) in their study of the town of Asheboro, North Carolina which concerned with identifying and understanding the dwelling and neighbourhood dimension satisfaction of the low-income families housing. In particular, seventeen (17) and twenty (20) attributes of dwelling and neighbourhood were identified respectively. Subsequent to Sanoff and Sawhney's work, there has been a series of other studies (Omuta, 1988; Azahan et al., 2009; Betanzo, 2009; Abdulazeez et al., 2010; Ismail et al., 2015) concerning the liveability of residential environment both nationally and internationally. Evidently, these studies have been inhibited by a range of problems including wide range and type of data collected. Also is the large numbers of variables of possible relevance. Similarly, there is difficulty in defining the concept of liveability and this has created significant conceptual differences between researchers (Balsas, 2004; Heylen, 2006; Omuta, 1988). Noticeably is the lack of theoretical development in the literature (Van den Heuvel, 2013), however a handful of empirical studies exist that broadly involve a direct comparison of a composite measure of liveability over different geographic areas (Giap *et al.*, 2013). Some other studies have operationalized liveability dimensions and various indicators (Omuta, 1988: Balsas, 2004: Heylen, 2006). However, liveability as described by some authors such as Cutter (1985), Castellati (1997), Balsas (2004), Southworth (2007) sees to the geographical quality of a place as it is being experience and appraise by the inhabitants, and relative importance of each of these to the individual.

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This is best described as a place-based study which evaluates inhabitant's quality of life against the backdrop of living environment, this is generally enough based that all sections of the community can accept as a basis for subsequent decision-making (Myers, 1988). The place-based liveability study connects both objective and subjective data to present precise picture of the local quality of life problems. Therefore, liveability is related to the features of the place, which constitutes community's quality of life and the shared characteristics that are experienced by the residents in the place, which the residents subjectively evaluate. It is against this background, this study explores the key factors to the residential environment liveability through subjective evaluation by the residents' of housing estates in Minna, Niger State of Nigeria.

Objectives

(1) To find out the level of predictions of the identified liveability dimensions of the study area

(2) To identify and highlight empirically the relative importance of the indicators as perceived by the inhabitants of the study area

LITERATURE REVIEW

The extant literature on the liveability of residential environment revealed a complex issue and open for debate is the method of measurement and value system (Pacione, 2003). Conceptualizing liveability in the early 70's sought the work of Sanoff and Sawhney (1972) identifying and understanding the dwelling and neighbourhoods dimension attributes focusing on low-income family housing in North Carolina. Other empirical studies shows wide-ranging liveability dimensions (Omuta, 1988; Balsas, 2004; Heylen, 2006; Salleh, 2008; Ismail *et al.,* 2015; Ukoha and Beamish, 1997; Leby and Hashim, 2010; Asiyanbola *et al.,* 2012 and Lawanson *et al.,* 2013). However, liveability connotes an urban system that contributes to the physical and social well-being as well as personal development of all inhabitants (Song, 2011). Liveability concept has also been linked to the quality of life given the microeconomic activities a city offers its inhabitants (Bouffard *et al*., 2013; Chaudhury, 2005; Song, 2011). According to VanZerr and Seskin, (2011) *"liveability refers to a community service and amenities, whereas quality of life refers to how those amenities shape and benefit the human experience"*. Thus, researchers such as Litman (2011) and *Lowe et al.,* 2013) observed that liveability is within the scope of sustainability. For instance, urban amenity, mixed uses, safety and sense of place and workable streets are goals of liveability and sustainability (Howley, *et al.,* 2009). However, several authors have measured liveability in different climes and revealed is the numerous attributes measuring liveability which depends on the goals and value system of the assessor. Previous studies suggest common agreement on the aspects that contribute to liveability such as housing/dwelling unit features (Omuta, 1988; Heylen, 2006; Li, 2012 *et al*; Namazi-Rad *et al.,* 2012; Buys *et al*; 2013), physical/neighbourhood conditions (Balsas, 2004; Chaudhury, 2005; Heylen, 2006; Leby and Hashim, 2010; Asiyanbola *et al*., 2012), economic vitality or development (Balsas, 2004; Song, 2011; Saitluanga, 2013), safety (Leby and Hashim, 2010; Asiyanbola *et al*., 2012; Lawanson *et al*., 2013) and social interaction (Pandey *et al*., 2014; Leby and Hashim, 2010; Saitluanga, 2013). However, Buys *et al* (2013) opine that residential satisfaction studies connects liveability to specific features of home and building, this includes; dwelling age, size, structure and aesthetic feelings (Lu, 1999) as well as features of the broader neighbourhood, including access to facilities, noise, pollution, safety risks and social features (Howley, *et al.,* 2009). Liveability as an umbrella to many other concepts like quality of life (QoL), QoL is recognised and being conceptualize but difficult to define for everyone to comprehend (Balsas, 2004). However, QoL is widely well-defined as having three broad dimensions: social, economic and environmental well-being and may be measured using objective and subjective indicators (Marans and Stimson, 2011; McCrea *et al.,* 2012). Arguably, the three concepts of liveability, quality of life and sustainability geared towards achieving the same goal or goals. These terms are driving vision of the 21st century. For example, at different times City mayors adopted these terms as their policy focus to address various urban issues (such as in the case of Bogota). Addressing various urban issues, liveability focused more on particular location at a particular point in time, this subjectively translate to quality of life whereas the objective of sustainability is future generations (Buys *et al*.,2013). Undeniably, liveability, quality of life and sustainability concepts overlap as shown in Figure 1; this is the gap in the literature and filled in this study.

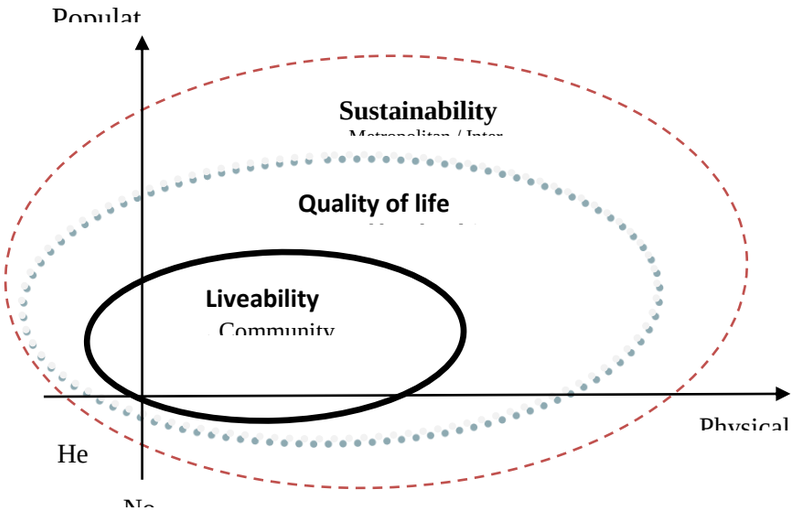

Figure 8: Liveability, Quality of life and Sustainability (Modified after Lowe *et al.*, 2013)

METHODOLOGY

This research is based on survey through which data was collected with the aid of questionnaire administration to the residents of the selected housing estates in Minna. The administration of the questionnaire was based on stratified random sampling; the elements of the strata were housing types- two bedrooms and three bedrooms. The selected housing estates include – Bosso Estate, M.I. Wushishi Estate and Tunga Low-Cost. The total housing units of the estates form the basis for sample size. Researchers use various ways to determine require sample size for their studies, for instance, Ifesanya (2012) sampled 215 houses out of 4,236 houses in the five selected communities of Ajegunle neighbourhood. However, Krejcie and Morgan (1970) sample size table shows that a total of 278 samples are require from a total population of 1000. Based on the aforementioned, a total sample of 400 housing units was selected out of the total housing units of 1000 (see Table 1). The distribution of the questionnaire was done by the researchers with the help of field assistants (see Table 1 for questionnaire distribution / sample size).

Table 1: Questionnaire distribution / Sample size

Housing Estates	Housing units	Number sampled	Received questionnaire	Non-received	Percentage (%)
Bosso Estate	250	125	115	10	92%
M.I.Wushishi	500	150	133	17	88.7%
Tunga Low-cost	250	125	118	7	94.4%
Total	1000	400	366	34	91.5%

Source: Field Survey, 2014(Information from Planning & Survey Unit, Niger State Housing Corporation)

Furthermore, the questionnaire distributed was based on the 5-point scale standard response format of Likert scale (Bertram, 2009). Data collected for this study were analysed with the use of regression analysis, ANOVA and relative importance index (RII). The five-point Likert scale was converted to a relative importance index for each indicator (Aibinu and Jagboro, 2002). The relative importance index serves as a useful supplement to regression analysis; it is useful in ranking the items in the factors so as to determine how the respondents perceived them in order of importance. The weighted average for each item in the four factors was determined, and ranks (R) were assigned to each item representing the overall perception of the respondents. The calculation of the relative importance index (RII) for each item was through the formulated statistical expression as found in the study of Aibinu and Jagboro (2002).

$$RII = \frac{5n1 + 4n2 + 3n3 + 2n2 + 1n5}{5N}$$

Where n1 = number of respondents for 'very unsatisfied'
n2 = number of respondents for 'unsatisfied'
n3 = number of respondents for 'fair'
n4 = number of respondents for 'satisfied'
n5 = number of respondents for 'very satisfied'
N is the total number of respondents.

RESULTS AND DISCUSSION

Table 1 shows the R^2 value obtained was 0.506 suggesting that 51% of the variance in the perception of the liveability of residential housing environment can be explained by housing unit characteristics, economic vitality, neighbourhood facilities and safety of the environment. The difference between R^2 (0.506) and the adjusted R^2 (0.501) is 0.005. In other words, if the model were derived from the total population rather than a sample of it, the outcome would have revealed a less variance of 0.5%.

Table 1: Regression analysis of the prediction of liveability indicators of residential environment

Model Summaryb

					Change Statistics			
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.711[a]	.506	.501	.42559	.506	92.442	4	361	.000

a. Predictors: (Constant), SAFE_ENV, H_UNIT, N_FAC, ECO_VIT
b. Dependent Variable: Liveability

Table 2 reveals that the four factors are very significant in the prediction of the liveability degree of residential housing environment with F (4, 361) = 92.442, P= 0.000. Based on the significant level ($p<0.05$), this implies that there were significant differences among the variables of the four factors.

Table 2: Analysis of variance of liveability indicators of residential environment

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	66.974	4	16.744	92.442	.000[b]
	Residual	65.386	361	.181		
	Total	132.360	365			

a. Dependent Variable: Liveability
b. Predictors: (Constant), SAFE_ENV, H_UNIT, N_FAC, ECO_VIT

Table 3 shows the regression analysis conducted based on survey data which revealed that neighbourhood facilities is the most predictor of the liveability of the housing estates selected with $\beta = 0.348$, $p < 0.000$, followed by housing unit characteristics with $\beta = 0.185$, $p < 0.000$, similar results were found by other authors such as (Salleh, 2008; Ukoha and Beamish, 1997). Other results such as safety of the environment with $\beta = 0.166$, $p < 0.003$ (Leby and Hashim, 2010; Asiyanbola *et al*., 2012; Lawanson *et al.*, 2013) and economic vitality with $\beta = 0.152$, $p < 0.009$ are key indicators of liveability of the living environment.

Table 3: regression analysis on the contribution of the independent variables

Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.317	.022		149.104	.000
	H_UNIT	.159	.039	.185	4.028	.000
	N_FAC	.368	.055	.348	6.696	.000
	ECO_VIT	.109	.041	.152	2.644	.009
	SAFE_ENV	.123	.041	.166	3.003	.003

a. Dependent Variable: Liveability

Based on the ranking of the weighted average of the relative importance indices (RII) for the eighteen items (see Table 4). It shows that two items of safety ranked most, that is, safety from accident (RII = 0.772) and safety of property (RII = 0.748). This implies that, building regulations and standard is considered top most for achieving safety from accidents that could result from building failure. Also, property safety has to do with security of tenure. Further, in the ranking order, house ventilation (RII = 0.745) emerged third factor influencing the perception of the respondents of the liveability of the housing estates. Other liveability indicators as perceived by the respondents indicate child's education (RII = 0.737) as fourth important. While, affordability (RII = 0.728) became the fifth consideration and safety from crime (RII = 0.725) in the housing estates is key to the liveability of the housing. Furthermore, housing unit, living area size and bedrooms were significant given their (RII = 0.723), (RII = 0.720) and (RII = 0.717) respectively. Moreover, health care services (RII = 0.712) and garbage collection (RII = 0.706) ranked 10^{th} and 11^{th} position indicating strong contribution to the residential environment liveability. On the other hand, the last three ranked elements indicate low level of satisfaction by the respondents. These elements are toilet and bath size (RII = 0.669), standard of living (RII = 0.634) and recreation facilities (RII = 0.630), it implies low level of contribution to the liveability of the study areas.

Table 4: Relative importance of the liveability attributes as perceived by the respondents

S/No	Liveability items	Rate of Responses					Sum	RII	Ranking
		5	4	3	2	1			(R)
1	Housing unit size	56	149	129	28	4	366	0.723	7th
2	Living size area	50	159	125	24	8	366	0.720	8th
3	Dining area size	41	124	143	44	13	365	0.675	15th
4	Bedrooms size	52	156	118	34	6	366	0.717	9th
5	Kitchen size	46	122	138	44	11	361	0.682	14th
6	Toilet and bath size	45	122	130	53	16	366	0.669	16th
7	Housing unit ventilation	66	164	107	27	2	366	0.745	3rd
8	Affordability	63	133	149	17	4	366	0.728	5th
9	Total monthly income	59	128	113	51	12	363	0.694	12th
10	Public transport accessibility	61	106	132	55	9	363	0.685	13th
11	Standard of living	23	58	245	39	1	366	0.634	17th
12	Children educational services	49	174	119	21	1	364	0.737	4th
13	Health care services	37	176	110	39	3	365	0.712	10th
14	Garbage collection	40	161	127	26	11	365	0.706	11th
15	Recreational facilities	40	110	122	38	49	359	0.630	18th
16	Safety from crime	63	143	129	20	10	365	0.725	6th
17	Safety from accident	73	178	107	4	3	365	0.772	1st
18	Safety of properties	75	155	106	23	6	365	0.748	2nd

CONCLUSION AND RECOMMENDATIONS

It is evident from this study that, neighbourhood facilities (34.8%) and housing unit characteristics (18.5%) have statistically significant contribution to the liveability of the living environment. Hence, these findings support the previous studies indicating that most significant predictors of liveability of the living environment are neighbourhood facilities and dwelling unit quality (Salleh, 2008; Ismail *et al*., 2015; Ilesanmi, 2012; Ibem and Aduwo, 2013; Ukoha and Beamish, 1997). However, safety from accident (RII = 0.772) and safety of property (RII = 0.748) ranked very high, indicating building regulations and standard is considered top most for achieving safety from accidents that could result from building failure. And, property safety has to do with security of tenure. The findings corroborate some other studies such as Leby and Hashim (2010), Asiyanbola *et al.* (2012) and Lawanson *et al.* (2013) where they confirmed that the safety of the environment is one of the key indicators of the liveability of living environment. This study provides evidence for the housing policy-makers, on the needs and aspirations of those being planned for and this will help the architects who design and the planners who planned such a housing estate environment on the significance of the four-factors and elements used in measuring liveability of the living environment. Based on the findings, this study recommends an upgrading of neighbourhood facilities and other key factors of liveability in the study area by the relevant authorities.

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ANALYSIS OF LIVELIHOOD DIVERSIFICATION IN PERI-URBAN SETTLEMENTS OF MINNA

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The changes in social, economic, political and generally the environment in our country Nigeria and other developing countries have continued to increase the need for an improved living condition. Due to the level of ever increasing deprivation in developing countries, people are striving for comfortable living, thereby engaging in livelihood diversification. In order to measure livelihood diversification there is need to recognize why and how people diversify livelihoods, especially in peri-urban areas as it is the most vulnerable place to poverty. This paper examines the livelihood diversification and reasons in peri-urban settlements of Minna city so as to promote sustainable development and poverty reduction. Questionnaire was used for data collection administration, and household heads as a sampling unit. Systematic sampling technique was employed at an interval of 3, 3, 4 and 5 buildings for Korokpan, Rafin Yashi, F.M. Village, and Gidan Mangoro respectively. Descriptive analysis was carried out on socio-economic data and Simpson's index was used to measure livelihood diversification and the result presented in pictorial and chart format.

Key Words: Diversification, livelihood, and Peri-urban.

INTRODUCTION

Urbanization as a phenomenon of twenty first century comes with positive and negative impacts; it has been asserted as broad opportunities for urban dwellers and at the same time posing threat to people living in peri-urban settlements (Aberra and King, 2005; Xie *et al.*, 2007; Olujimi, 2009). The changing social, economic, political and environmental condition in Nigeria and other developing countries across the globe have continued to impact on the living conditions of lots of households, especially those living in the peri-urban areas (Oluwatayo, 2009). Aberra and king (2005) hold the opinion that urbanization generates opportunities in waged employment and trading for peri-urban dwellers and provide them with access to services and infrastructure, while Cinner and Bodin (2010) assert that to lessen the negative effects and access the benefits of urbanization, livelihood strategies are developed to build the asset base. It has been noted that in the last two decades that people expand their livelihood activities both on-farm (crops, livestock, fisheries) and off- farm activities, or market and non-market activities to mitigate risks inherent in unpredictable economic circumstances (Ellis, 1998, 2000; Byceson, 2005). Diversification was not initially considered as the best option, however, studies have shown that rather than encouraging specialisation within existing portfolios, upgrading them to enhance income could be more realistic and relevant for poverty reduction (Ellis and Freeman, 2005). There have been debates on the most reliable livelihood diversification between farming base and non-farming base activities on poverty reduction in the developing world, non-farming livelihood diversification has been asserted as the best strategy for poverty reduction (Bryceson, 1999; Barrette, *et al*, 2001).

Awoyemi (2007) suggested that, increasing the productivity and variety of non-farm activities would in turn improve their livelihood security and living conditions of people especially those living in the peri-urban areas. In the developing world, economic development is not solely based on agriculture, but rather on various arrays of activities (Ellis, 1999).

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In Nigeria, the agricultural sector is plagued with problems which include soil infertility, infrastructural inadequacy, risk and uncertainty, loss of farm lands to residential purposes and seasonality among others. In other words, the situation in the peri-urban areas has negative welfare implications and predisposes the residents to various risks which threaten their livelihoods and their existence. As a result of this, they struggle to survive and in order to improve their welfare, off-farm and non-farm activities have become an important component of livelihood strategies among rural households in Nigeria. In Niger state, most people originally derive their livelihoods from farming, fishing, animal rearing and local arts and crafts to augment their livelihood and Niger state has a poverty incidence and income inequality at 30.19% and 97.19% respectively. This has in turn brought about the extensive and increasing reliance on non-farm activities. This is an emerging feature of Niger State especially in the peri-urban areas of Korokpan, Rafin Yashi, F.M village and Gida Mangoro, which also enhance the livelihood of the peri-urban dwellers.

The paper explores the sustainable livelihood framework (SLF) concept towards how the peri-urban dwellers manage the effects of urbanization. The framework considers the challenges associated with shocks and stresses as well as external forces such as policies that affect accessibility to assets that the people depend on. The concept of livelihood encompasses the capabilities, assets (both material and social resources) and activities required for a means of living, (Chambers and Conway, 1992). A livelihood is viewed as sustainable when it can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets and provides sustainable livelihood prospects for future use and also contributes net benefits to other livelihoods at both short and long term. The effect of rapid urban growth does not only make people exposed, but presents many opportunities to people living in peri-urban areas. Thus, this paper identifies urban growth as one of the bases within which the peri-urban livelihood is ordered as well as the environment which the peri-urban dwellers have limited or no control.

In the course of city growth, assets are both destroyed and created this is evident in the limitations and prospects that urban growth presents which includes land use change, forfeiture of farmland access to urban markets and waged job opportunities; these contributes on constraints to asset base. A Peri-urban household dwells mostly on diverse livelihood resources in order to develop their livelihood. The range of assets that people have in their possession contribute to how they are able to manoeuvre their way through the opportunities and constraints of city growth. The livelihood assets are natural capital, human capital, financial capital, social and physical capital. The amount of assets available to individuals, households and communities translates into livelihood strategies aimed at achieving an outcome when farmlands are converted to non-farm purposes, peri-urban dweller resorts to all kinds of livelihood strategies that may include, farming, migration and non-farm income generating activities to cope with this trend (Ellis and Freeman, 2005). These strategies are means, choices or the activities that people undertake to gain additional income. The activities engaged in may either be natural resource based or non-natural resource based. These Livelihood strategies in turn reduce vulnerability of the poor and improve the asset base of households and individuals with increased income, improved well-being and improved food security among others.

Livelihood activities can be seen as a convenient intermediate measure to link assets and outcomes. Livelihood activity options are dependent on an individual asset and their ability to convert assets to activities (Ellis 2000; Rakodi, 2002). There are distinct patterns in the types of activities engaged in by different social groups and individuals that are structured by similar assets and abilities to access different activities (Ellis, 2000; Gladwin, 2001; Jiggins, 1989 and Rakodi, 2002). Ellis in 1998 said the role of livelihood diversification cannot be over emphasized in respect to rural communities unfortunately it has been ignored by policy makers. There are many views on livelihood diversification. Some view it as a continuous adaptation of a highly diverse portfolio of activities that is a distinguishing feature of rural survival strategies in contemporary poor countries and some see it as participation in multiple activities by farm families. In industrial countries, it has been referred to as 'pluractivity' (Smith *et al*., 2001; Evans and Liberry, 1993).

Diversity in livelihood perspective refers to the existence at a point in time of many different income sources. Diversification on the other hand represents the creation of variety as an ongoing social and economic process reflecting factors of both pressure and opportunity that cause families to adopt increasingly intricate and diverse livelihood strategies. While both diversity and diversification may be seen as having multiple and multiplying income sources, they often occur in the local development scene to mean 'moving away from farming as the predominant or primary source of rural survival' (Ellis, 2000). From the above definitions, it has helped to put forward the 'livelihood diversification to mean the process in which households construct an increasing diverse portfolio of activities and assets in order to survive and improved their living standard'. Diversification is pervasive and enduring; Pervasive in the sense that it is not just an isolated phenomenon particular to a few farm families. Livelihood diversification is widespread and is found in all locations as well as across farm sizes and ranges of income and wealth. It is enduring in the sense that it is not a transient feature in the otherwise smooth transition from agriculture industry (Saith, 1992; Bryceson, 1999).

A diversity index is a quantitative measure that reflects how many different types of species there are in a data set or in a community. It simultaneously takes into account how evenly the basic entities

or activities are distributed among those specie types. Basically, diversity indices are used in ecology, their types of interest is species, but they can also be other categories, genera, families, functional types or haplotypes. The entities of interest are usually individual plants or animals and the measures of abundance. There are various indicators and indices that are used to measure livelihood diversification. These include number of income sources and the number of people involved in doing what. Simpson index, Herfindahl index, Ogive index, Entropy index, Modified Entropy index, Composite Entropy index (Shiyani and Pandya, 1998). In this study, Simpson index will be used because of its computational simplicity, robustness and wide applicability.

METHODOLOGY

This paper focuses on four selected areas to serve as case studies and they are; Korokpan, Rafin Yashi, Gidan Mangoro and F.M. Village as selected peri-urban settlements of Minna, Niger State. The four selected areas were selected from the four major routes that links Minna to other parts of the state and the country at large. Farming is the primary occupation of the settlements and the Gbagys were the predominant ethnic group. Koropkan falls on latitude 233300^{00} - 234200^{00} and longitude 1054800^{00} - 1054000^{00}, located about 9km from the Minna along Minna – Paiko road; Rafin Yashi falls on latitude 115600^{00} – 117000^{00} and longitude 6^{o} 30'36E^{00}, it is located about 8.5km from Minna along Minna-Zungeru road; Gidan Mangoro falls on latitude 224000^{00} - 226400^{00} and longitude 1058000 - 1060000^{00}, it is located about 9km from the city of Minna, along Minna-Bida road which host institutions such as NECO Headquater and Federal University of Technology. F.M. Village falls on latitude 234400 - 235600^{00} and longitude 1066800^{00} - 1065800^{00}, previously called Sauke Kahuta now referred to as F.M village because of the presence of FM 91.2 Radio Station located in the village and the settlement is about 6km from the Minna along Eastern By-pass road. The research methodology employed was survey method, which involves collection of data through the use of structured questionnaire and household head was used as sample unit. The sample frame employed was buildings counts and one household per building was assumed which gave household population of 636, 774, 568, and 480 for Korokpan, Rafin Yashi, F.M. Village and Gida Mangoro respectively with total population of 2458 for the study. The sample size is 391 using Dillman (2007) sample size. 72 questionnaires were sampled from population of 391 at an interval of 3 for Korokpan Village, Rafin-Yashi 99 at an interval of 3, Gidan Mangoro 106 at the interval of 5 and F.M. Village 114 at interval of 4 systematically. Descriptive analysis was used to analyse the livelihood activities and the income generated, while Sipson index was employed for livelihood diversification assessment. The Simpson formula employed is represented in equation 1.

Equation 1.....S.I. = $1 - \frac{\sum n(n-1)}{N(N-1)}$

Where n represents number of economic activities, Nis the total number of income sources. Simpson index range from 0 to 1. The 0 value represents a complete specialization while 1 represents the highest level of diversification of livelihoods.

Simpson's index of diversification (SID) was also used in measuring livelihood diversity, Simpson index was used because of its computational simplicity, robustness and wider applicability.

FINDINGS AND DISCUSSION

Livelihood activities

Primary economic activities classified in the study areas were five and the findings revealed as presented in the table 1, that an average of 5% engaged in artisanal activities and civil service at city level, trading was found out to be the lowest at 2% at a city level average while farming has the highest average proportion of 11% at city level. This indicates that most people in peri-urban area of Minna are farmers.This can be attributed to the cultural heritage of Gbagyis as the indigenous and predominant people in the study areas.

Table 1: Primary Economic Activities

Communities	Artisans	Civil servants	Traders	Farming	Waged	Total
Korokpan	18 (5%)	18 (5%)	4 (1%)	29 (7%)	3 (1%)	**72 (19%)**
Rafin Yashi	25 (6%)	15 (4%)	8 (2%)	35 (9 %)	16 (4%)	**99 (25%)**
Gidan Mangoro	9 (2%)	13 (3%)	10 (3%)	65 (17%)	9 (2%)	**106 (27%)**
F.M.Village	29 (7%)	27 (7%)	8 (2%)	36 (9%)	14 (4%)	**114 (29%)**

City level Average	**20 (5%)**	**18 (5%)**	**8 (2%)**	**41 (11%)**	**11 (3%)**	**391 (100%)**

Source: Author survey work (2017)

The secondary economic activities in the study area were; animal farming, grains farming, tuber farming, trading, waged labour and driving. Farming was separated in secondary economic activities as presented in table 2, because as an alternative means of livelihood, the different aspects of farming (agriculture) would be difficult to engage in, but specialization has to come to play. There is no wide gap at city level average in secondary economic activities which ranges from 3% for animal farming, 4 % for grains farming, 4% for tubers farming, 6% for trading, 4% for waged labour and 5% for driving. At village level Gida Mangoro was noticed to have the highest percentage (30%) with 5.31% for grains farming, 5.43% for tubers farming and 6.12% for waged labour all as the highest proportion compare to other villages. Gidan Mangoro village aligned at the apron of Minna-Bida road is very close to some institutions as discussed earlier, it has a robust secondary economic activity to provide for the needs of the increasing population of students of FUT Minna residing at the off campus. The number of livelihood per household assessed revealed that there is a minimum of 1 livelihood activity and maximum of 6 with an average of 3 in all the four settlements.

Table 2: Secondary Economic Activities

Communities	**Animal farming**	**Grains farming**	**Tubers farming**	**Trading**	**Waged labour**	**Driving**	**Total**
Korokpan	22 (2.54 %)	17 (1.96%)	32 (3.7%)	33 (3.81%)	14 (1.62%)	36 (4.16%)	**154 (18%)**
Rafin Yashi	21 (2.42%)	22 (2.54%)	22 (2.54%)	65 (7.51%)	27 (3.12%)	51 (5.89%)	**208 (24%)**
Gidan Mangoro	27 (3.12%)	46 (5.31%)	47 (5.43%)	44 (5.08%)	53 (6.12%)	47 (5.43%)	**264 (30%)**
F.M.Village	33 (3.81%)	38 (4.39%)	31 (3.58%)	60 (6.93%)	30 (3.4629%)	48 (5.54%)	**240 (28%)**
City level average	**26 (3%)**	**31 (4%)**	**34 (4%)**	**52 (6%)**	**32 (4%)**	**47 (5%)**	**866 (100%)**

Source: Author survey work (2017)

Income from livelihood activities

The average income from primary economic activities presented in the table 3, indicates that the civil service has the highest average income of NGN159,813 at city level while waged labour has NGN35,462 as the lowest. Gidan Mangoro is noted to have the highest average income at village level with NGN155,855 compare to Korokpan the average income of NGN53,485 has the lowest.

For secondary economic activities, Animal farming was noted to has the highest income from secondary economic activities at the city level with an average of NGN128,225 while driving has the lowest an average income of NGN32750 at the city level as presented in table 4.

Table 3: Average Income from Primary Economic Activities

Communities/ Economic Activities Income	**Artisans NGN**	**Civil service NGN**	**Trading NGN**	**Farming NGN**	**Waged Labour NGN**	**Village level average NGN**
Korokpan	50,154	82,750	52,000	52,522	30,000	**53,485**
Rafin Yashi	63,280	99,833	13,937	87,071	43,846	**86,681**
Gidan Mangoro	13,571	351,250	25,658	13,687	21,000	**155,855**
F.M.Village	109,500	105,417	13,324	49,034	47,000	**88,838**
City level average	**59,126**	**159,813**	**104,919**	**81,374**	**35,462**	

Source: Author survey work (2017)

F.M. Village was noticed to have the highest average income in animal farming and grains farming of NGN171,996 and 140,337 respectively, while Gidan Mangoro has the highest average income in tubers farming, trading, waged labour and driving at an average of NGN173,614, NGN35000, NGN30000,and NGN68000 respectively compare to other peri-urban settlements in the study area.

Table 4: Average Income from Secondary Economic Activities

Communities/Economic Activities Income	**Animal farming**	**Grains farming**	**Tubers farming**	**Trading**	**Waged labour**	**Driving**	**Village level average**
Korokpan	101,070	14,331	59,000	17,500	15,000	21,000	**37,984**
Rafin Yashi	95,524	87,830	116,685	19,000	19,000	23,000	**60,173**
Gidan Mangoro	144,310	66,977	173,614	35,000	30,000	68,000	**86,317**
F.M.Village	171,996	140,337	150,183	18,000	15,000	19,000	**72,867**

City level average	**128,225**	**77,368.75**	**116,433**	**22,375**	**19,750**	**32,750**

Source: Author survey work (2017)

Diversification Measurement

Simpson index of diversification was adopted as a tool for measuring the level of livelihood diversification in the study areas using equation (1) discussed earlier. Findings revealed that there is a high level of livelihood diversification in the study areas as presented in the table 5 , with the four settlements have 0.9 index and city level average of 0.99 which is very close to 1 has the highest level of diversification.

Table 5: Simpson Index of Diversification Measurement

Communities/Diversification measurement	**Livelihood Diversification Per Community (N)**	**∑n(n-1)**	**Simpson Index**
Korokpan	226	548	0.989
Rafin Yashi	307	756	0.992
Gidan Mangoro	370	1038	0.992
F.M.Village	354	990	0.992
City level average	**314**	**833**	**0.99**

Source: Author survey work (2017)

CONCLUSION

It can be inferred based on the analysis of livelihood diversification in peri-urban areas of Minna that seven livelihood diversification exists in the study areas with farming as the predominant both in primary and secondary economic activities and contributes mostly to the income generated. This can be attributed to vast land span for agriculture and the fact that farming is the cultural heritage of the indigenous people of the areas which is not yet fully polluted. Though farming contributes mostly to the livelihood of the area, it can be asserted that there were high level livelihood diversifications in the peri-urban areas of Minna which indicates the "quest for more" syndrome and the needs to negate the negative effect of urbanization on the peri-urban areas.

Recommendation

Although there is a high level of livelihood diversification in the study areas nevertheless the paper sees the need for more livelihood diversification than the present seven livelihoods, therefore the paper recommends that skill acquisition and improvement programme should be set up to create room for more livelihood diversifications and income generation among peri-urban people. As a predominant farming society, there is a need for the establishment of agro-allied industries in the peri-urban areas of Minna for processing and adding value to agricultural produces which would also contribute to livelihood diversification and income generation.

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INVESTIGATION OF SPACE FLEXIBILITY PRINCIPLES IN THE DESIGN OF STUDENT'S SOCIAL CENTRES

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Space flexibility is one of the principles of universal design that is not being used as efficiently as it needs to be. It has been implemented in some part of architectural design and construction of mostly offices and event centres but not well utilised in public spaces such as commercial centres, student centres, institutions amongst others. This research basically looks into how this principle of universal design can be adopted into such classifications of buildings and determine how well it will enhance the productivity of the building as well as provide satisfactory services to the end users. The research method that was used comprises of observation schedules and non- formal interviews of end users. The data that was gotten from this research methods will be analysed and collated using Micro-soft Excel .the results of this research will show how space flexibility is not properly used in student's social centres and how the end users are not satisfied with the spaces provided for them in such buildings. The research will also show how important it is to adopt the principles of space flexibility in such designs in order to satisfy the end users not only the owners of such buildings. The research will be concluded by encouraging designers to consider space flexibility before embarking in public space designs in other to increase the longevity of such buildings.

Keywords: end users, student centres, space flexibility, public buildings, universal design

INTRODUCTION

Space flexibility can be defined as the variability of a space in order for it to enhance mobility and sensual needs of end users (Jessica, 2010). It is a form of architecture that has been used subconsciously without initial visualization of how important it is to design and also way of life and how activities vary in our environment. For a space to be termed flexible, it should have the five basic properties that determines flexibility. These are fluidity, convertibility, scalability, versatility and modifiability. Space flexibility has been one of the principles of architecture that has been in existence for a long time. From the use of adjustable furniture in theatres to the use of architectural elements which are flexible to influence the type of design created by architects to maximize the potential structures when they are constructed. Due to rapid changes made in social areas by end users for the purpose of meeting the demands of different varieties of people that will use these spaces, the need for spaces created in architectural designs should be flexible. It was also noted that most buildings that were designed in order to achieve flexibility finally tends to be inflexible, boring and blocky just because the planning and design stages were not justified (Young-Ju 2008). Young-Ju also noted that flexibility cannot be accomplished only by varying or interchanging the usage of space, it also has to do with changing the orientation of various spaces to be able to take multiple functions.

Rigid spaces are known to exist due to lack of knowledge or being able to predict what future buildings will need to affect or change the existing layout to be used for the interior spaces provided. (Haworths 2009). Reino (2012) also identified defects with most interior spaces that are used for pedagogy. This study explained how planned spaces tends to be less flexible, versatile and don't give room for variable use.

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Aliyu (2018). **INVESTIGATION OF SPACE FLEXIBILITY PRINCIPLES IN THE DESIGN OF STUDENT'S SOCIAL CENTRES.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

The use of load bearing walls and also Sandcrete blocks tends to normally hinder variability. It is also noted that installations for cooling, electricity, ventilation, information and communications are rigid. With these points raised above, there is need for modern designs to solve these problems of rigidity in order to accommodate future changes for both long term, intermediate, and short term purposes.

However, Reino (2012) also noted that space flexibility in architecture encourages designers to adapt a building, the floor shape and room volume should have the capacity to accommodate the activities of its initial design while allowing multi-anticipated user requirement. This statement could be very effective if implemented in the design of a student's social centre because of the numerous activities that can be achieved in such designs, it could give options to end users to change sizes of units and functions of spaces that was provided in the initial design. The capacity of a building to absorb future functional change and increment in size, enables a smooth operation of activities.

Types of Space Flexibility

There are three basic types of space flexibility which are in use in most designs and construction of buildings and environments that can adopt space flexibility (Arto and Pekka, 2008). The first notable type of space flexibility is **Service Flexibility** which refers to the ability of a structure to acclimatize to frequent changes in the type of load it carries due to the fluctuations in the functions that are carried out in a particular space, and also the variation of the number of users that will be using the spaces provided. The movable partitions and adjustable ventilations can easily be enhanced in order to make transitions much more convenient.

Another space flexibility type that was noted by the researchers is known as **Modifiability** which in known to be the type of flexibility where the building capacity is in line with the changes that were made due to similarities of end users or type of business that was performed in the space having a bit of similarity. Loose dimensioning of walling systems and building services will be used to enhance this type of space flexibility.

The third type of flexibility is the **Long-Term Adaptability** which is known for the structure to adapt to new uses and activities. Floor height, permissible floor loads and building spans are highly influenced by this type of Adaptability.

Archiving Flexible Spaces in Designs

In order to archive space flexibility in design, the use of Demountable walling systems cannot be over emphasized. These types of walling systems are the most associated with space flexibility. This is because their variations are made of vary light materials that suit the purpose of archiving space flexibility. Harrison and Hutton (2013) made a research on the different variations of demountable walling systems used to accomplish active divisions of space noted that the walling systems should be lightweight materials ranging from glass to aluminium and should be able to be operated in different ways.

Table 1.0: Sizes of Movable partitions and types

s/no	Movable Partitions	Prefabricated sizes (width)	Prefabricated sizes (height)
1	Sliding Partitions	0.6m 0.75m 0.9m 1.2m 1.25m	2.7m (min) 6.0m (max)
2	Folding Partitions	0.45m 0.60m 0.75m 0.90m	5.0m (max)
3	Flexible Partitions	Not fixed	5.0m (max)

Source: Harrison and Hutton (2013)

Table 1.0 above reviews the different width and height of partitions that are movable which could be used for enclosed spaces. These prefabricated materials are manufactured in factories based on fixed dimensions and also according to user preference. However Flexible partitions are the only type of flexible walls that can take a curvilinear form due to the nature of operating principle. They are made up of pantographic steel frames, aluminium track systems and vinyl-coated fabric which are used to achieve any type of curved spaces required (Ryan 2011).

These types of movable partitions are considered flexible because the can be expanded and compressed unlike other type of partitions listed in the Table 2.0 below.

Table 2.0: Degree of Flexibility on different types of walling materials

s/no	Walling Types	Degree of Flexibility
1	Concrete wall	Non-Flexible
2	Sandcrete wall	Non-Flexible
3	Curtain wall	Non-Flexible
4	Cavity wall	Non-Flexible
5	Fixed Partition	Flexible (partially)
6	Movable Partition	Flexible

Source: Neufert (2000)

Table 2.0 are the standards for analysing different types of walling materials that are associated with space flexibility. Movable partitions are flexible they are designed and fabricated with a specific operating principle that gives room for modification and variability with the sizes of spaces they enclose. These movable partitions can be moved or adjusted manually or electrically depending on the type of installations done for them. They are also manufactured with horizontal tracks on the floors and also some ceilings that is if the partitions are as high as the room height that was designed, these tacks helps the panels fit perfectly and also allow for sliding and folding when the partitions are to be removed or adjusted. The table above also noted that fixed partitions are partially flexible, this is because they are fabricated with aluminium frames that are permanently fixed unlike the normal Sandcrete walls that have to be demolished when there will be need for any form of modification or expansion. They will also need a different type of removal when they are not needed in a particular space.

RESEARCH METHOD

Observation schedule and non-formal interviews were the method of data collection used for this research as it gives proper understanding of how space flexibility should be adopted in buildings and users' opinion on the subject matter. Observation is a purposeful, systematic and selective way of watching and listening to an interaction or phenomenon as it takes place (Kumar R. 2011). He also explained how the strength of non- formal (unstructured) interviews is the almost complete freedom they provide in terms of content and structure. You are free to order these in whatever sequence you wish. You also have complete freedom in terms of the wording you use and the way you explain questions to your respondents. Research was carried out by selecting various case studies which were selected based on the availability of student's centres in Nigerian Universities. Analysis were made based on the use of space flexibility principles and how they are adopted. Other case studies that were carried out on buildings that have adopted space flexibility principles in order to see how they function and serve the users in various capacity.

Table 3.0 Description of study area

S/N	Name of Study Area	Location of Study Area
1	University of Ibadan	Oyo State
2	Aliyu Mustapha social centre	A.B.U Zaria, Kaduna State
3	Student's Solidarity Centre	University of Jos, Plateau State
4	Student's Conventional Area	The University Of Texas, Austin
5	Ladi Kwali Hall	Sherathon Hotel, F.C.T Abuja
6	Yar'adua Events centre/Conference Hall	F.C.T, Abuja

Source: Researchers field work (2016).

Table 3.0 shows the list of study areas which were selected by purposive random sampling technique. This technique was used in order to select similar designs and structures relevant to this research and buildings that have adopted the principles of space flexibility in their way of solving design problems. The study areas also consist of a foreign case study which has a similar design to this research and it also adopted some of the principles of space flexibility. The choice of these study areas is due to the fact that all student's centres visited are to be examined to see how their activities and occupant can benefit from the use of space flexibility and to also examine the user's perception of the users and occupants of the other buildings.

RESULTS AND DISCUSSION

Based on the research that was made with the methods that were used which are stated above. The results show that students' centres where designed without the principle of space flexibility adopted based on the rigidity of their internal partition walls. It was also observed that the perception of users vary widely in terms of space allocations and its flexibility when examined individually in different centres but when combined and analysed together, it gives an average perception of the measurement .

Ascertainment of the Various Types of Walls in the Various Study Areas.

The types of walls in various study areas visited were ascertained by direct observation by the researcher and recorded using an observation schedule which was structured based on the conventional wall partitions known. This is to see which wall types used by student's social centres and event centres visited could adopt space flexibility without serious alterations. Table 4.0 below shows the types of walls that was noticed across the study areas that were observed.

Table 4.0 Type of walls used for partitions.

S/N	Selected Study Areas	Wall Types				
		sandcrete walls	**curtain walls**	**fixed partitions**	**flexible partitions**	**total**
1	University of Ibadan, Oyo state.	24	2	0	0	**26**
2	Aliyu Mustapha social centre, A.B.U Zaria	18	0	5	0	**23**
3	Student's Solidarity Centre, University of Jos	16	2	6	0	**24**
4	Ladi Kwali Hall, Sherathon Hotel, Abuja	4	4	8	10	**26**
5	Yar'adua Events centre/conference Hall, F.C.T Abuja	8	0	0	4	**12**
	TOTAL	**70**	**8**	**19**	**14**	**111**

Source: researcher's field survey (2016).

The above table explains the various types of walls used in the study areas visited. It was also observed that observed that some of the internal walls of these study areas had to be demolished and rebuilt in order to fit the end users which does not make a good bargain for cost efficiency and adaptability of the present rigid walling materials used. It was also noted that the use of flexible materials are not used in the construction of student's social centres as they are used in event centres. This was a very big concern due to the fact that the two types of building have a bit of similarity as to the diverse population of users found in them, not to mention the numerous activities that will be done within these buildings.

Frequency of the Ascertained Wall Types in the Various Event Centres.

As illustrated in a component bar chart in figure 1.0 below, the frequency of the wall types used in building the internal walls of a student's social centre is very one sided. The use of Sandcrete blocks have been very consistent in the study area visited which does not give any room for the building to adapt, expand or convert its spaces provided to accommodate different types of activities in these centres. The only form change that can occur will definitely be inappropriate by the lack of size reduction or expansion of space. New functions will have to make do with the space available by the previous functions even if it will be in sufficient. This proofs that the student's social centres do not have flexible space due to their inability to increase and decrease of interior spaces provided.

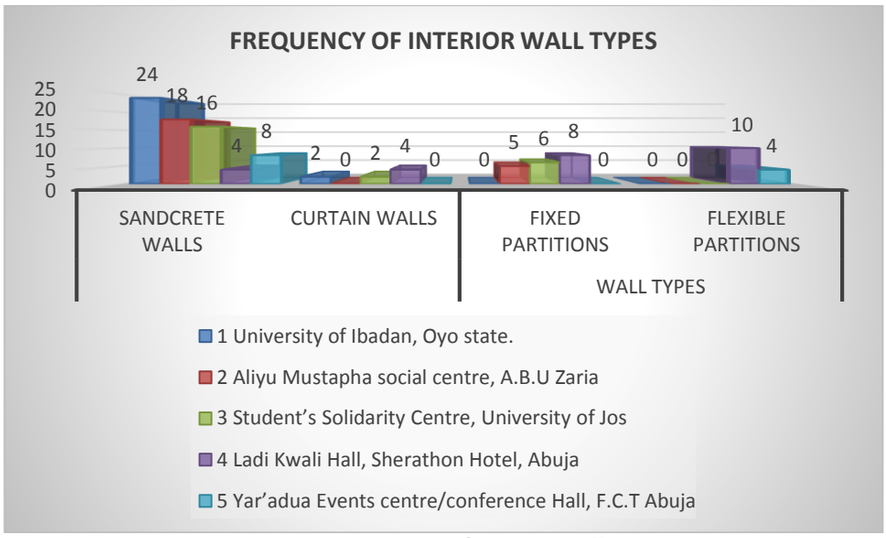

Figure 1.0 Frequency of interior wall types
Source: Researcher's field survey (2016).

On the other hand, the two event centres that were visited used have used flexible materials to some extent. The halls can be reduced and increased based on user's preference. Movable walling systems help in making the halls smaller or bigger in order to accommodate different variations of sizes that will be using the facilities. This shows the importance of space flexibility and how it could diversify space in which they are used in. It will be a very good idea if the use of space flexibility principles are used in student's social centres as they are used in event centres.

Determining user's perception of satisfaction with the circulation spaces in student's social centres

Determining satisfaction of user's with regards to circulation is very important and a key variable in determining the satisfaction of space flexibility in general. This is because when a space is rigid, it normally does not have sufficient circulation spaces. This makes it important for users to be very comfortable with the spaces provided within buildings for circulation. The data collection tool that was used in determining user's perception with the circulation spaces provided were the structured interview questions and also the observation schedule used by the researcher. The five local study areas visited were examined to see how the corridors and circulation spaces provided served the purpose and also a minimum of three respondents from each study area helped in administering the structured interview which was summarized in the table below. The summary of the degree of satisfaction was done to show the collation of the five study areas was expressed on a four-scale rating which are: very satisfied, satisfied, dissatisfied and very dissatisfied. The table shows the percentage of the four-scale ratings based on the survey carried out by the researcher.

Table 5.0 Summary of users' satisfaction with the circulation spaces.

S/N	Level of satisfaction of circulation spaces	Percentage
1	Satisfied	20%
2	Very Satisfied	15%
3	Dissatisfied	25%
4	Very Dissatisfied	40%
	Total	100%

Source: Field survey (2016).

Based on the responses shown on the above table, 65% (combination of dissatisfied and very dissatisfied) of the users and shop owners that responded to the structured interview are not satisfied with the circulation spaces that was provided within the student's social centres and also the event centres. This is due to the fact that most of the corridors provided have been used by shop owners to display goods. It also shows that the shops don't have the flexibility to store and display goods based on the rigid nature of the shops provided. This makes the remaining space left very insufficient for free movement of users, during entry, exit or general circulation within the building. Rigid spaces normally don not have a standard circulation spaces because seats are either too closely spaced or the halls, restaurants, and tutorial spaces are not large enough to accommodate the required number of users. Therefore the percentage of dissatisfied user's shows that circulation space provided are not satisfactory in the student centres and event centres visited which makes them not flexible.

Determining users' perception of modifiability, convertibility and versatility of spaces.

This variable is very important in the determining users' perception towards buildings that will adopt space flexibility. This is due to the fact that users' perception on modifiability, convertibility, or versatility of space is a very important variable in determining whether space are rigid or flexible. Therefore if users of the study areas examined react negatively to the space in the building being difficult to convert or modify, it indicates that the social centres are not flexible since the standards which were stated in the introductory part of this research states that a space is considered flexible, if it can be converted, modified, and also versatile in nature. The users' perception of this component of space flexibility were collated by the use of structured interviews which were answered by three respondents from the study area listed in chapter three, which was further analysed and was expressed on a four-scaled rating: strongly agree, agree, disagree, and strongly disagree. The figure below shows the percentages given to the ratings as obtained during the field survey conducted by the researcher and presented in a pie chart format.

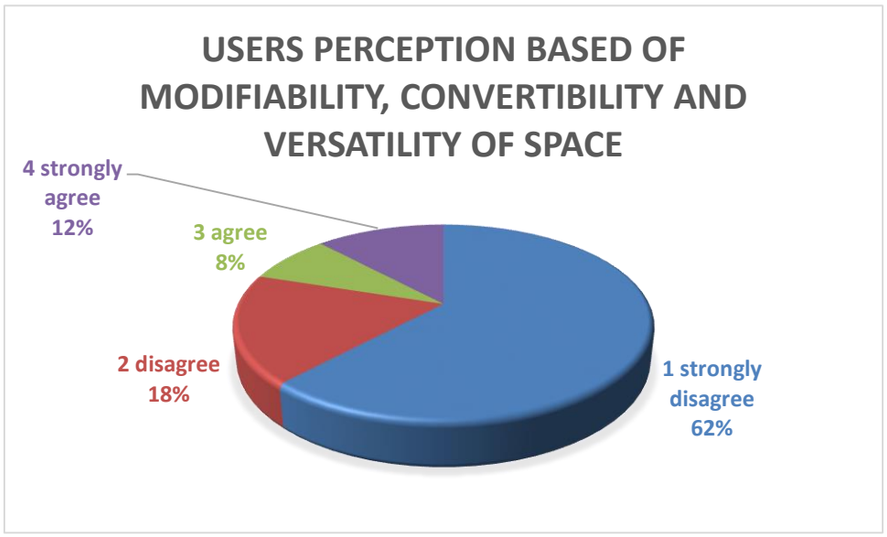

Figure 2.0 Users' perception on the components of space flexibility
Source; researchers field survey (2016)

The pie chart above shows how the respondents that answered the structured interview questions have felt about the buildings they have been using to have these components of space flexibility. Most of the structure that were examined have to adapt with the provided materials and design in order to make their activities flexible enough to accommodate numerous functions. 80% (both the strongly disagree and disagree variables) of the respondent have rendered the student's social centre they uses as not flexible due to the rigid materials that was used in its construction and also the nature of design approach that was used. These type of materials that are used in the construction cannot allow for the reduction or addition to spaces in order to fit the needs of the users.

Users' Perception on the Need for Flexible Spaces in Student's Social Centres.

This is a very important variable in determining the overall users' perception with regards needs for flexible spaces to be Inco-operated in to student's social centre. This is due to the fact that some shop owners might want larger spaces than provided or less spaces as the case may be. The students that use the building should also be able to perform more than one function in a particular space to increase the versatile nature of their extracurricular activities. From the structured questioned answered by respondents in different study areas, the table below shows how respondents reactions were summarized based on their perception on the need for flexible space.

Table 6.0 Summary of user's perception on the need for flexible spaces.

S/N	Level of users' perception on the need for flexible spaces	Percentage
1	Strongly Agree	12%
2	Agree	76%
3	Strongly Disagree	8%
4	Disagree	4%
	Total	**100%**

Source: Field survey (2016)

CONCLUSION

It is of paramount importance that space flexibility is to be one of the key considerations in any design that is to be carried out. This is because of how our recent means of construction is known not to be able to accommodate any form of change in either function or shape. Most of the student's social centres that was visited clearly shows the importance of the application of space flexibility in its design and application. Shops were noted to have uniform sizes for all types of activities that is carried out in the student's centre, this forces end users to expand their shops by covering walkways and circulation spaces. Other designs and buildings that has effected the application of space flexibility in its design as mentioned in this research shows how new structures can benefit from the principles of space flexibility. If this principles are being applied in the design of a student's social centre for the campus, it will benefit immensely in terms of attracting various types and sizes of end users. It will also give room for expansion for both inside and outside and also be a very good case study for other new projects in the campus.

The research further reveals that most of the student's centres that was visited used the default Sandcrete blocks in most of the internal spaces which makes it difficult for any form of alterations to be made when the need arises. Demolition and alterations becomes as expensive as erecting a new structure. This is where flexible partitions come in handy and much easier to dismantle and assemble as the case may be. Space flexibility is a much easy way of approaching new commercial structures because of its relatively reduced cost of implementing change or transformation which is known to occur frequently in commercial buildings.

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INTEGRATION OF RECREATIONAL SPACES IN ABUJA COMMERCIAL CENTRES DESIGN

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The crave for people to unwind and relax as a result of the rising negative effect caused by fatigue and daily work pressure in the society has made recreation to be a primary need. It is expected of any commercial building design that space maximization is given top priority in order to meet the rising expectation of the users. These activities are chosen freely by the users in order to derive pleasure. It has been observed that despite the socio-economic boom during commerce there has not been any change in the design of new commercial centres. The most significant change that has currently affected commerce is the consciousness of extra facilities available, due to the fact that not everyone that patronises a commercial centre comes there to buy or sell. The problem therefore is traceable to the fact that users of commercial centres are finding it increasingly difficult to find recreational spaces where they can relax comfortably and derive pleasure independently aside from other commercial activities. This paper assessed both passive and active recreational spaces in commercial centres with a view to integrating these design features in commercial centres within the Federal Capital City (FCC). The aim of the paper is to examine how recreational space integration fit into commercial buildings. The research method adopted is a mixed method with the use of structured observation schedule and questionnaires. Data collected were analysed using descriptive statistical tool such as mean, averages and percentages. Also SPSS 17.0 software was used and the results transferred to Micro-soft excel 2010. The results generated were shown in tables and charts. The results will reveal that users in commercial centres are not satisfied with the recreational spaces. It will also reveal that integration is the best option when dealing with recreation in a commercial environment. The paper will conclude that to achieve recreational space integration in commercial centres, there is need to have more recreational attractors.

Keywords: *Integration, Pleasure, Recreational Attractors, Recreational Spaces, User.*

INTRODUCTION

The significance of recreation to both the society and economy cannot be over-emphasized. It provides for one of the primary human needs of residents where they spend some of their time either daily or occasionally aside from working, eating and sleeping. This study will in turn offer direct or indirect social benefits to the resident of the Abuja Municipal Area Council (AMAC) and in most cases boost their standard of commerce and quality of livelihood. The drive for recreation is so paramount that socializing which involves making new friends, meeting people and getting together with friends portrays man existence (Southworth, 2005). It is a well known fact to researchers and designers that the importance of recreation is of immense benefit to the human development across economic, social and emotional context. In the FCC Abuja, the traffic gridlock often encountered by residents when going out either for their daily business purpose or work contributes negatively to the daily fatigue suffered by residents which affect their productivity. In order to bridge the gap, there must be a harmonious balance between commerce and recreation for AMAC residents so as to derive pleasure and enjoy themselves during official break periods or after working hours respectively. Sadly, the management of most commercial centres within the FCC have converted most of the recreational spaces available into shops to generate more personal revenue. The crave by the owners or facility managers for the economic benefit to which each space allocated to a vendor or tenant would fit in a commercial centre is gradually making recreational spaces to fade away.

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This problem makes users that patronise a commercial centre to seek their recreational demand elsewhere outside commercial premises. The recreational content provided in a commercial centre is often affected by its urban dynamics. The incorporation of architectural treatment to add visual interest depicting our cultural heritage by avoiding dull and repetitive facade must be taking into commercial designs consideration (Abayomi, 2007). This is because thoughtful design component reinforce the positive identity of a particular community which in turn contributes to their architectural character. The controlled environment where the recreational boom is expected to thrive is of significant importance due to the fact that it can create a sense of belonging, comfort and emotional intelligence. According to a study by Susan (2005), she ascertained the design fundamentals of recreational space arising from the human need for free movement of air and penetration of sunlight. It is therefore paramount that recreational spaces provided for the users' meet the required design standards and suit their recreational needs accordingly. This is achieved through a design process that allows for design brief development and data to be collected and utilized in the actual design guidelines. The need for integration of the recreational space is so important because not everyone that visit a commercial centre comes there to buy or sell, so there requirements and aspirations vary from one person to another. However, a harmonious balance would be struck to accommodate their needs. The present practice of active and passive recreation that makes use of green spaces restricts the integration possibilities for the users' hence the need to critically examine this is paramount.

Design Process in Recreational Provision in Nigeria

Generally speaking, it is a common practice in the design of commercial buildings in Nigeria that the architectural spaces to be provided are first discussed with the hierarchy of the project heralded by the project sponsor and the architect (s) who usually initiates the project and produce architectural design respectively that is presented to the project stakeholders for considerations or approval. This practice is in accordance with the project management standards where the architect whom is appointed by the client either as a prime consultant or not conceives the design based on the brief interpretation from the client. As shown in Plate 1.0a, after the brief development by the architect, the purpose of the facility coupled with users need are taking into consideration starting from the planning or programming stages. The illustration represents a summary of the lifecycle of how originally a space is intended to be used in the entire design process which is also applicable to any given building project.

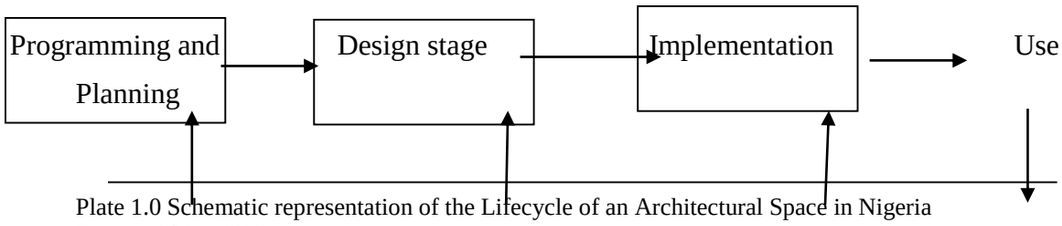

Plate 1.0 Schematic representation of the Lifecycle of an Architectural Space in Nigeria
Source: Ching (2007)

Predominantly, the pleasure to which the end users deemed necessary to relax & enjoy is not been given adequate attention. Unfortunately they are forced to either adapt to the recreational spaces provided or seek there recreational adventures elsewhere. According to Jiffy (2013), the integral part of any commercial centre is the recreational spaces available. He portrays the benefits of integrating recreation amidst the busy commercial boom, due to the fact that the recreational spaces varies in which some are present in the entire lifecycle of the building while some are integrated by virtue of users demand and rising expectations. In order to appreciate the spatial solutions for recreational benefits, it is important to know the conceptual issues associated with spatial dynamics to suit the end users. Figure 1.0a show

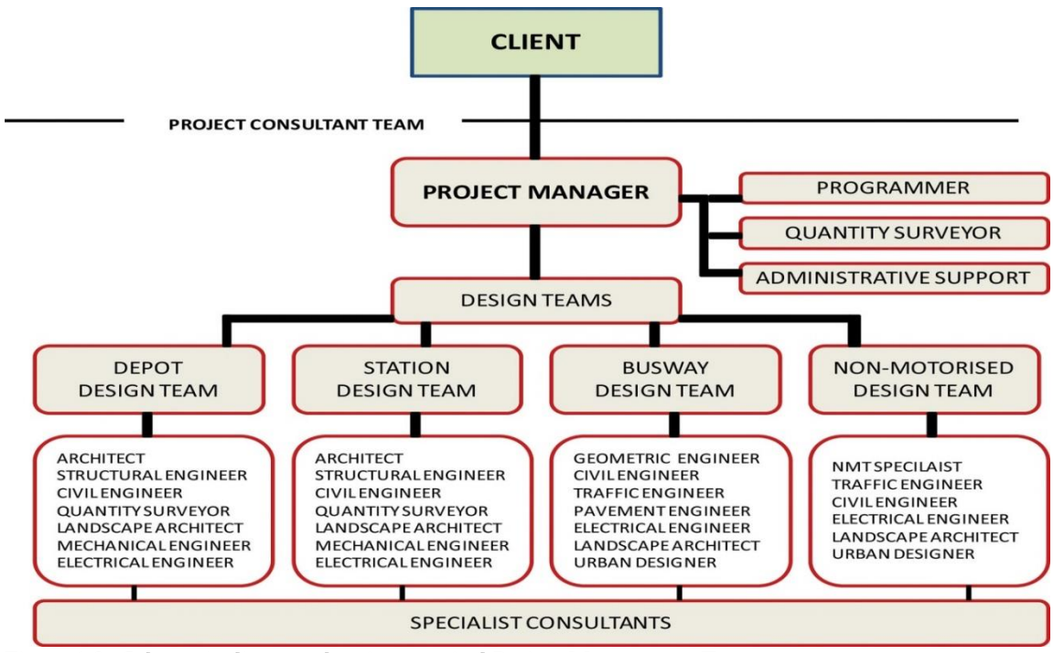

Figure 1.0a Schematic diagram showing a typical Project Management Team
Source: Online BRT Planning Guide (2018)

According to Vischer& Fischer (2005), the aim of any building project is to achieve high level of user comfort both functionally and visually attractive. In order to realise this objective; the need to assess what users deemed to be comfortable for them is important. This should be reflected generally in new commercial designs in the FCC Abuja. In the design of commercial centres in Nigeria most especially the FCC Abuja, the assumptions is that architects are just involved in the building design having in mind of the economic gain that these commercial spaces would benefit their client. While the other category is in the change of use of the facility when leased to a new owner. It is obvious in the space allocation that the space originally intended to serve a particular purpose are often interchangeably the same in terms of its floor area. Obviously, the difference is in the choice of shape and the emphasis given to how spacious a given space would yield more economically. The nature of activity or the functions that the recreational space would serve needs to be given abrupt attention during the initial design stages. However, some researchers' claim that the role of atmosphere in the choice of a particular commercial centre seem to be more limited than the socio-cultural concerns (Erkip, 2005). This is why Frasquet (2001), buttress the fact when he stated that a good atmospheric serene motivates people to stay longer and purchases more.

In the development of commercial buildings in Nigeria, particularly those owned by the private sector in the FCC Abuja, they usually buy there plot from the Federal Capital Development Authority (FCDA) upon detail confirmation with the Abuja Geographic Information System (AGIS), in which the commencement of the building projects are to be executed on approved government site and location. However it can be understood that the building upon completion is expected to meet the end users requirement with appropriate design standards considered, so the fear of building demolition by FCTA should be completed eliminated from thought. Furthermore, cases of government commercial centres in AMAC such as the UTC Area 10 can be understood of been on a temporary location when a new government decides to utilize the venue to serve different government functions and hence relocating the centre to a different location. So proper design and recreational space should be well integrated in commercial centres on approved plots, as the case should not be the same for temporary centres such as the old parade ground at Area 10 Abuja. While it might pose a challenge to meet the rising demands and expectations of the users in terms of their recreational needs, there is however the need to integrate recreational spaces within the defined space allocated in commercial centres.

According to Ginsburg (2007) ''recreational attractors should be integrated in commercial centres in order to achieve more intellectual stimulation and visual interest.'' The study is based on this quotation that the socio-economic boom expected in commercial centres is usually affected by the position, size, frequency of use and proximity of the recreational space provided respectively. This is achieved by space integration technique to serve the recreational need of the users at that point in time which paves the way for data to be gathered and utilized in the design parameters. It is worthy to note that the manner at which commercial boom expected to be buoyant in commercial centres within the FCC Abuja has

changed over the years, based on the introduction of new forms of recreational attractors and over dependency on technology. Therefore, there is need to examine the crave for recreation by users and meeting the rising expectations of the workforce populace within commercial centres. In achieving this Post Occupancy Evaluation method is considered best, because according to Meir, Garb, Jiao & Cicelsky (2009), the information obtained from the current users of a building will assist in the development of new buildings. The research aims to examine how recreational space integration fit into commercial building design. The research is based on the findings of interactions with some FCTA staffs and end users such as customers, staffs and facility managers of different commercial centres within AMAC, which can be summarised as:

a. Upon building approval of commercial buildings in AMAC, there is no any input from the end-user in terms of the spatial solution whether to integrate recreation or not.
b. Commercial designs are done based on the assumption that everyone whom patronises a commercial centre comes to either buy or sell.

As stated, it can be seen from this assumption if found to be the fact can affect the comfort of users because of their different recreational needs and aspirations, as stated by Arnold (2003) said that users may need entertainment, recreation, social interactions or intellectual stimulation. The issue of recreational space integration is important because commercial users have different forms of seeking recreation particularly in commercial centres where socializing and meeting people is inevitable.

Recreational Space Types and Recreational Attractors in Commercial Centres within AMAC

A research carried out in the study to ascertain the traditional concept of recreational spaces by Obeja (2012) *''Defines recreational spaces as green spaces with the provision of recreational facilities''.* Mitkovic (2002) said that there are several forms of urban recreation which includes: physical, pscho-physical, active and passive recreation which varies according to the users' perception on recreation. It is important to note that recreational spaces could either be open and closed. Changing lifestyle and work pressure have modified recreation to be a primary need. This is because customers demand and rising expectations are very paramount to understand properly. Obeja (2012) said that customers are conscious about extra facilities and services provided by personal selling in commercial centres. Length of stay is one of the key elements in tourist decision making in shopping centres (Ambavale, 2013). The loyalty of customers to patronize a particular commercial centre is dependent on the recreational attractors provided in such centres (Bull, 2005). Recreational attractors also plays a vital role in attracting tourism, this is because one of the three major element of tourism apart from accommodation and accessibility to natural features such as mountains, glaciers, lakes, forest and even decent landforms propels tourism attraction, this gave rise for large number of people to develop interest to visit such places. Recreational attractors should be integrated in commercial designs in order to achieve more intellectual stimulation and visual interest (Ginsburg, 2007).

Overview of Recreational Spaces

Integration of the recreational spaces is highly connected to the functional, aesthetics and socio-cultural factors pertaining to the building. Integration is the basic principle for the arrangement of recreational spaces since in each environment, the recreational usage of spaces varies (Manana, 2009). According to a Space Management Group (2006) document, there are three factors in determining how efficient a space should be utilized:

1. *The quantity of space, generally calculated in terms of floor area though occasionally volume may also be relevant*
2. *The number of users, potential and actual*
3. *The amount of time the space is used.*

These factors are very momentous to the recreational demand of users which reflects on the mode by which users seek to derive pleasure within the commercial complex in order to strike a balance for pleasurable commercial boom. The necessity of seeking users' opinion on their recreational demand is owing to the fact that they are the core beneficiaries of the facility. To assess the effectiveness of commercial centre, the focal interest of the consumer behavior is the visual appearance and atmosphere (Ambavale, 2013). The said human needs reflect on the daily lifecycle of everyone which also reflects in their work, recreation and

eating habits. It is therefore so important to appreciate the signifance which recreation offers both in the commercial and medical context as it creates favourable conditions for refreshment, relaxation and recovery of organism in the physiological and psychological terms that arose due to forms of fatigue generated either from the regular vehicular traffic gridlock or working conditions which affect the living conditions of resident within the FCC. It is therefore important to seek ways in ensuring that enough recreational attractors are properly integrated in commercial design in order to meet the rising expectations of the users as they come to buy and sell. This buttresses the key issues that would be tackled at the initial design stage for users in commercial centres

Table 1.0a: Types of Recreation frequently utilized in the Commercial Centre

Category of Recreation	First Floor	Second Floor	Ground Floor	Others	Total
Active Recreation	78	60	26	2	169
Passive Recreation	96	22	62	1	181
Others	5	5	11	5	26
Sub-Total	179	87	99	8	376

Source**:** Authors' fieldwork, 2017

RESEARCH METHOD

The research work undertaken determines to a large extent the methods to be employed to get the desired result. The study has already given a background as well as reviewed relevant literatures as it concerns the area of study. Research method describes the schemes, procedures and strategies used by the researcher during the study. Therefore, it is planned, methodical and scientific in nature and is made in such manner as to be replicated again (Rajasekar, Philominathan, Chinnathambi, 2013). It often describes a procedure by which the research or inquiry can be carried out in order to examine a research problem. A post occupancy evaluation method was adopted for the study as this gives a view of the users' opinion of the research. According to Adedeji & Fadamiro (2012) Post Occupancy Evaluation (POE) has generally been accepted as method of obtaining opinion of users in the built environment. According to Zimmerman and Martin (2001), more precisely POE tests generic and specific aspects of the planning and detailed design of facility buildings like commercial centres. The impacts on the building users are been examined also in relation to some parameters such as accessibility, historical and cultural factors, indoor air quality, atmospheric conditions, safety and security standards as well.

AMAC in Federal Capital Territory Abuja was selected because it has a wide range of various forms of commercial centres spread across the FCC Abuja, hence which gives a mix blend of respondents based on the historical and cultural point of views. A questionnaire was generated and administered to all the respondents selected from eight commercial centres out of a study population of 10 commercial centres which was carried out based on the high influx of people to patronises those places and also based on its strategic locations as well. A total of 400 copies of questionnaire were administered with 250 copies returned giving a 62.5% return rate. The selection of respondents within all the commercial centres was based on selective bias which spread across all stakeholders concerned with the facility using a Stratified Random sampling method. The category of users selected was because they form the nucleus to which commercial design thrives upon. Furthermore about 15 research assistants were selected whom were on their student industrial work experience scheme (SIWES) at AMAC and FCTA respectively, which were distributed among the eight commercial centres for administration. The category of commercial centres that were selected was based on the assumption that commercial facilities must fulfil both aesthetics and functional requirement with adherence to the principles of space integration and organization of recreational spaces. The types and source of data used for this research are primary and secondary sources in order to retrieve consistent, valid and relevant information. The data that have been collected were checked or analyzed for improvement on the design. The data gathered was sorted out based on the study population and was analysed using Statistical Package for Social Science (SPSS) 17.0 and Microsoft Excel 2010 for analysis. The results were expressed using descriptive analysis to explore each variable for performance and are presented in tables and charts. Descriptive data mainly obtained from secondary sources were used to establish the research objectives of the paper. Pictures of

some recreational spaces are presented as figures for further explanation within results discussion. The calculation of the rating of selected integration questions and users opinion on the subject of recreation was based on the likert scale with the view of generating strong recommendations to buttress the research based on the adequate decisions previously taken.

Table 2.1: Commercial Centres Studied within AMAC

Name of Centre
Ceddi Plaza
Silver bird Galleria
Next Cash n Carry
Omega Centre
Banex Plaza
Jabi Lake mall
Metro Plaza
Shoprite Apo
Febson Mall
UTC Area 10

Source: Authors' fieldwork, 2017

RESULTS AND DISCUSSION

The results show that the position of recreational spaces vary widely in terms of the position for these recreational spaces when viewed as a dependent variable. However in order to determine the positional mean values across the samples when combined together, there is some finite cluster of recreational spaces spread across some floors in the commercial centres. Hence the need for recreational attractors on each floor respectively to allow for adequate space integration in selected specific cases have been discussed earlier in the literature review. The Likert scale measurement is discussed in the first segment of this section while selected specific cases shall be discussed along.

Likert Scale Measurement of Recreational Spaces and Users Opinion

A weighted scoring of 1-4 was allocated to the various options for choice for the respondents based of their opinions of the variable being measured. The scoring of the options are stated below;

Very Dissatisfied	1
Dissatisfied	2
Satisfied	3
Very Satisfied	4

Table 3.0 shows that a high percentage of the respondents were spread within the satisfied and dissatisfied section of the scale of measurement. The number of respondents in each section is multiplied by the weighted score apportioned to them, hence the calculation for this is shown in table 4.0 and the total score across the rows are added up and presented as the total at the end of the table.

Table 3.0: Number of respondents per opinion on Satisfaction with recreational space Measured

Measured Variable	Very Dissatisfied (X1)	Dissatisfied (X2)	Satisfied (X3)	Very Satisfied (X4)	Total
Rating of Recreational space size	41	122	100	4	267
Rating of seating areas in the centre	33	185	96	18	332
Rating of recreational space within the building	16	205	86	22	329
Rating of position of recreational spaces	34	198	91	30	353
Rating of privacy level during recreation	42	97	84	32	255
Rating of users recreational space	68	238	102	14	422
Rating of frequency of use by users	86	211	66	16	379
Rating of Interference with recreational space during commercial activities	38	122	120	22	302
Rating of adaptation for users	52	218	88	18	376
Rating of adaptation functions between commerce and recreation	18	120	135	12	285
Rating of strategic location of the recreational spaces	20	75	220	132	447

Source**:** Author's fieldwork, 2017

Table 4.0: Sum of respondents' responses on Satisfaction with recreational spaces provided

Measured Variable	Very Dissatisfied (X1)	Dissatisfied (X2)	Satisfied (X3)	Very Satisfied (X4)	Total
Rating of recreational space size	42	222	400	80	744
Rating of seating areas in the centre	31	288	337	68	560
Rating of recreational space within building	8	290	213	56	724
Rating of position of recreational attractors	31	208	267	56	562
Rating of position of recreational spaces	38	194	231	88	551
Rating of privacy level during recreation	46	210	231	30	517
Rating of users recreational space	94	311	236	56	697
Rating of frequency of use by users	29	192	294	48	563
Rating of Interference with recreational space during commercial activities	35	236	228	36	535
Rating of adaptation for users	16	249	282	24	571
Rating of integration functions between commerce and recreation	9	118	300	262	689
Rating of strategic location of the recreational spaces					

Source**:** Author's fieldwork, 2017

The interpretation of the results obtained based on the Likert scale calculation is based on the range of scale stated as follows:

1.0	-	1.49	Very Dissatisfied
1.5	-	2.49	Dissatisfied
2.5	-	3.49	Satisfied
	>	3.5	Very Satisfied

Table 5.0: Respondents' opinion on Satisfaction with recreational spaces provided in commercial centre

Measured Variable	Sum	Mean	Interpretation
Rating of recreational space size	575	2.42	Dissatisfied
Rating of seating areas in the centre	560	2.36	Dissatisfied
Rating of recreational space within building	567	2.38	Dissatisfied
Rating of position of recreational attractors	562	2.36	Dissatisfied
Rating of position of recreational spaces	551	2.35	Dissatisfied
Rating of privacy level during recreation	515	2.19	Dissatisfied
Rating of users recreational space	479	2.02	Dissatisfied
Rating of frequency of use by users	563	2.40	Dissatisfied
Rating of Interference with recreational space during commercial activities	535	2.24	Dissatisfied
Rating of adaptation for users	562	2.38	Dissatisfied
Rating of integration functions of commerce and recreation	687	2.95	Satisfied

Source**:** Author's fieldwork, 2017

It can be observed from table 5.0 that a large number of the respondents are dissatisfied with the recreational spaces provided for them and welcomes the idea of integration as the ideal design principle when dealing with the subject of recreation. However, it can be explained why they welcome such idea, as the benefit of recreation cannot be over emphasised.

Adaptation of Recreational Spaces Based on Users Perception for Comfort

The design brief interpreted by the architect guides in the allocation of spaces to serve its intended functions. Spatial justification is very paramount in ensuring that the sole functions of a given space are adequately utilized. In view of this, the initial design stage of recreational spaces is often associated with the characteristics of the environment and the specific demands that each environment require. It is worthy to note that each recreational space is unique in terms of it specific functions, type of recreational activities that is happening there, the frequency and flow of usage, size and capacity of people it will take at that point in time and also updated social practice in line with other globalized cities. However, for users to optimally utilize the recreational spaces on regular basis, it is vital that there should be a harmonious balance to historical and cultural factors which are affected by the accessibility, proximity and adequate information provided at that point in time. Consumer shop for different purpose, which perhaps is not necessarily the need for a particular product or service. For instance they may need entertainment, recreation, social interactions or intellectual stimulation (Arnold *et.al.* (2003). Historical and cultural elements also attract the interests of people to a particular commercial centre. The incorporation of architectural

treatment to add visual interest depicting our cultural heritage by avoiding dull and repetitive façade must be taking into commercial design consideration (Abayomi, 2007). This experience changed the nature of shopping now merged into leisure and entertainment (Erkip, 2005). The recreational content provided in a particular commercial centre is affected by its urban dynamics. Thoughtful design component reinforce the positive identity of a community's core and contributes to neighbourhood character. The prime areas encapsulated in the recreational opportunity spectrum in attaining high quality design standards solely for commercial designs include: Maintenance and preservation of the city architectural character, striking a balance between residential and commercial uses by way of building mass transitions, maintaining spatial and visual relationships with adjacent spaces and maximising the recreational opportunity to allow for additional spaces to be integrated that will strengthen the visual and functional quality of the commercial environment within the FCC Abuja.

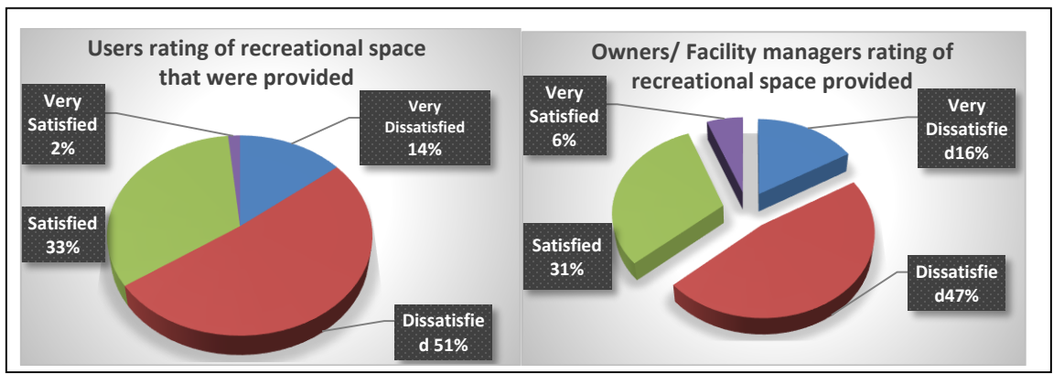

Figure1.0: Chart Showing Distribution Of Recreational Spaces Provided In Selected Commercial Centres.
Source: Authors' Fieldwork (2017)

Inclusive Design Approach Based on Recreational Benefits, Users Aspirations and Rising Expectation

Inclusive design aims to remove barriers that create undue effort and separation. An inclusive approach to design offers new insights with the way we interact within the built environment. It creates avenue to adopt creative and problem solving skills. Inclusive design offers choice where a single design solution cannot accommodate all of its users. In some commercial centres, the creation of additional spaces hinders the circulation flow of movement within the commercial complex. These problem need to be checked so as to establish a finite inclusive design approach in the area of the study. The key reason with the high level of dissatisfaction of the recreational spaces was based on the fact that inclusive design approach was not properly considered; rather the spaces provided were predominantly as after-thought which were later converted to commercial spaces to generate more income. In the case of strategic location of the commercial centre, about 23% were satisfied with the strategic locations since the predominant commercial hub of the FCC are located on plot at central business districts.

This accounted for some of the percentage of dissatisfaction from those who view inclusive design approach as a core necessity when integrating recreational spaces in commercial centres. This figure 2.0 depicts that inclusive design is not just a requirement, but the best principle to use when dealing with the concept of integration.

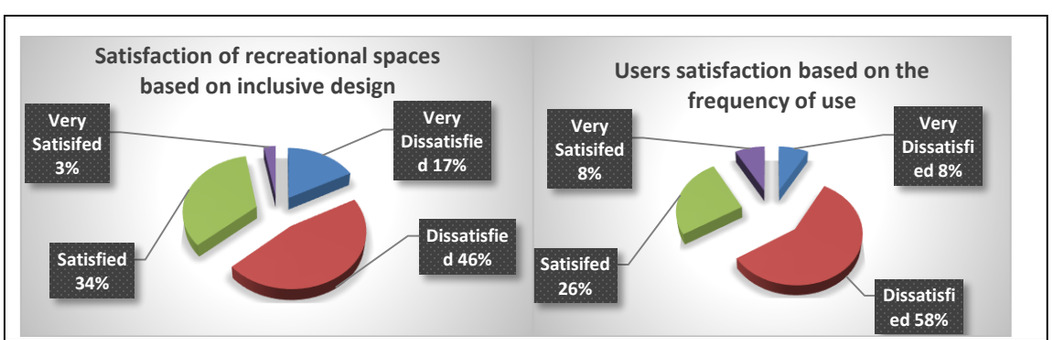

Figure2.0a: Satisfaction of recreational spaces based on inclusive design approach.
Source: Authors' fieldwork (2017)

Figure 2.0b shows the position of recreational spaces integrated in the commercial centres

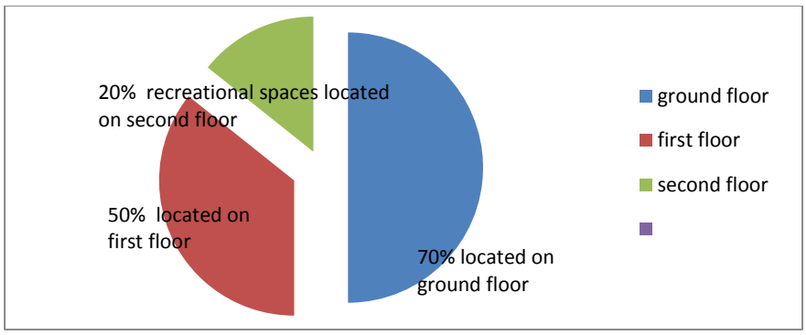

Figure 2.0b: Showing the position of recreational spaces that were integrated
Source**:** Author's fieldwork, 2017

Privacy Opinion Based on the Number of People to use Recreational Spaces per Time

Privacy is a major concern in many public buildings visited during this research work and many respondents affirmed that the reason why they do not want to derive pleasure in commercial centres is due to the fact that the level of noise generated as a result of commercial activities would drastically affect their comfort level. While some people chose to freely derive pleasure in commercial centres which Sollner (2013) describes as an amusement centres. Changing lifestyle and work pressure have modified recreation to be a primary need. Current research that covers wide aspect of consumer behavior revealed that shopping centres serve as a place to stimulate social behavior (Feinberg *et.al.* (1991). It is worthy to note that commercial centres are now designed as complexes which provide new experience for post modern citizens or users in western culture. This experience changed shopping now merged into leisure and entertainment (Erkip, 2005). Cinemas, food court, music concert shows, restaurant, kid play spaces, shops, terraces, open spaces, cyber cafes, art exhibition halls, bar and entertainment galleria constitutes recreational spaces for entertainment and leisure functions. Shopping is a form of leisure (Mugan *et.al.* (2009).

The essence of privacy is very important because not everybody that visit a commercial centre comes to buy or sell. Some people visit commercial premises in order to relax as a result of daily work pressure and vehicular traffic gridlock associated with the FCC Abuja. In attempting to achieve a significant harmony to ensure adequate privacy is attained during recreation, most users prefers to engage in passive recreation to ensure they are not seeing other scenes and views. In some cases of passive recreation, a screen landscaping elements such as hedges are used to achieve some degree of privacy during recreation.

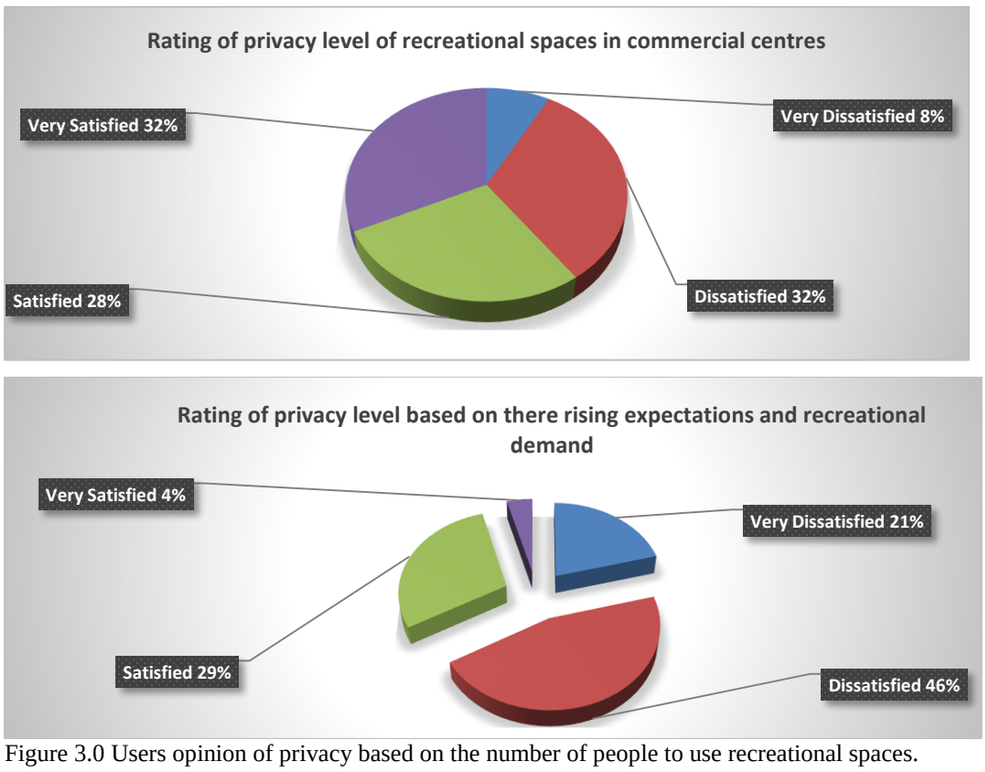

Figure 3.0 Users opinion of privacy based on the number of people to use recreational spaces.
Source: Authors' fieldwork (2017)

CONCLUSION

This paper sought to integrate recreation as a driving factor and need which arose as a result of tremendous work pressure coupled with the rising standard of living encountered by residents in the FCC. This is due to the fact that commercial centres provide diverse opportunity for their users to socialize. Although most of the commercial centres in the FCC were privately owned, such recreational spaces are used by the public for business purpose. However, it is the hope of this study that rapt attention would now be adhered so as to fulfil the recreational demand of users amidst daily busy lifestyle associated with residents of the FCC. It is therefore important to seek ways in ensuring that enough recreational attractors are properly integrated in commercial design in order to meet the global current trends of recreational demand and rising expectations. This should be taking into consideration by architects during the design stage. During the course of the research when reviewing the empirical researches on the activities and characteristics important to consumer behaviour about commercial centres, it was revealed that recreational attractors serve as catalyst to harness both commerce and recreation together. This paves way for more socio-economic boom. However, going by the present state of commercial designs in the FCC, this recreational deficit has not been given detailed attention. The adoption of space integration techniques offers good design solutions most especially in the study of recreation. With continued implementation of integration techniques even the initial cost will eventually level off. In a well-run integrated design process, the additional time that a team spends developing a schematic design is offset by a reduction in the number of meetings needed later to strike a balance between recreational spaces to be integrated and commercial venues respectively. The Architect involved in commercial design should begin to consider the principle for organization, arrangement and usage of recreational spaces for optimal functions. In conclusion, it is apparent through performance integration that recreational spaces and other commercial spaces can be unified together so as to allow two functions merged into one element which can be achieved through both visual and performance integration of recreational attractors respectively. It is important to consider integration as the basic principle for the arrangement of recreational spaces since in each environment, the recreational usage of spaces varies.

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SOCIAL INTEGRATION IN CITIES

SOCIAL CAPITAL: A POVERTY REDUCTION MECHANISM IN MINNA, NIGER STATE, NIGERIA

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Social capital in its simplest form is the sum total of all the experiences an individual acquired through participation in informal networks, registered organizations, associations of different kinds and social movement. Social capital theorists argued that social capital has positive impacts on various aspects of societal life, such as economic well-being, health, crime rates, educational achievement, and adolescent development. This study therefore appraised the role of social capital in poverty reduction in two selected neighbourhoods in Minna (Tunga and Maitumbi) by assessing households participation in social network and the impact of social network participation on households livelihood improvement and wellbeing. The study adopt the survey research design for data collection. Primary and secondary data were collected and analyzed descriptively. A total of 107 households were sampled using multi-stage sampling technique. The study revealed that, 72% of the households are well off as a result of participation in social network groups. The result also shows that 49% of the respondents have acquired training and benefit that have direct bearing on their livelihood, while 81% have acquired benefits with direct bearing on their general wellbeing. The study concluded that participation in social networks, both formal and informal has impact on household livelihood development and wellbeing, hence can serve as a tool for poverty reduction. The study recommends that government should partner with social networks groups to initiate programs that can help to alleviate poverty in the study area. Social networks should also be integrated into local poverty reduction action plan at the grassroots.

Keywords: *Livelihood Improvement, Poverty Reduction, Social Capital, Social Network, Wellbeing.*

INTRODUCTION

Poverty do not mean absence of earnings and basic services, it is simply dearth of social network and support system. It is not only lack of clothes, housing, nutrition and important needs of life, but also, he who has nobody is also really and truly poor (Woolcock and Narayan,2000 ; World Bank 2001). Africa in general and Nigeria in particular have rich natural, material and human resources yet most citizens are extremely poor. Many poverty reduction policies and strategies have been introduced and implemented at both national and local levels, yet many lack improved livelihood. According to Ellis and Freeman, (2005) livelihood is a means of survival, activities individuals or group engage in to make ends meet. It is also the assets that afford people the ability to build a suitable living considering all environmental threats and established rules that assist or prevent the achievement of sustainable existence. Social capital as a concept was advanced by Pierre Bourdieu, Loury and many other researchers as an approach of describing features of collective organization, such as trust and value, network interaction, rules and reliable supports systems that enable group achievement and institutionalized endeavour (Coleman,1990). Social capital is seen as a safe basket for the poor to save their eggs, a bunch of broom that sweeps better and glue that binds together.

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Martins, et al., (2018). **SOCIAL CAPITAL: A POVERTY REDUCTION MECHANISM IN MINNA, NIGER STATE, NIGERIA.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

Hamdan , *et.al.* (2014) described social capital as a form of livelihood improvement mechanism that the poor use in shaping their creation, distribution and usage of resources. It can also be said to be a minimum or societal threshold of collective support that could get people out of poverty trap. The notion of social capital is as old as man, and will continue to be part of man's way of life to relate and contribute to the survival of individual and the society. Social capital is a resource and a process that facilitates achievement in areas of wellbeing, learning, employments, livelihood improvement, societal marginalization and security (Hamdan , *et.al.* 2014).

The term social capital has found its way into environmental analysis only recently. Although different professions most especially the economists have been focusing on social capital, only a very few have perceived it from environmental and spatial perspectives. Social capital as benefits or assets that accrues to individuals or groups happen in space, hence its spatial dimension is important. The idea is crucial to survival and helps in overcoming risks to livelihoods, and also, a reduction of the effects of economic shocks. Among Nigerians, social capital serves as a means to livelihood improvement, where staff of institutions, traders, students come together to achieve a desired aim. Examples of this are various cooperatives in institutions, collection or contribution groups commonly called Adashe in the north, Esusu in the east and Olidara among the Bini tribe.

Several studies have been directed towards analyses of social capital and poverty, both in Nigeria and Minna. These studies have related social capital to mainly economic and welfare issues. Giving the instance of the study of (Ogwumike, 2002 and Okunmadewa, 2005) in Abia, Cross River, Ekiti, Kebbi, Kogi, and Yobe, Nigeria on impact of social capital on welfare and poverty, the studies revealed that Social capital have positive influence on per capita expenditure by reducing the probability of being poor. In Minna, the study of Ijaiya *et.al.*; (2012) revealed the impact of social capital on poverty reduction in Minna. Although reviewed literatures has revealed the importance of social capital as an economic mechanism against poverty shocks, other functions that social capital plays in livelihood improvement among dwellers in Minna to tackle poverty and its forces other than the economic aspect have not been investigated. Hence, this study seeks to fill this gap by establishing the role of social capital as a poverty reduction mechanism. This will be achieved through the following objectives; assessing household's participation in social network; and examining the impact of social network participation on households livelihood improvement and wellbeing.

Theoretical Consideration in Social Capital

Theoretically, local level associations contribute to societal progress (Okunmadewa, 2008). They are contemporary traditional actions that exist at national, regional and local levels that facilitate societal progress. Social capital, is a social connection with a measure of trust, norms and commitment that empower individual or group to make reasonable progress. Okunmadewa *et al.* (2005) observed that the idea of social capital exist in environments where there are social interaction to enhance the quality of relationship and improve societal welfare. Coleman (1988) and Putnam *et al.* (1993) see the concept as having confidence, passionate connection in network or societal values that assist in the achievement of collective goals. It is viewed as associations, connections, beliefs and trust that form the strength and bond of people societal relations, The ideal is not only just an association or means of support for the people but also a bond that keep them together (World Bank, 1998; Lynch *et al.*, 2000 Tabi, 2009;).

Although several meanings and view of the concept have been proposed by many researchers; the most used definition is that advanced by Robert Putnam who sees the concept as a part or way of life that help people work collectively and more efficiently to chase common goals (Barron *et al.*, 2010). Social capital can also be seen as assets that the poor accumulate through different associations either inter or intra family relationship to add to their lot and make their voice heard in a complex society. It is usually a social benefit earned based on trust, understanding, sacrifice and focus. It is commonly construed as the amount of reliance, collective rules, groups and links in an environment (Tabi, 2009). In summary social capital is referred to as the worth of social association as well as the gains that originate from such interaction that can be of huge advantage or assistance to The People In Such Association.

Levels and Types of Social Capital

Patacchini (2015) maintained that the level of social interaction in network in the geographical space is inversely related to the geographical distance. Increase in this distance attracts more cost and this decreases the incentives in social capital. Weak ties benefit substantially from geographical proximity, weak ties need frequent interaction to be sustained; frequent interaction, in turn, is best achieved among individuals who are located in the same geographical space (Roel *et al.,* 2009).

Network group linkages form the bedrock of social capital (Roel *et al.,* 2009). Rules and beliefs differ greatly among individuals and associations; one may ask whether rules and beliefs are associated with space. It can then be said that several networks are establish at different spatial levels, from regional to global, and the variance between networks are bigger than variance among spatial units on the similar level, for instance sports club. However, it can be claimed that there are dissimilarities in beliefs, such as confidence and tolerance, between places, regions and countries. The spatial distribution of social capital is a relative function of the spatial distribution of people, People tend to interact more with others that are highly central in the network of social contacts and that are geographically closer; Social interactions and social network are important components of social and economic life of people (Roel *et al.,* 2010).

Social capital is multi-dimensional with each dimension contributing to the meaning of social capital. Each of the dimensions cannot capture fully the concept in its totality. They are commonly seen as; groups and networks, trust and solidarity, collective action and cooperation, information and communication, social cohesion and inclusion, and empowerment and political action. Discussing the different dimensions separately and collectively to achieve a shared goal, which is an important goal of social capital, (Woolcock *et. al* 2000) Informal networks are manifested in spontaneous, informal, and unregulated exchanges of information and resources within communities, as well as efforts at cooperation, coordination, and mutual assistance that help maximize the utilization of available resources.

Social capital exits at individual level, the informal social group, the formal organization, the community, the ethnic group and even the nation (Bankston and Zhou 2002; Coleman, 1988; Portes, 1998; Putnam, 1995; Sampson *et al.*, 1999). There are different views on the level at which social capital exist; some authors put forward that social capital is at individual level. As posited by Kilby (2002) social capital exists within levels or scales as one feels belonging to family, community, profession, country concurrently. Adler and Kwon (2002) supported this argument stating that social capital's sources lie in the social structure within which the actor is located. Thus, social capital can be thought of as having an individual and an aggregate component (Buys and Bow, 2002; Slangen *et al.,* 2004). Social capital belongs to the group and can be used by the group or individuals within the group (Kilpatrick et al. 1998; Sander, 2002). An individual's social capital perspective views social capital as a personal belonging such as personal financial assets (Portes, 1998). In contrast, an aggregate social capital perspective views social capital as a collective belonging, such as the amount of social capital held at a community level or even at national level (Putnam, 2000). Aggregate social capital implies that each person in a community or even a nation owns the same amount of aggregate social capital, despite their individual variations. Therefore, aggregate social capital can be viewed as an important component shaping community or national social contexts.

A question may be asked whether social capital can be increased in the short term. This question is similar to the debate of whether social capital can be measured, as without measurement, change cannot be determined. There are views in the literature over whether social capital can be built in the short term (Claridge, 2004). According to Putnam (1993), social capital is largely determined by historical factors; it can thus not be enhanced in the short term. This has been challenged by Petersen (2002) who posited that social capital creation is possible. This is supported by (Schmid, 2000 ; Uslaner, 2001) who saw social capital development as a by-product of other activities that result in dynamic changes. Any social interaction creates, or at least, changes social capital. This is supported by Soubeyran and Weber (2002) who stated that social capital can be created through repeated exchange and face-to-face contacts.

Social capital is perceived to be multi-dimensional in nature; hence it has different forms. It can be discussed from gender and ethnic perspective. According to Fox and Gershman

(2000); Molinas (1998) Ethnic and gender dimensions of social capital remain under-recognized. Social capital in the literature is generally conceptualized gender blind paying little attention to gendered intra-household issues of power and hierarchy (Silvey and Elmhirst 2003). Silvey and Elmhirst (2003) argued that for a more complete picture of social capital, it is specifically one that includes attention to the gendered and intergenerational conflicts and hierarchies within social networks, and the broader context of gender difference within which social networks are forged.

Role of Social Capital in Wellbeing and Community Development

The concept of community, according to ABS (2002) refers to either place-based or non-place-based communities. Place based communities are considered to exist at a variety of geographical levels, such as neighbourhood, work place, suburb, town or city, district or region state and Connery or even a global community. Non-place based communities are group of common interest which includes sport clubs, hobby groups, ethnic and religious group, common bonding characteristics may be in this category. An understanding of the fact that some forms of social capital are placed based should promote scope for it.

Social capital is not embodied in any particular person, but in people social relationships and social capital is realized by individuals Coleman, (1998). As put by Putnam (1993) "working together is easier in a community blessed with substantial stock of social capital". He also stated that communities, not people, posses stock of social capital. So, social capital simultaneously is both a private and public good. Social connection and networks help in moving people and community out of poverty. With the assets accumulated as social capital, they are able to build houses, buy cars, create good living conditions for themselves and other families, send children to school, buy land and other developmental projects that lead to development of a community. When people come together to form social network, it helps them to accumulate capital which in turn give them power to make decisions and controls what come to them in form of land, employment, education investment and any other gains. All these are carried out in space which makes their study very important in relation to spatial analysis of social capital (Claridge 2004).

Cox (2000) on this, believes that the strength of social capital come into play when communities have to deal with conflict, problems or challenges. A community with high accumulation of social capital will be able to manage difficulties while one with low levels will manage less well. This is likely to be because social network is like a bunch of broom that sweeps and cleans better than a single stick. People are motivated and socially engaged when in groups than when alone. According to Bush and Baum (2001) social infrastructure in form of groups, network and organizations are prerequisite for a healthy community.

Putnam, (2000) and Coleman, (1988) suggested that involvement of families, community and religious bodies can improve educational outputs. Social capital was linked to the lower dropout rates in catholic high schools as compared to public schools and non-catholic high schools in the United States (Putnam, 2000).

There are several debates and controversies over the possibility, desirability and practicability of measuring social capital, yet without a measure of the store of social capital, its characteristics and potential remain unknown (Durlauf 2002; Falk and Harrison 1998). Measurement attempts are flawed by problems with separating form, source and consequences (Adam and Roncevic 2003; Onyx and Bullen 2001; Sobels *et al.*, 2001). Social capital cannot be measured directly but must be measured by the use of proxy indicators of social capital. Social capital is such a complex concept that it is not likely to be represented by any single measure or figure. The multiple dimensions require sets of indicators to be effective (Cox and Caldwell 2000).

Social Capital and Livelihood Improvement

Social capital has great significance on the poor. According to Woolcock and Narayan (2000) social capital is not ''what you know, it is who you know". Availability of various social capital, help groups and individuals fight poverty more effectively (Woolcock and Narayan 2000). According to Grootaert (1999, 2001, 2003), social capital influence household livelihood by reducing the probability of being poor; economic development among individuals, households and groups are enhanced by making possible dealings through increasing information, reducing costs and facilitating collective action.

Most poor that belongs to society network groups at times buy land or purchase built houses, buy cars, send children to school and get other necessities of life that ordinarily without social capital they can never acquire in their life time. Social capital assists people in meeting the desire of their hearts by way of acquiring assets in the group they belong (Odumosun *et al.*, 2003). High levels of social capital at the state level are correlated with lower rates of murders and violent crimes (Sander and Minicucci 2007). According to Sander and Minicucci (2007), social capital is associated with effective governance and a healthy participatory democracy.

RESEARCH METHODOLOGY

Cross sectional survey research design was employed in the gathering and collection of data for the study. Primary and secondary data were collected and analysed descriptively. A total of 107 copies of questionnaires were administered to households in Maitumbi and Tunga area in Minna. Simple random sampling technique was used to select respondents for the study. The primary data collected for the study are; households' participation in social network, number of social network, types of social network, contribution of social network households' livelihood as well as benefit acquired from social networks. The data were analysed using simple frequency, percentages, mean and standard deviation. Instrument for data collection includes questionnaire, digital camera and hand held GPS.

RESULTS AND DISCUSSION

Summary of Respondents Socio-Economic Characteristics

Socio-Economic characteristics of respondents are presented in Table 1. Majority of the respondents were male; 59%, while female respondent account for 41%. This shows that both male and female opinion was adequately captured for the study. The mean age for the respondents is 38 years, while the average household size is 5.5 persons per household. The average monthly income for the respondents is ₦37, 356.00, the minimum income recorded is ₦15, 000.00 and maximum (₦180, 000.00). This implies that both that respondents for the study cut across various socio-economic class. The result also shows that majority of the respondents (57%) are married, followed by singles who account for 30% of the respondents.

Table 1: Summary of Respondents Socio-Economic Characteristics

Gender	**Frequency**	**Percentage**	**Age Distribution**	
Male	63	59	Mean	38
Female	44	41	Minimum	25
Total	**107**	**100**	Maximum	57
Marital Status	**Frequency**	**Percentage**	**Household Size**	
Married	61	57	Mean	5.5
Separated	9	8	Minimum	3
Single	30	28	Maximum	8
Widow/Widower	7	7		
Divorced	0	0	**Income Distribution**	
Total	**107**	**100**	Mean	₦37,356.00
			Minimum	₦15,000.00
Education Status	**Frequency**	**Percentage**	Maximum	₦180,000.00
No Formal Education	2	2		
Quranic	0	0		
Primary	5	5		
Secondary	43	41		
Tertiary	57	53		
Total	**107**	**100**		
Artisan	21	20		
Civil Servant	36	34		
Trader/Business	32	30		
Unemployed	11	10		
Others	7	7		
Total	**107**	**100**		

Source: Authors Fieldwork (2017)

Respondents for the study can be said to be literate as majority have attained (53%) at higher education in form of tertiary education, while 41% have secondary education. The study also shows that respondents are from diverse occupation where the majority are either civil servant (34%), Trader/businessmen (30%), and Artisans (20%).

Participation in Social Network

The study assessed the promotion of respondents that participate in at least one form of social network group and the result is presented in Table2. The result reveals that 73% of the respondents belong to one form of social network or the other, while 27% do not belong to any form of social network. The high level of participation in social network group may be as a result of the benefit derived from participation in social networks.

Table 2: Participation in social network

	Yes	No
Neighbourhood	**Frequency (%)**	**Frequency (%)**
Tunga	34 (78%)	9 (22%)
Maitumbi	44 (69%)	20 (31%)
Total	**78 (73%)**	**29 (27%)**

Source: Authors fieldwork (2017)

Furthermore, the study also revealed that the mean number of social network groups that respondents belong to is 3. In Tunga, respondents belong to an average of two (2) social network groups, while Maitumbi is four (4) (Table 3). This implies that respondents in Maitumbi which is a low income neighbourhood tend to participate in more social network groups than respondents from Tunga (medial income neighbourhood).

Table 3: Number of social network

Neighbourhood	Mean	Minimum	Maximum
Tunga	2	1	3
Maitumbi	4	1	6
Total	**3**	**1**	**6**

Source: Authors fieldwork (2017)

The study also analysed the nature of social network groups that respondents belong to, and the result is presented in Figure 1. The result shows that respondents from Tunga are more into profession based (53%) social network groups, followed by Faith-based social network (35%). While majority of respondents from Maitumbi belong to faith based social networks, followed by township and gender-based (25%) social network groups.

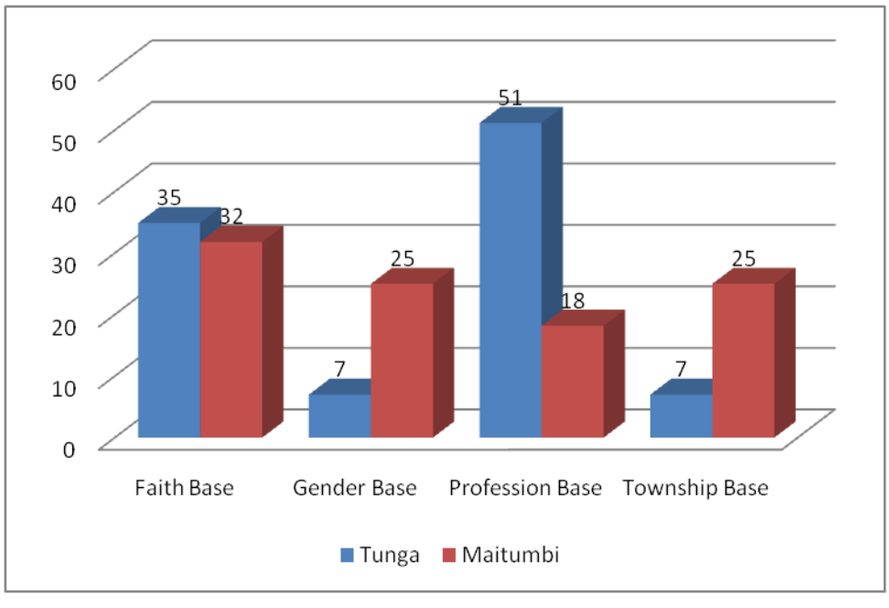

Figure 1: Types of Social Network Groups by Neighbourhood
Source: Authors fieldwork (2017)

Composition of Social Network Groups

Table 4, shows the composition of various types of social networks by occupation. The result shows that artisans are more into township-based (38%) and profession based (37%), while civil servant are more into profession-based (50%), and faith-based (33%) social network group. The analysis also shows that majority of traders are into faith-based (41%), and township-based social network groups.

Table 4: Composition of Social network Group by Occupation

Occupation	Faith Base	Gender Base	Profession Base	Township Base
Artisan	25	0	37	38
Civil Servant	33	17	50	0
Trader/Business Men	41	9	18	32
Unemployed	29	57	0	14
Others	54	0	23	23
Total	42	18	18	22

Source: Authors fieldwork (2017)

Similarly, gender composition of the various types of social network group was also assessed, and the result is presented in Table 5. The analysis shows that male and female respondents participated almost equally in faith-based social network 54% and 46% respectively. Female respondents are more into gender based (55%) social network group than their male counterpart. Male respondents dominate profession and township-based social network with 73% and 86% respectively. It is can be observed that participation in social network group is not a function of occupation or gender.

Table 5: Gender Composition of Social Network Group

Types of Social Network	Male	Female
Faith Base	54	46
Gender Base	45	55
Profession Base	73	27
Township	86	14
Total	63	37

Source: Authors fieldwork (2017)

Frequency of Meeting

Table 6, shows the meeting schedule of social network groups. Majority of the social network group meets on monthly basis (41%), followed by those that meet every week (39%). This pattern is also observed at neighbourhood level in Tunga and Maitumbi.

Table 6: Social Network Meeting Schedule

Meeting Schedule	Tunga	Maitumbi	Overall
Daily	7	10	9
Fortnight	8	14	11
Weekly	41	37	39
Monthly	44	39	41
Total	**100**	**100**	**100**

Source: Authors fieldwork (2017)

Benefit and Livelihood Improvement from Social Network

The benefits gained from participation in social networks were categorized into tangible and intangible assets. Tangible assets include; land, household appliance, car, livelihood instrument, and livestock, while the intangible asset include employment opportunities, education, training, loan (cash) and others in form of good will messages and more. Figure 2, shows the proportion of respondents who have benefited from various forms of tangible asset. The result shows that 86% have gained tangible asset in form of household appliance

(television, radio, handset), followed by livelihood instrument (36%), land or landed properties (27%), car (25%) and Livestock (22%)

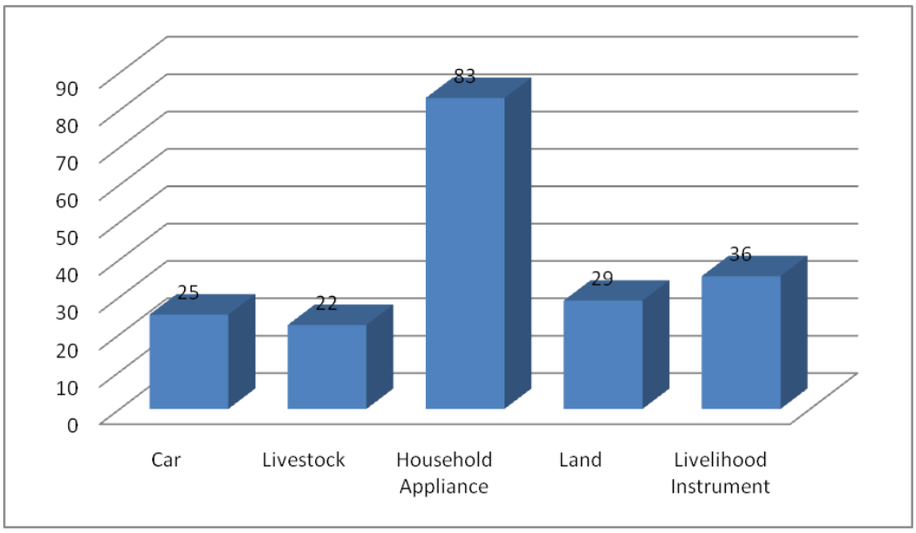

Figure 2: Tangible Asset Gained from Social Network
Source: Authors fieldwork (2017)

Similarly, Figure 3, shows the proportion of respondents who have benefitted from intangible asset as a result of participation in social network. The result shows that majority of the respondents enjoy goodwill message (100%), loan (71%), spiritual/moral support (54%), and employment opportunities (53%) as intangible benefit as gains for participation in social network.

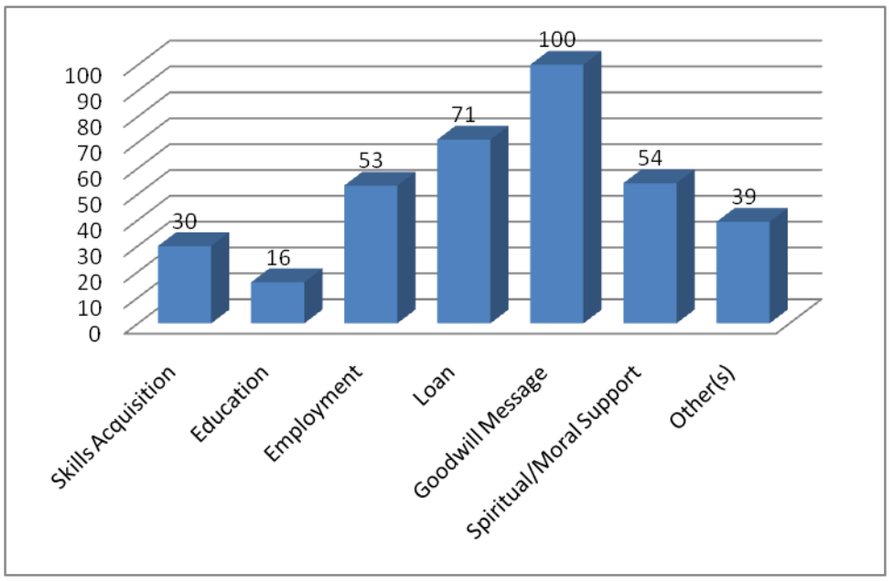

Figure 3: Intangible Asset Gained from Social Network
Source: Authors fieldwork (2017)

Contribution to Livelihood Improvement

Respondents were asked to rate the extent to which active participation in social network has contributed to their livelihood improvement, using a likert scale of five. The result is presented in Table 7. The shows that in Maitumbi, 62% of the respondents agreed that contribution to livelihood improvement from social network participation is highly significant, and Tunga (31%). While significant contribution to livelihood improvement in Maitumbi and Tunga is 33% and 45% respectively. Maitumbi recorded the highest mean weighted value of 4.4, and Tunga 3.9. The general mean score for contribution to livelihood improvement is 4.2, hence it can be inferred that social network participation has significant impact on livelihood improvement of the respondents.

Table 7: Extent of Social Network Participation on Livelihood Improvement

	Maitumbi	Weighted Sum	Tunga	Weighted Sum
Highly Significant	62	310	31	155
Significant	33	132	45	180
Moderate	10	30	24	72
Insignificant	2	4	7	14
Highly Insignificant	0	0	0	0
Total	100	476	100	421
Mean		4.4		3.9
Composite Mean			4.2	

Source: Authors fieldwork (2017)

Furthermore, the study also assessed the impact of social network on the general wellbeing and livelihood improvement and the result is presented in Figure 4. The result shows that 72% of the respondents agreed that social network participation has impact on their livelihood improvement, while 81% of the respondents say social network participation has impact on their general wellbeing. From the foregoing analysis, it can be observed that majority of the respondents have acquired diverse gains that have impacted positively on their livelihood means and general wellbeing due to participation in social network.

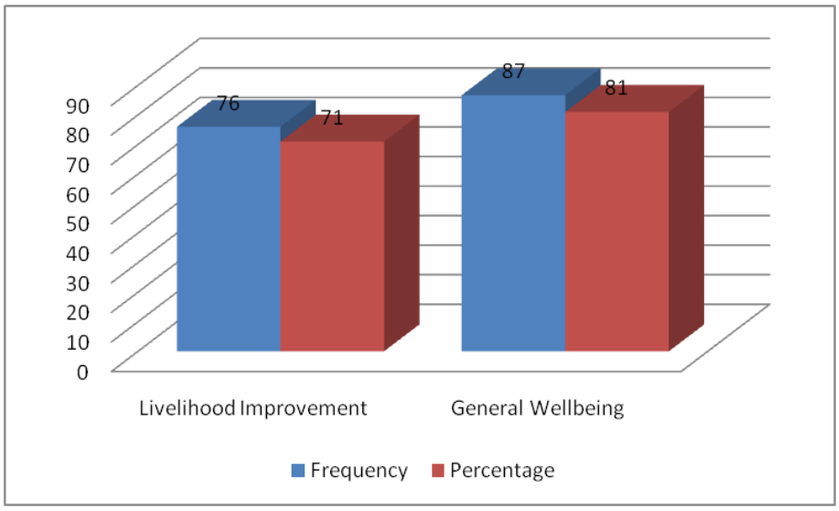

Figure 3: Impact on General Wellbeing
Source: Authors fieldwork (2017)

CONCLUSION

Having assessed the types, nature, participation and impact of social network on livelihood development of the people, the study concludes that social capital is a veritable tool for poverty reduction. Participation in social network group provides the people with financial, moral, and spiritual support in terms of need. Participation in social network is no doubt a form of resilience measure put in place by households. Most people have benefitted immensely from active participation in social network through the acquisition of various forms of benefit (Tangible and Intangible). These benefits have direct or indirect link the livelihood improvement and general wellbeing of the masses. The study therefore recommends that, the government should integrate the social network groups into various poverty reduction programmes at all levels. Government should partner with social networks groups to initiate programs that can help to alleviate poverty in the study area. Social networks should also be integrated into local poverty reduction action plan at the grassroots.

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APPRAISAL OF THE ROLE OF INFORMAL ECONOMIC ENTERPRISES IN MINNA, NIGERIA

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The term 'informal economic entreprises' was foremost invented by the British anthropologist Hart in a research conducted in Accra, Ghana, where he observe that several people engaged in activities that are not clearly defined by the literature. Literature on the informal economic entreprises and institutional governance were studied to elaborate on concepts, characteristics, arguments and explanations as it related to good governance. Policy responses on the informal economy enterprises in Nigeria and other nations of the world were reviewed. Six government institutions relating to direct relationship with informal economic enterprises were studied. The study aimed at appraising the government institutional practices on development of informal economic enterprises in Minna; with the following objectives: general spatial and structural characteristics of informal economic enterprises and the financial status of the informal economic enterprises. A uniform number of informal economic enterprises were selected for the studies from the 12 neighbourhoods totaling 1,200 because of lack of accurate number of entrepreneurs from three main sub-sectors of informal economic enterprises. Random sampling technique was employed to administer the questionnaire to the respondents. This sample was used to gain insight into the characteristics of enterprises, and their opinions and perceptions on the practices of these selected government institutions. The study revealed that retailing was the predominant activity in the study area. It was also found that a higher percentage of operators were utilizing public space without formal authorization. The proliferation of these economic activities in public space also did not promote environmental aesthetics.

Keywords: Informal Economic Entreprises, location, sub-sectors, relationship, and development

INTRODUCTION

The term 'informal economic enterprises' was foremost invented by the British anthropologist Hart (1973) in a research conducted in Accra, Ghana, where he observe that several people engaged in activities that are not clearly defined by the literature. The term achieved extensive acceptance at the beginning of 1970s, because the International Labour Office (ILO, 2002) agreed to it as the best language needed to explain Informal Economic Enterprises in a city research put together by the World Employment Programme. It was unanimously agreed by ILO that the organized sector of the economy consists of itemized; large scale, huge capital overlay enterprises. One man enterprises that largely offer a means of livelihood to people and new comers to the towns and cities is known as informal entreprises. Informal economic enterprises in urban setting include all activities that are not governmental. Further to this; urban informal economic activities offer merchandise and services to urban dwellers at moderately lower charges.

Research carried out in third world countries by Sethuraman (1981) indicated that Informal Economic Enterprises employs between 20%-70% of work force in urban areas. The analysis of Nigerian Informal Economic Enterprises shows that it provides higher propensity of employment than formal sector (Ijaya *et al.,* 2004; Rukuma, 2007). Analysis of the Nigerian situation also revealed that several factors accounts for this and one of the reason is the inability of the organized economic enterprises to adequately provide jobs and wages to the populace (UN-Habitat, 2003). Onyechere (2003; 2011) further supported the assertion that the percentage of urban Informal Economic Enterprises employment is higher.

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On the other hand, Governance is a tradition and institutions that have the authority to control activities within a country, state or localities as the case might be. Good urban governance on the other hand, shows different ways in which power and authority relations are structured in a given society. It has the following characteristics as a measure accountability and voice; effectiveness of governance;; rule of law; political stability; anti-corruption crusade and quality regulation(Azende, 2011a; 2011b).. This implies that good urban governance indicators show diverse methods that authority and influence are related for the smooth governance of a structured given society to encourage well-being and socio-economic development of towns and cities. Good urban governance is meant to bring about successful social and economic transition for future development. It should involve creative interventions by institutions (national, state and local) -governance to change structures that inhibit the full expression of informal economic activities and other stakeholder's potential within the city (Adeyinka *et al.*, 2006; Azende, 2011c).

The Nigerian informal economic enterprises sector of the labour market is the prevalent (Meagher and Yunusa, 1996; Kpelai, 2009). Informal economic enterprises play an important role and involving large percentage of urban dwellers and better contributor to urban economy. The Informal Economic Enterprises supply between 70% and 80% of the total employment opportunities that is available citizens of a country, state or city as the case might be and over 55% of national GDP is contributed by the informal economy in Nigeria (FGN, 2006). Knowing the immense economic offerings that the informal economic enterprises offer to the economy of urban area, the governance institutions at state and local government levels must be acquainted with its significance and to implement existing guidelines to encourage its development and employment of the citizens to reduce unemployment (Mambula, 2002).

Urban governance tends to refer to both the formal and casual political procedures that establishes and sway the happening in a town or city. Good urban governance operates by building town and cities to be more well-organized, impartial, perfect, safer and sustainable. Methods employed in good urban governance shows that it is centered on efficient, effective, transparent and accountable techniques that can therefore influence the cities to be more inclusive (World Bank, 2015). This study therefore, aimed at appraising the role of informal economic enterprises in Minna, Nigeria.

Study Area

Minna as a city is positioned on latitude $9^0$37' North and $9^0$51'and longitude $6^0$33' and $6^0$48'East. The northeast section of the city is characterized by a rock outcrop that in the past acts as physical constraint to development (Maxlock, 1980). However the occurrence of urban development has led to the infringement on the subterranean vault of the valley for urban expansion. Minna as a city continue to develop from a meager rural settlement to a metropolitan city which at the present performs a two function activities of being the Niger State capital and Chanchaga Local government headquarters. Because of growth of the city Minna have at the present annexed fraction of Bosso Local Government. Presently, parts of Bosso Local Government Areas and entire Chanchaga Local Government form the actual boundary of Minna metropolis when taken together Minna city. Maikunkele, the Bosso Local Government headquarters is at the extreme northeastern part of the city. Figure 1 show the location Minna within the context of Niger State.

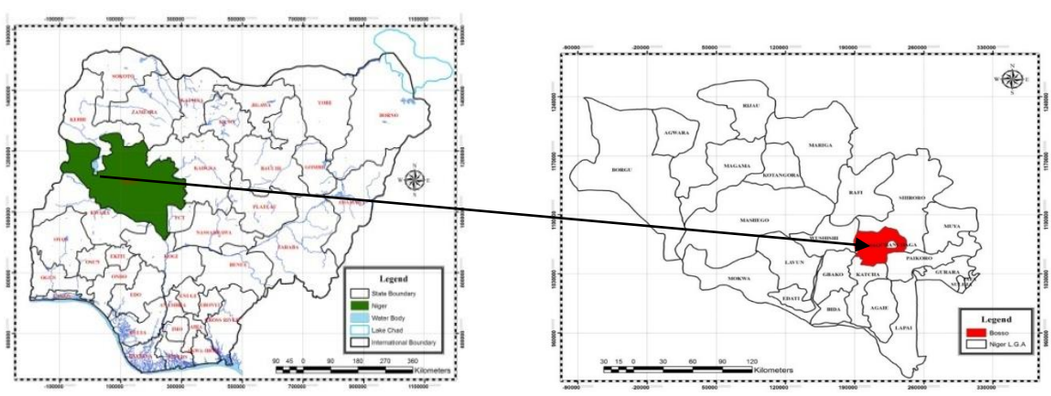

Figure 2: Minna within the context of Niger State

Urban Governance in Minna

The process of urban governance in Minna involves the following, the governed and the government at all levels. The process involves collaborations of different stakeholders in the management and administration of the city. The stakeholders in the administration of Minna metropolis include the Community Based Organizations (CBOs), the Non-Governmental Organizations (NGOs), Trade Associations, government agencies and donor agencies. For any urban governance strategies to work effectively in Minna, informal economic enterprise development requires effective urban governance strategies and practices.

(a) Bosso and Chanchaga Local Government Councils

The fourth schedule of the constitution of the Federal Republic of Nigeria, stipulates the functions of local governments. The aspects which clearly show the areas that affect informal economic activities are stated thus:

i. The deliberation and creating of suggestions to the State Commission on Economic Planning or several comparable bodies on the economic development of the state, predominantly in so far as the areas of authority of the council and of the state are influenced.
ii. The local Governments also manage and control out-door advertising and placement of bill board, shops and kiosks within their jurisdiction, restaurants, bakeries and other places for sale of food to the public, laundries, and licensing, regulation, and control of the sale of liquor. (Federal Republic of Nigeria Constitution 1999).

(b) Associations in Minna Township

For the development of small and micro scale economic enterprises in an informal sector has proved to be important as members engage in formation of different associations which are interested in protecting the interest of members, cooperative associations, trade unions among other has prang up from the artisans. There are numerous based on the types of occupation in the city.

(c) Government-Community Relationship

This as a strategy for urban governance well-articulated in the activities of government agencies that provide employment, services and loan to the informal economic enterprises in the city, these agencies include:

(d) The National Directorate of Employment (NDE)

The NDE was inaugurated in November 1986. The institution was charged with the responsibility of creating employment with emphasis on ensuring self-reliance. This covers the training of individuals on the vocational skills development programme and the Small scaleenterprise development programme. NDEs mandate at inception was to train applicants on how to be self-employed and empower such trainees through financial loans. This was the mandate between 1987 and 1994. However, from 1994 till date, financial loans were stopped and changed to demonstrative loans (Sewing machines, welding machines, tool boxes) whereby trainees were given implements that would aid them in their vocation, and they usually pay back within 4 years.

(e) The Niger State Ministry of Commerce, Mine and Industry (MCMI)

The Ministry of Commerce, Mine and Industry is saddled with the function of preserving the betterfiscalenvironment in the state, in order to promote industrial and commercial enterprises. The Ministry is supposed to run entrepreneurship development programmes, give technical support to enterprises and also offer managerial and financial training to entrepreneurs.

The ministry has the authorization to develop the fiscal environment that contains the two mechanisms, specifically commerce and manufacturing (industrialization). Another platform is for start-up commercial activities that people engaged in. this is for people that are graduates of University, Polytechnics and Colleges of Education, they good concept of business and wish to develop and nurture it. The Ministry has mandate of making sure that local government become the incubator and the local government offersfresh business opportunities and infrastructure needed to stimulate the people into creating businesses and less dependence on white collar jobs. This is carried out by operating in tandem with the organized private sector of the economy.

(f) The Niger State Urban Development Board (NSUDB)

The board was established in 1995 by the Niger State Government in order to expand the activities of the former Niger State Development Company (NSDC) to all the chosen urban centers in the state. The Niger State Urban Development Board (NSUDB) is charged with the following responsibilities for proper planning and development of all the urban centres of Niger state. Niger State Urban Development Board's (NSUDB) perform the following tasks:

i. Guarantees the growth and management of comprehensive planning design in all urban centres of Niger state.
ii. Approval of the entire building plans for all purposes such as residential development, commercial development, and industrial development, recreational facilities and institutional development.
iii. Gives enforcing order on unapproved development such as stop workorder on illegal buildings and other illegal development in the urban centres in the state.

(g) National Poverty Eradication Programme (NAPEP)

It was introduced in early 2001; NAPEP centered on the provision of approaches that alleviate of extreme poverty among the urban and rural poor in Nigeria (FRN, 2001). The programme is complimented by the National Poverty Eradication Council (NPEC) has a mandate of coordinating all the poverty eradication programmes of the entire appropriate ministries, parastatals and agencies of the government at all levels. Thus, the programme identified the following ministries as core poverty eradication ministries. They include amongst others labour and productivity, power and steel,water resources, industry, employment, agricultural and rural development, education, women affairs and youth development, health, works and housing and environments.

(h) Subsidy Re-investment and Empowerment Programme (SURE-P)

Subsidy Re-investment and Empowerment Programme better known as SURE-P was set up by the Government of Nigeria throughout the government of Dr. Goodluck Ebele Jonathan (GCFR), to advance support to the citizens of Nigeria after the hardship brought on Nigerian by fuel subsidy removal on 1st January 2012. The programme was to provide critical infrastructure and serve as social safety net to reduce poverty with straightforward effect on the people of Nigeria. Subsidy Re-investment and Empowerment Programme (SURE-P) was an act of parliament and became effective on 1st January, 2012, this is as a result of Federal government's proclamation on the elimination of the subsidy on petroleum product especially petrol.

RESEARCH METHODOLOGY

This study is an empirical research that requires the gathering of both primary and secondary data for the study. The research methods adopted for this study were both quantitative and qualitative. The three major assessment methods employed were the administration of questionnaires; interviews and field survey. The choice of these techniques will enable the collection of both qualitative and quantitative data from the questionnaire administration and physical observation of the informal economic enterprises in Minna Township.

Source and Type of Data

Data that will be employed in this research will be gathered beginning from both primary and secondary sources. The primary data will be collected through questionnaire administration and physical observation of the informal economic enterprises in Minna Township. These will be complimented with physical observation of the characteristics of the locations and the types, nature, capital required and incentives for smooth running of informal economic enterprises in Minna. The secondary data was obtained from numerous sources including the following published and unpublished materials in books, journals, encyclopedias, magazines, research works, conference and seminar and working papers. The study also requires the collection of secondary data that will be collected from secondary sources such as governance institutions and documents from organizations directly connected with the study such as the Niger State Urban Development Board (NSUDB), the Local Government Departments, the National Directorate of Employment and the Ministry of commerce and Industry in Minna, Niger state. Other secondary data will be collected via the internet, textbooks, journals, newspapers, and other viable sources.

The National Population Census (2011) put the household size in Minna to be about 6 persons per household. According to Owoyele (2014) there are 29 neighborhoods in Minna. The neighborhoods of this research include Tudun Fulani, Bosso Town, Jikpan, Dutsen – Kura Gwari, Kpakungu, Nyikangbe, Barkin Sale, Sauka Kahuta, Maitumbi, F-Layout, NngwanDaji and Chanchaga.

The number of questionnaire to be administered in each neighborhood is known as sample size. A sample size of 1,200 informal economic enterprises will be adopted for this research. Though the National Population Commission indicated that 70% of the total national populations are involved in informal economic activities (National Urban Development Policy, 2006). The 1,200 questionnaires will be administered in the selected neighborhoods as selected based on even geographical spread.

A sum of 1,142 entrepreneurs were selected for the research as some of the respondents do not responds to the question that rendered the questionnaire invalid for the study. This is about 95.2% of the total questionnaire used for the study.

The sampling procedure used for the administration of questionnaire for the study involves two steps. The first step entails the use of stratified sampling to divide the city of Minna into the 29 neighbourhoods identified by Owoyele (2014). The strata form the basis for selection of the sample size. Figure 1 shows the 12 neighbourhoods identified as the high density areas were the selected.

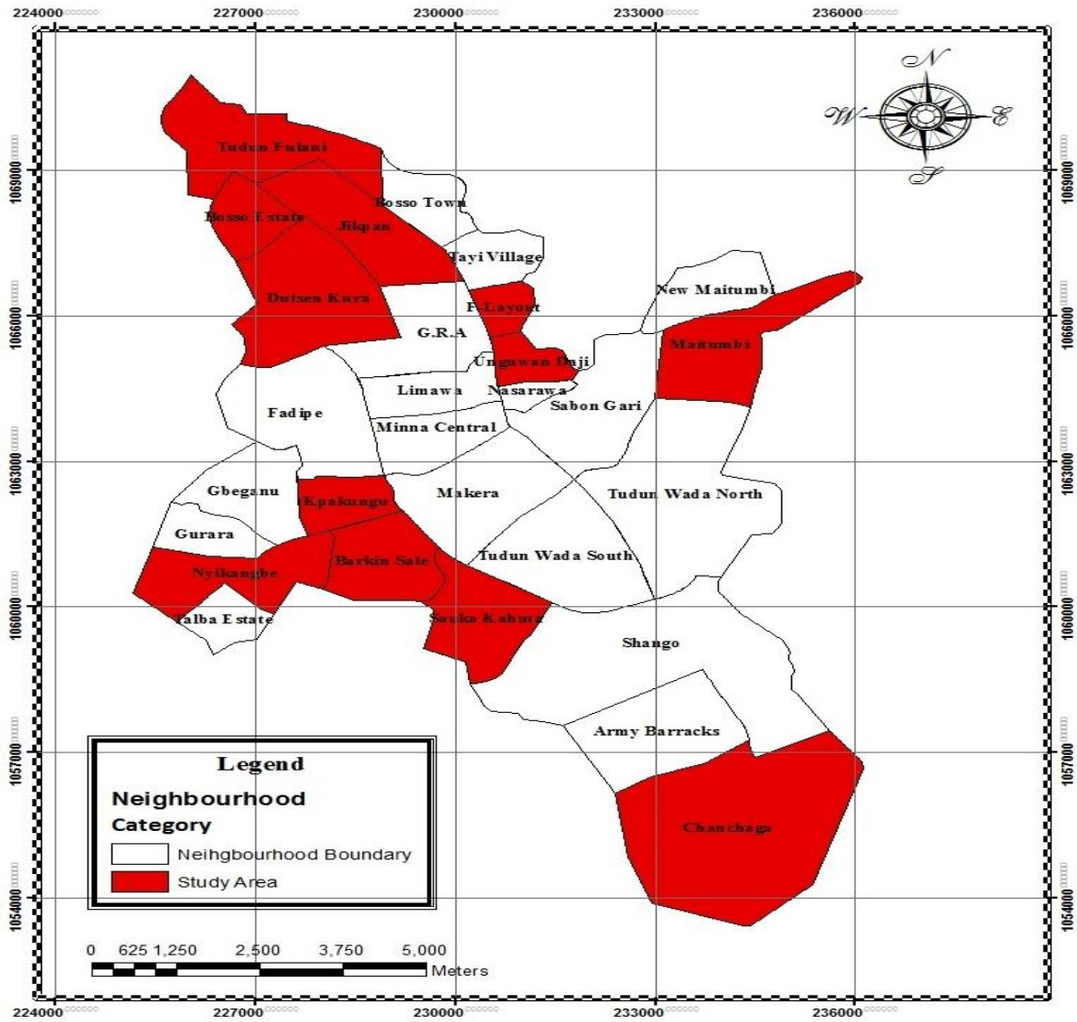

Figure 2: Minna showing the 12 Selected Neighbouthoods.
Source: Department of Urban and Regional Planning

RESULT AND DISCUSSIONS

Socio-Economic Characteristics of Informal Economic Enterprises in Minna

This section of the study focused on the socio-economic characteristics of informal economic entrepreneurs in Minna. This enabled the researcher to understand the antecedents

of the informal economic entrepreneur and the circumstances influencing their decisions on informal economic enterprises.

Age of Informal Economic Entrepreneurs in Minna

The analysis of the age of the informal economic entrepreneurs in Minna shows that that it ranges between 20 and 70 years. About 22.4% of the respondents are within the age brackets of 20 and 30 years; 25.0% are within the ages of 31 and 40 years; 37.6% are within 41 and 50 years while 15.0% are within the ages of 51 and 70 years. The implication of this is that large percentage of respondents (informal economic entrepreneurs) in Minna are within the working class age and therefore work hard to cater for their household and implication is utilization of the profits from the informal economic enterprises do not allow them to re-invest their profit in the business so as to allow the enterprises to grow further. Figure 2 shows the age characteristics of the informal economic entrepreneurs in Minna

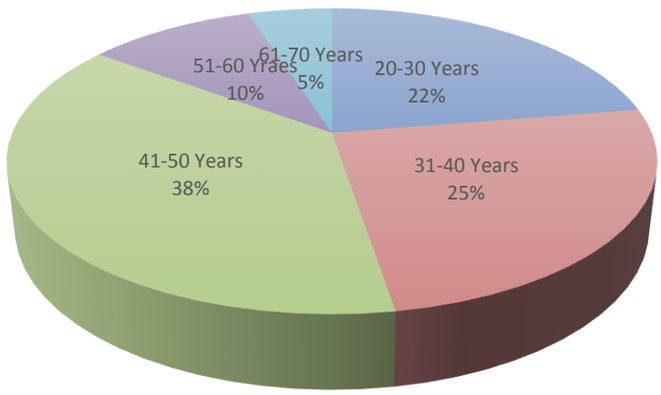

Figure 2: Age of the Informal Economic Enterprises in Minna

Educational Status of Informal Economic Entrepreneurs in Minna

The result of the study on the educational status of respondents (entrepreneurs) shows that the educational status ranges between No Formal Education to all level of educational attainment. 39.7% of the entrepreneur does not have formal education; 20.0% have quarnic education; 10.5% had primary education; 18.8% had secondary education while 6.0% had one form of tertiary education. Table 1 indicated the educational attainment of the informal economic entrepreneurs in Minna. The implication of this is that large proportions of the entrepreneur have no formal education of lower level of education. This will have effect on the decision on their businesses and poor management of the business. In fact these set of people takes decisions that do not corresponds with their business status and sometimes go bankrupt due to poor managerial skills and wrong decisions.

Table 1: Education Attainment of Informal Economic Entrepreneurs in Minna

Educational Attainment	No. of Respondents	Percentage
No Formal Education	453	39.7
Quranic Education	286	25.0
Primary Education	120	10.5
Secondary Education	215	18.8
Tertiary Education	68	6.0
Total	**1,142**	**100.0**

Source: Author's Field Survey, July, 2017

Ownership and Operation of Informal Economic Enterprises in Minna

Analysis of the ownership of the informal economic enterprises in Minna indicated that 85.0% of the respondents (entrepreneurs) are the rightful owner while 15.0% are manned by employee. The implication of this is the fact that micro-enterprises are usually one man business. It implies that the informal economic enterprises in Minna are owner operated businesses.

Employment Status in Urban Informal Enterprises

The analysis of the profile of staff working within categories of city informal economic enterprises in Minna Township is shown in Figure 3. The Table indicated that retail enterprises sub-sector has majorly of the workers in Minna (42.9%) and nearly all are manage by the informal economic entrepreneurs on their own, while repair and service sub-

sector operators employ their services and services of members of the household (30.5%). Also some entrepreneurs especially the production sub-sector employ services of other workers to facilitate their operation (26.6%).

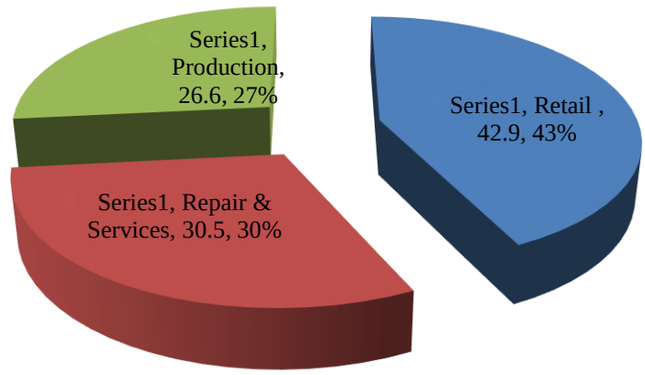

Figure 3: Employment Status of Informal Economic Enterprises in Minna

Categories of Staff Employed by Informal Economic Enterprises in Minna

The analysis of the activities of informal economic enterprises shows that the three categories of workers employed by them for their daily activities. The result shows that 20.5% of the informal economic enterprises are manned by the owners' only (especially in retail sub-sector). On the other hand, 30.5% of the informal economic enterprises are operated by owner and member of the households especially in the repair and services sub-sector. About 12.1% of the informal economic enterprises in Minna are operated by workers and household members where the owner has other work to be done elsewhere (this is common among government workers who uses the informal economic enterprises to argument their salaries at the end of the month). 19.7% of the informal economic enterprises in Minna employ workers only to operate their businesses which usually the case in the production sub-sector, while 17.2% employ theservices of workers and the owner for the operation of their informal economic enterprises.

Table 2: Categories of Employees of Informal Economic Entreprises in Minna

Employment Status	No. of Respondents	Percentage
Owner only	234	20.5
Owner and Household Members	286	25.0
Workers and Household member	228	20.0
Workers only	271	23.7
Owner and Workers	123	10.8
Total	**1,142**	**100.0**

Source: Author's Field Survey, July, 2017

The findings on the type of workers employed in provision of services to each of the sub-sectors of city's informal economic enterprises is not surprising since large proportion the entrepreneurs concerned with the actions of retailing do not essentially needs expertise about. The proprietor of the business will be able to still run autonomously given the scale of enterprises is comparatively petite.

General Characteristics of Informal Economic Enterprises in Minna

The objective two of this study presents the general characteristic of informal economic enterprises in Minna Township. This is to relate the locational characteristics, extents of the informal enterprises, the categories of the informal economic enterprises based on this research and other variables that identify, function, features and extent of informality in Minna Township.

Locational Characteristics of Informal Economic Enterprises in Minna

The result of the findings indicated that 78.4% of the Informal Economic Enterprises in Minna Township take place in public places along the road right of ways, street, open spaces that are not occupied and vacant plots. 14.6% operates within the shops near their homes or parts of their buildings; while 6.0% uses other locations that are available to them. The operation of informal economic enterprises on the street distorts traffic flow as parts of the

road are usually used to display their wares. The informal economic entrepreneur always chooses locations where they can easily be reached by their customers. However, the choice of on street locations sometimes narrows road widths. Figure 4 shows the locational characteristics of informal economic enterprises in Minna Township.

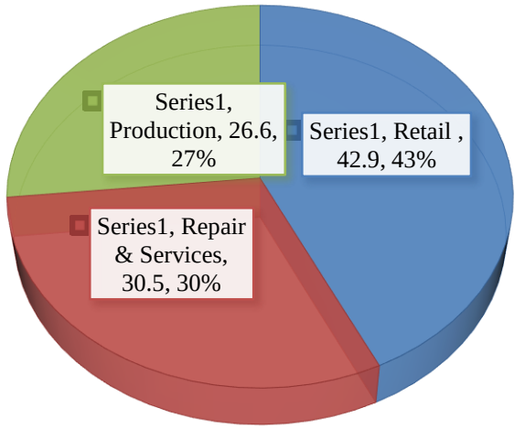

Figure 4: Locational Characteristics of Informal Economic Enterprises in Minna

The effect of this type of operation is the utilization of public space along road reservation setbacks, and other roadside spaces they consider advantageous to their businesses, regardless of the functional suitability of such locations. The home based operators are mostly women who render their services to nearby neighbours in the residential areas.

Plate I: Informal Economic Enterprises operating along Sabongari Road, Minna

Plate II: Vulcanizer operating along Minna-Bida Road in Kpakungu, Minna

Plate I shows an amount of commercial motorcyclists and retailers operating along the Sabongari road in the central area of Minna. The activities of these informal economic entrepreneurs had reduced the Ogbomoso Road and deteriorate the traffic congestion usually experienced in the neighbourhood. This has led to changing the status of the road to one way.

The right of way along Western Bye-pass, Minna for example are in sequentially occupied by auto-mechanic workshops and vulcanizers and related repairs. Informal economic entrepreneurs in the act of producing items in the chain of informal economic entreprises in Minna, does agglomerate like the auto-mechanics on public land, activities such as retailing and service and repairs subsectors are abound round the Township. What causes the agglomeration of auto-mechanic and allied services was their relationship, whereas others like trading, repairs and production of household need do not agglomerate due to the types and process of conducting their activities. This implies that they do not need large space to operate. In the case of retailing sub-sector, there are several of them who operate from homestead such as GSM recharge card sellers, Food vendors and general provisions providers; and others have to obtain shops somewhere else within or between neighbourhoods such as petrol and engine oil sellers, Hawkers of essential household goods, vendors, DVD and CD retailers, accessories, stationery among others.

Plate III: Auto-Mechanic Workshops along Minna- Zungeru Road, Tudun Fulani

Plate IV: Food Stuff Retailers along Bosso Road in Bosso, Minna

Plate III shows anAuto-mechanic workshops along Minna-Zungeru road, Tudun Fulani, Minna having concentration of several carpenters, furniture and upholstery work along the streetscape.

Informal Enterprises and Contribution to Poverty Reduction in Minna

Informal economic enterprises contribute significantly to the urban economy in Minna and reduce the level of poverty among the urban poor. Majority of the operators of the informal economic enterprises falls among the poor in Minna. This assertion was established by quite a lot of researchers such as Menyah (2009); Onyechere(2011); Sethuraman(1981) and host of others both in advanced and third world nations. The contributions of informal economic enterprises were scrutinized in Minna with the help of likhert's scale scoring.

As Table 3 revealed, it was showed that with Poverty Reduction Index (PRI) was 3.98, it implies that larger proportions of urban informal economic enterprises provide low level job for the poor in Minna. It was also strongly perceived (3.73) by the entrepreneurs that the location used for business premises especially around houses creates purchase of every day goods and services readily available to residents instead of going to Kure Ultra-Modern Markets for purchase. It was equally strongly perceived (PRI 3.93) that it enhances their earnings of informal economic entrepreneurs particularly those people that are involve in the business with the aim to support livelihood. Other variables on economic impact with lower deviation about the mean include, it averts the young people from participating in criminal activities (PRI 4.22) and reduces transport cost (PRI 3.99).This is due to the fact that most of the household items are gladly available at locality despite the fact that a number of people desires to go to Kure Ultra-Modern Markets for shopping and to purchase in bulk.

Table 3: Impacts of Informal Economic Enterprises on Poverty Reduction

Economic Impact	HS 5	S 4	F 3	D 2	HU 1	SWW	Total	PRI
Provide job for people	1.42	1.06	0.78	0.56	0.16	4557	1142	**3.98**
Readily available daily goods	1.52	1.04	0.67	0.45	0.05	4260	1142	**3.73**
Increases income of operator	1.48	1.10	0.70	0.55	0.10	4488	1142	**3.93**
Prevents criminal activities	1.62	1.08	1.00	0.42	.10	4819	1142	**4.22**
Reduces Transport Cost	1.45	1.03	0.80	0.54	0.17	4557	1142	**3.99**

Source: Author'sField Survey, July, 2017

Space Acquisition by Informal Economic Enterprises in Minna

The space required by the operators of informal economic enterprises in Minna is usually obtained from two sources. The first being directly obtained from the Niger State Urban Development Board (NSUDB) who are saddled with the task of controlling the growth of land in the Township. The other way by which the informal economic enterprises in Minna access space for their operation is through the land owner.

The number of applicants to NSUDB for space for development of land for informal economic enterprises in Minna is minute as majority of the informal economic enterprises are land acquired from the land owner. This has led to proliferation of these spaces and uncoordinated nature of the space. Figure 5 shows various means by which the informal economic enterprises in Minna Township got their space for operation of their businesses.

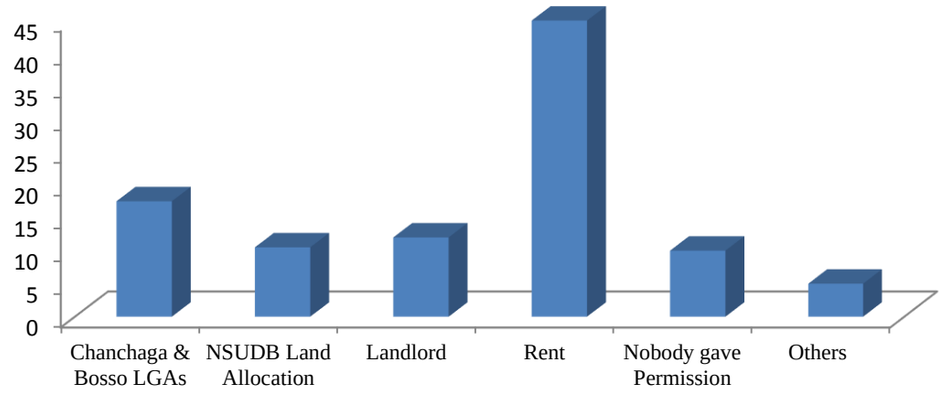

Figure 5: Space Acquisition by Informal Economic Enterprises in Minna

Large percentage of the informal economic enterprise entrepreneurs (45.0%) attained their site for operating their businesses through rent. The acquisition of such space might be through usage of public space without any authorization and through illegal means. It is clear from Figure 4.4 that 28.0% of the informal economic entrepreneurs obtained authorization from the Local Governments and NSUDB of the site for their operations (17.5% and 10.5% respectively. 12.0% obtained the permission of the Landlord to build their shops, kiosk and other form of space needed for their operation. The implication if this is that large percentages of the operators are illegal occupants of the space for their operation that is operating without official authorization.

Payment of Revenue to the Authority by Informal Economic Enterprises in Minna

As majority of the informal economic entrepreneur acquire their land illegally, it implies that the authorities concerned with the collection of rates, taxes and revenue do not have correct number of the informal economic entrepreneur in specific location. This definitely will lead to poor accountability in revenue collection to the government at all levels and poor development control of business locations in Minna urban space. Though it is believed that operators that acquire the space legally will usually pay ground rent to the agency that provide the land to them either LGA or the NUDB.

Considering the general arrangement of the sites for the informal economic enterprises premises shows poor arrangement of shops and sheds and unaesthetic nature of the arrangement thereby causing environmental degradation. The activities of the land speculators have had an adverse effect on the control of the use of urban land in Minna. The effect of this on financial system of the city as revenue will not be generated to all tiers of government despite the use of urban space. The effect of poor urban space usage is that there will be loss in ground rent and other levies that are supposed to be paid by these informal economic entrepreneurs.

Physical Facility for Informal Economic Enterprises in Minna

Retailing account for larger percentage of informal economic enterprises in Minna and these operators can be seen operating their activities in shops, kiosks, tents, and open spaces. Figure 6 shows the types of spaces available to informal economic entrepreneurs in Minna. Plate II also shows different spaces used by the entrepreneurs to conduct their daily activities in Minna.

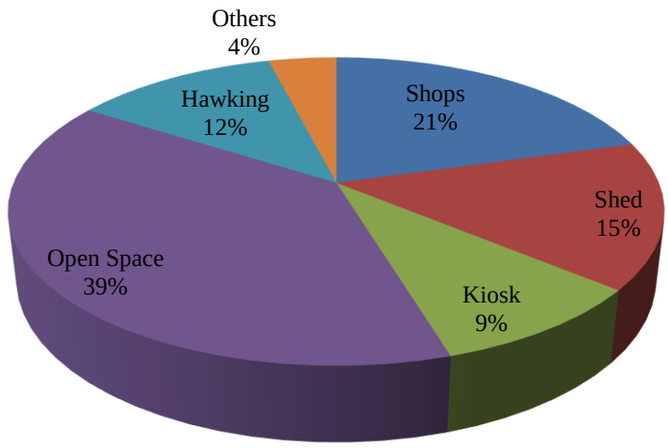

Figure 6: Types of Spaces Used by Informal Economic Entrepreneurs in Minna

The result of the analysis indicated that the use of shops (20.6%); open spaces (38.7%) and shed (15.4%) were the most favoured spaces used for operation of informal economic enterprise premises in Minna. Other such as hawking (12.0%); and others are less favoured because of the stress involved. Land needed for operation by informal economic enterprises when developed, is structured by the entrepreneur for their uses, others erect temporary sheds and kiosks are usually operated using necessary implements, while open space on the other hand requires only tables for its operation.

Categorization of different sub-sector shows that informal economic entrepreneur in retail sub-sector mostly operate in shops and sheds. Repairs and service sub-sector prefer the use of open space and make-shift shed. For example, auto-mechanic and allied professionals prefer to work in clusters at specific location that have enough open spaces and provision of sheds for their rest and keeping of their tools. Most GSM repairers normally use tables and umbrella as make-shift sheds to perform their activities. The production sub-sector on the other hand uses shed as their space for operation in the study area.

Plate V: Fruit Sellers along Western Bye Pass, Minna

Plate VI: Petroleum Product Retailer Tunga Road, Minna

The plates IV and V show that the informal economic entrepreneurs using open public spaces along roadsides for their businesses. These informal economic entrepreneurs use the spaces without formal authorization from either the Chanchaga Local Government or NSUDB. This use of space gives roadside views poor aesthetics and creates unnecessary street clutter.

Plate VI shows a black market petrol retailer apparently using urban space without formal authorization along Tunga neighborhood in Minna, while Plate 7 on the other hand show retailers using space authorized by NSUDB along Bida road in Kpakungu neighborhood. This shows two contrasting retail sub-sector entrepreneur which is as a result of start-up capital. The petroleum marketer requires lower start-up capital compared with the retailer who uses shop to display their own goods for sale to the public. The two set of entrepreneur are serving the need of the people of the city of Minna.

Proportion of Informal Economic Enterprises in Minna

Observation revealed that retail sub-sector has highest number of operators in Minna compared with other two sub-sectors in the informal economic enterprises. The second sub-sector was repairs and service while production sub-sectors has the least entrepreneur in the Town. Table 7 indicated that the distribution of the entrepreneurs to different sub-sector in the informal economic enterprises in Minna.

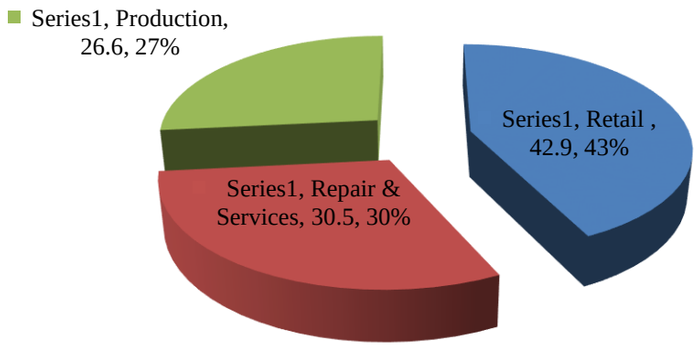

Figure 7: Proportion of Sub-sectors to Informal Economic Enterprises in Minna

Period of Operation of Informal Economic Enterprises in Minna

Analysis of the research conducted, it was showed that the informal economic enterprises in Minna indicated that several entrepreneurs had been in the business for as long as 40 years. The analysis show that 60.6% of the respondents have been operating between 1 year and 10 years; 21.4% had been in business between 11 and 20 years; 18.0% have started their informal economic enterprises between 21 and 40 years. The implication of this is that entrepreneurs in Minna are not developing accordingly as the city growth in prosperity. The research has proved that most informal economic enterprises last between 6 and 10 years. Table 4 shows the period of operation of informal economic enterprises in Minna. This justifies why informal economic entrepreneurs employ multiple mode of livelihood, whereby they are neither full time government worker nor full time trader. This study further reveals that a majority of entrepreneurs in Minna who engaged in informal economic activities, do not have significant access to institutional finance, neither do they for socio-economic services that could enhance the informal economic activities.

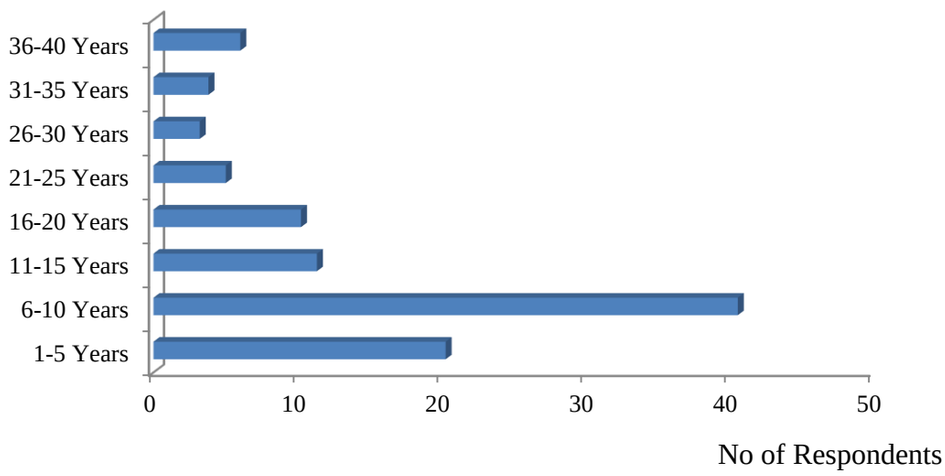

Figure 8: Period of Operation of Informal Economic Entrepreneurs in Minna

Financial Status of Informal Economic Enterprises in Minna

This section of the study interpreted the source of finance to informal economic enterprises in Minna. This is because informal sources are more available Nigeria to informal economic entrepreneurs than the official and organized sources. Family members, loan from thrift and co-operative societies advancing credits are usually obtained from groups that are living in the same neighborhoods with the entrepreneur. Also the direct or relatives from the same family have better opportunity to advance loan because of the absolute trust they have in each other. In a formal clime, commerce is performed on formulated set of laws and not on trust that has no basis. This is the explanation that makes the trust as yardstick for loan advancement in informal financial alternative become attractive by the informal economic enterprises in Minna. The financial status considered includes start-up capital, sources of the start-up capital and benefits derived by engaging in informal economic enterprises by the entrepreneurs.

Start-Up Capital of Informal Economic Enterprises in Minna

Analysis of the start-up capital of the informal economic enterprises in Minna as shown in Table 4 implies that large percentage of the informal economic entrepreneurs started with amount that ranges between ten thousand (N10,000) and fifty thousand (N50,000). About 60.0% of the informal economic entrepreneur started operation with an amount of money (start-up capital) that is usually lower than fifty thousand Naira; because, this is an indication of the extent of subsistent that is characterized with poor people. 22.0% of the respondents start-up capital was between N50,001 and N100,000 which many of them attributed to collection of thrift from, from children and relatives. This implies that informal economic enterprises engaged in. 12.0% started up with between N100,001 and N150,000 while about 6.0% start-up with between N150,001 and N200,000.About 78.0% of the informal economic entrepreneurs in Minna, start-up the enterprises from personal savings, gift from relatives and loans from family members and friends, 12.0% obtain start-up from thrift collection (Esusu), while 10.0% got their start-up capital from loan obtained from different sources such as Local Government (5.0%), NDE (5.0%).

Table 4: Start-up Capital of Informal Economic Enterprises in Minna.

Start-up Capital (₦)	No. of Respondents	Percentage
10,000- 50,000	685	60.0
50,001-100,000	251	22.0
100,001-150,000	137	12.0
N50,001-200,000	69	6.0
Total	**1,142**	**100.0**

Source: Author's Field Survey, July, 2017

Sources of Start-up Capital for Informal Economic Enterprises in Minna

Table 6 indicated the sources of the start-up capital and the total amount that serve as start-up capital. In spite of the fact that large proportion of the informal economic enterprises have been existing in Minna for more than 20 years (see Table 3),they are still operating at subsistence level due to the shortage of a functional micro-credit scheme and a responsive governance system. The analysis of the present capital of the informal economic enterprises proved that they were still operating within the start-up capital with little profit added to the start-up capital, because of poverty level and high dependency on these businesses for their survival in a globally recessed economy.

Table 5: Sources of Start-up Capital for Informal Economic Enterprises in Minna

Source of Start-up Capital (₦)	No. of Respondents	Percentage
Personal Savings	891	78.0
Thrift Collection	137	12.0
Chanchaga LGA	57	5.0
NDE	57	5.0
Total	**1,142**	**100.0**

Benefits Derived in Engaging in Informal Economic Enterprises in Minna

Analysis presented in Table 6 revealed that about 23.5% of the respondents examined have doubled their start-up capital while 76.5% have marginal increase in their start-up capital due to profits and proceeds from informal economic enterprises. The implication of this is that informal economic enterprises in Minna do give the entrepreneur opportunity to accumulate wealth.

Table 6: Benefits of Engaging in Informal Economic Enterprises in Minna

Increase in Start-up Capital (%)	No. of Respondents	Percentage
1-25	577	50.5
26-50	171	15.0
51-75	126	11.0
76-100	268	23.5
Total	**1,142**	**100.0**

Summary of the Findings

Analysis of the educational qualifications of the informal economic entrepreneurs revealed that 64.7% of the informal economic enterprises operators have either no-formal education or Quranic education, this has negative effect on decision they make on their enterprises. Over 75.0% of the entrepreneurs are between the ages of 20 and 50. This implies that majority of the entrepreneurs are working class therefore uses the informal economic

enterprises as their means of livelihood. The ownership status proved that 85.0% of the enterprises are owned and manned by the entrepreneur while only 15.0% of the premises are manned by employees.

The analysis of the activities of informal economic enterprises shows that the three categories of workers employed by them for their daily activities. 30.5% of the informal economic enterprises are operated by owner and member of the households while 17.2% employ the services of workers and the owner for the operation of their informal economic enterprises. The Poverty Reduction Index (PRI) was 3.98, it implies that larger proportions of urban informal economic enterprises provide low level job for the poor in Minna.

The result of the analysis indicated that the use of shops (20.6%); open spaces (38.7%) and shed (15.4%) were the most favoured spaces used for operation of informal economic enterprise premises in Minna. Other such as hawking (12.0%); and others are less favoured because of the stress involved.

Analysis of the research conducted, it was showed that the informal economic enterprises in Minna indicated that several entrepreneurs had been in the business for as long as 40 years. The analysis show that 60.6% of the respondents have been operating between 1 year and 10 years.

Large percentage of the informal economic entrepreneurs started with amount that ranges between ten thousand (N10,000) and fifty thousand (N50,000). About 60.0% of the informal economic entrepreneur have start-up capital less than fifty thousand Naira; because, this is an indication of the extent of subsistent that is characterized with poor people.

23.5% of the respondents examined have doubled their start-up capital while 76.5% have marginal increase in their start-up capital due to profits and proceeds from informal economic enterprises.

CONCLUSION AND RECOMMENDATIONS

It is evident from the research that the established governance method in Minna Township is currently making the development of informal economic enterprises to be slow and impact not felt. To have an enabling environment that will enhance informal economic enterprise development, the institutions of urban governance need to be created and proper implementation. This is against the backdrop that the bulk of citizens in the urban realm are engaged in informal economic enterprises, consequently to eliminate poverty within town and cities and enhance local economic growth, institutions of urban governance must pay attention to informal enterprise development. Furthermore, research needs to be carried out on local economic development planning especially for cities in developing nations. This is necessary if a sustaining and enabling environment for general economic growth and development is to be achieved in cities of developing nations.

RECOMMENDATIONS

Based on the research conducted on the role of government institutional practices on the informal economic enterprises development in Minna Township, the following recommendations are hereby proposed:

i. Government should provide adequate space for the informal economic enterprises to display their wares rather than taking illegal spaces such as roadsides.
ii. There should be provision of assistance to informal economic enterprises to improve their start-up capitals.

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LIVELIHOOD OPPORTUNITIES FROM THE PERIODIC MARKETS IN EASTERN PART OF NIGER STATE, NIGERIA

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Livelihood has remained a subject of utmost importance due to its inevitable role to human existence. It is seen as activities that allow people to secure basic necessities of life while market is a physical place where sellers and buyers meet to exchange goods and services. The study examined livelihood opportunities on agricultural produce from eight periodic markets in Niger East Senatorial district with main objectives on spatial characteristics and livelihood opportunities from the markets. Using non-probabilistic sampling approach, a purposive sampling technique was applied to randomly distribute two sets of questionnaires to sellers and buyers. A total number of 671 questionnaires were administered and the data was analysed descriptively. The study revealed that agricultural trade account for 44% of the livelihoods opportunities from the periodic markets, while livestock trade account 27%. Other livelihood opportunities from the periodic markets include; off-loading, loading, wheelbarrow pushers and others. The study concluded that, there are numerous livelihood opportunities from the periodic markets in Niger State especially on agro and livestock which serves as a major source of income for the populace, both within and outside the host communities of the markets. The study therefore recommended that, improved and developed market facilities conditions will enhance the socio economic conditions of the people within and outside the host communities and also contribute to poverty alleviation in all forms.

Keywords: Livelihood, Periodic Rural Markets, and Agricultural produce.

INTRODUCTION

Livelihood is salient to all as it is the functions the people engaged in so as to make ends meet. This argument is supported by UNHCR (2014) that, livelihoods are "activities that allow people to secure the basic necessities of life, such as food, water, shelter and clothing". They further stressed that, "engaging in livelihoods activities means acquiring the knowledge, skills, social network, raw materials, and other resources to meet individual or collective needs on a sustainable basis with dignity". These activities according to UNHCR are usually carried out in a number of times within an income stream such as agriculture, pastora1ism, fishing and employment within a market sector. On the other hand, the study of periodic market is salient to the daily livelihood of the people of Niger State as Hodder (1965) opined as documented in Mulimani and Belgaum (2012) that, the study of markets and the communities they are located is important because, market structure and mechanism majorly defined the people's way of life, culture, tradition and socioeconomic lifestyle.

Generally, the term market has been defined by different researchers based on their precepts and ideologies. However, this study focused on periodic markets also called traditional markets by some researchers. Market is traditionally a physical place where buyers and sellers gather to exchange goods and services (Kotler, 2002). According to Belgaum and Mulimani (2012), periodic markets are "an authorised public gathering of buyers and sellers of different commodities, goods and services in rural areas". Similarly, Obateru (2003) stated that, periodic market takes place at a particular time and day within specified intervals at a strategically located place bringing buyers and sellers together for trading activities.

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Livelihoods as defined by Chambers and Conway (1991) includes capabilities, assets (physical, human, natural resources, financial, social and political assets) and activities required for a means of living. According to UNDP (2006) as cited in Sati(2014) , livelihoods includes also creativities, new opportunities, people's attempts, willingness and capabilities to cope with shocks, risks, and stress like natural disasters, epidemic like deadly diseases (HIV/AIDS, EBOLA), conflicts or financial crisis and competition at both national and international levels. Ellis (2000) viewed livelihoods as access to resources, materials and services. Ellis further stated that, the concept of livelihood has been widely used to also cover poverty and rural development approaches.

Collectively, the concept of market focuses on trader (buyer and seller), place, goods and services (Belgaum and Mulimani, 2012; Obateru, 2003; Belgaum, 2014; Detonjo, John and Chikagbum, 2015). On the other hand, the concept of livelihood as defined by Chambers and Conway (1991) concentrated on People, capabilities, assets (tangible and intangible) and activities.

Nigeria Poverty profile (2010) as reported by the National Bureau of Statistics (NBS) put Niger state at 43.6% relatively poor, 33.8% absolutely poor and 33.9% lived on less than a dollar per day (NBS, 2010). These statistics are worrisome because, despite all the efforts by Nigerian government and multinationals to end poverty in all forms, the prevalence rate is still high. However, majority of the populace in the State, about 85% are farmers while others constituting 15% are involved in vocations such as white collar jobs, business, craft and arts (Niger State Bureau of Statistics, 2012). The climate nature and availability of a wide variety of agricultural products and mineral resources also attest to the economic potentials of the State. The study of Niger state traditional (periodic) markets is necessary as it will bring to limelight the livelihood opportunities targeted at the economic viability of the rural people in the study area for effective poverty eradication.

Periodic Market and Rural Economy

Periodic market development enhances rural economic growth, it improves economic recovery and stabilises rural livelihoods (World Development Report, 2008; UNDP, 2013). According to UNDP (2013), economic recovery includes market development, job creation (both public and private), reinforcement of existing agribusinesses and encouraging new ones. Also included are policy formulation, legal institution and the economic process changes and infrastructure development that will encourage and boost rural trade and commerce and economy of the region. Similarly, Komarovsky and Bondaruk (2013) noted that, ensuring local economic development is key to live1ihoods stabi1ization and regiona1 growth. They stressed that, this is underpinned by the 'growth pole' model which could determine rura1 economic programs and regiona1 p1anning for practical 'growth pole' theory app1ication that sees the region as a territory with several certain integra1 and mutua1 characteristics that make it different from others.

Mulimani and Belgaum (2012) observed that, periodic markets are the immediate and the first contact point for farmers and it is linked with the modern world, thereby providing commercial services and transportation nodes for services and growth in the region located. Mulimani and Belgaum further stressed that, rural economy and development are almost solely dependent on agricultural produce that are disposed in their periodic markets.

Market Development

Mulimani and Belgaum (2012) asserted that, market is a geographical area with clearly defined limits with services rendered to customers from different areas. They noted that, markets cannot exist or function in isolation, there must be a networking with the community and the surrounding settlement where the market is located, and that, the economic prosperity of the settlements, villages and towns the periodic markets are located also represent regional development pattern. Clark (1968) cited in Mulimani and Belgaum (2012) viewed that, periodic markets open up opportunities and outlets for the rural produce, local supplies and other periodic and fixed services are hinged on.

Detonjo, *et al* (2015) stressed that, periodic markets are central places for growth and development of the rural communities; they serve as nodal places to service the population of those communities. It provides a platform for agricultural exports, meeting rural people's need in exchange for what their communities are not advantaged to have. According to Mulimani and Belgaum (2012), without the market, the settlement will not grow to a certain level, creating a spatial gap between rural settlements and the market. Allen (2012) in his

study of characteristics of periodic markets in Akungba-Akoko, Ondo State concluded that, the economic status of the people and the nature of goods around the market coverage determined the turn-out. Similarly, Wankhede (2014) identified that, periodic markets have a special role and function in rural life. He further observed that, periodic markets are the lifeline of the rural people of Umred in Nagpur district of India. He concluded that, the growth of periodic markets is followed by agriculture and transport development. More so, Belgaum and Mulimani (2012) also concluded that, periodic markets are the centre of attraction that open up for spatial mobility and channel for distribution of agricultural produce, periodic market development will not only spark development of the hinterlands but will build up integrated rural communities and services to a substantial nucleated settlement.

Rural Livelihoods

Basically, rural activities are predominantly agricultural. According to World Development Report (WDR, 2008) agriculture include crops, livestock, agro-forestry and aquaculture. This excludes forestry and commercial fisheries because it is totally a different analysis. Agriculture is the highest source of livelihood for the global rural populace, it is estimated that, about 86% of the rural people lived on agriculture as their livelihood sources and it's provide jobs for about 1.3billion people without access to land and smallholder workers (WDR, 2008; FOA, 2014). Following Ellis (1999) argument that, increased agricultural produce would produce more income and livelihood opportunities to non-farmers is not tenable anymore because, poor rural households are not living on farming alone in regions with peculiar challenges resulting to diversified portfolios especially with the mechanised farming and advanced technology. Sati (2014) assertion that, rural household demand for food in respects their multiple functions, income and family size justified rural livelihood

Agricultural Products and Livelihood Opportunities

Agricultural development is fundamental to the achievement of Sustainable Development Goals come 2030 with specific relation to goals: to end poverty in all forms everywhere; and end hunger, achieve food security and improve nutrition and promote sustainable agriculture and yet, compare to that of Latin America and Asia, agriculture produce in Africa still remains small leaving farmers to live and remain in poverty (UNDP, 2015a; UNDP, 2015b; African Development Bank, 2016). In Sub-Saharan Africa (SSA), there is no alternative for motivating rural growth, eradicating poverty and enhancing sustainable food security, it is possible through agriculture as other economic spheres are hinged on its productivity. In the words of Zoelick Robert, former World Bank president, 2008, rural job creation cannot be done without thorough labour diversification, active rural connection to the technologically advanced agricultural system with other non Agric sectors. He said, three out of four poor people in developing countries of the world are in rural areas depending on agriculture as direct livelihood or indirect livelihood (WDR, 2008).

According to UNDP (2013), the intensity of poverty in Africa is in rural areas. This is so because it is in SSA that most of the agricultural based countries are and agriculture still remains as self employed in rura1 areas of the SSA. In Africa, millions of farmers go through difficu1t times in order to survive on agriculture as the on1y avai1ab1e resources (AfDB, 2016).

Today, according to WDR (2008), AfDB (2016) and Steel and Lindert (2017), agriculture is providing supportive livelihood means to millions of rural poor through traditional farming, emerging rural jobs, animal husbandry, smallholder farmers, new agricultural employment, entrepreneur, and nonfarm economy get out of poverty and thereby making rural areas attractive for investment. An estimated population of about 86 per cent of the world rural people lived on agriculture as their livelihood sources (WDR, 2008). It is clear that for agricultural to support sustainable growth and eradicate poverty require a fair socio-political atmosphere, better macroeconomics fundamentals and good governance.

RESEARCH METHODOLOGY

Majority of the people in Niger State, Nigeria, is predominantly farmers (NSBS, 2010); this study is based on the periodic markets in the Niger East Senatorial District. The study focused on agricultural produce in the periodic markets in the state. The study area has

Twenty Two major periodic markets. Eight (8) periodic markets out of the Twenty-Two were considered under this study (Table 1).

Table 1: Periodic Markets under Study.

S/N	Market Name	Local Govt	Market days
1	Beji Market	Bosso	Monday/Tuesday/Wednesday
2	Diko	Gurara	Saturday
3	Garatu	Bosso	Mondays
4	Kagara	Rafi	Tuesday
5	Kuta	Shiroro	Friday
6	Lambata	Gurara	After 4days
7	Paiko	Paikoro	Friday
8	Sarkin Pawa	Munya	Tuesday

Source: Authors' Fieldwork, 2017

This study designed and used Non-probability sampling technique; purposive sampling technique was employed for the administration of the questionnaires. Primary and secondary data were the data sources used. Primary data were acquired from the geographical locations of the eight selected periodic markets from the study area. The study sourced secondary data from books, journals, articles, maps, seminars, working papers, and other related literatures that were useful to the study.

The population for this study was estimated with the use of quadrant method. Two sets of questionnaires were designed and administered to sellers and buyers. A set of about 375 questionnaires were administered to sellers and another set of 373 questionnaires was administered to buyers. A total number of 748 questionnaires were administered in the eight periodic markets on each market's day using Open Data toolKit(ODK). A total of 341 questionnaires to sellers returned and 330 questionnaires to buyers returned. A total of 671 questionnaires representing 90% retuned.

The descriptive statistical approach was used for data analysis and interpretation. Results were presented in tables, charts and maps.

RESULTS AND DISCUSSION

Size, Population and Population Density by Markets

The study examined the size, population and the population density of the markets. However, measurement of these markets shows their hierarchy in terms of area coverage with Beji having the largest coverage of about 24.6hectares (245,994 square meters), Paiko is 18.4 (183,817), Lambatta is 12.6 (126,201), Dikko is 7.6 (76,139), Kuta is 5.1 (51,336), Garatu is 4.2 (41,538), Sarkin Pawa is 4.1 (40,996) and Kagara is 3.1 (30,997) hectares (square meters) respectively (Table 2). Similarly, Beji has the highest population of about 4,652 sellers and buyers while Dikko has the lowest population of about 2,241 sellers and buyers respectively. The population was assessed using the quadrant method from the markets using a sample plot of 10m x 10m during the market day. On the other hand, the result represented that, population density was determined considering the area coverage and the estimated population. Kagara has the highest population density of 1,223 persons per hectare while Sarkin Pawa has 1,084 persons per hectare, Garatu has 928 persons per hectare, Kuta has 817 persons per hectare, Dikko has 295 persons per hectare. Paiko, Beji, and Lambatta have the lowest population density of 159, 189, and 202 persons per hectare respectively.

Table 2: Market Size, Population and the Population Density

Name of Market	Market Size Area (Hectares)	Population	Population Density (Hectare)	Location Coordinates	
				Longitude	Latitude
Beji	24.6ha	4,652	189	9°37'26.74"N	6°19'52.11"E
Dikko	7.6ha	2,241	295	9°16'17.69"N	7°12'59.10"E
Garatu	4.2ha	3,898	928	9°28'59.11"N	6°26'24.99"E
Kagara	3.1ha	3,791	1,223	10°12'1.04"N	6°15'34.57"E
Kuta	5.1ha	4,164	817	9°52'9.18"N	6°42'23.14"E
Lambata	12.6ha	2,540	202	9°16'47.98"N	6°59'47.95"E
Paiko	18.4ha	2,930	159	9°26'41.67"N	6°37'58.14"E
Sarkin Pawa	4.1ha	4,445	1,084	10° 1'9.59"N	7° 7'16.56"E

Source: Authors' Fieldwork, 2017

Product Varieties by Markets

Generally, analysis of the markets shows that, common types of available crops in all the market include Maize, Rice, Mellon, Millet, Beans, Soya beans, Guinea Corn, Groundnuts, Yam tubers and Cassava while livestock types include Cattle, Goat, Sheep and Chicken. Yam tubers were the dominant crop type in seven markets representing about 88 per cent, only in Kagara market that, Yam tubers were moderate in availability status. This result implies that, Yam tubers are the most staple crops in the study area that provide the most livelihood opportunities. This confirmed Detonjo *et al* (2015) report on the development of rural periodic markets in Rivers State that, one of the characteristics of rural periodic markets is dominant products which displays the economic geography of the people as every periodic market has dominant product or commodity and the cheaper price determined it dominance and geographical area advantage over such product as it moves to other geographical areas of higher demand.

Table 3: Products Varieties by Markets.

Name of Market	Products Varieties			Total Varieties	Rank
	Grain Crops	Tuber Crops	Animals/ Livestock		
Beji	7	2	4	**13**	**1**
Dikko	6	2	3	**11**	**6**
Garatu	0	1	1	**2**	**8**
Kagara	8	1	4	**13**	**1**
Kuta	7	1	4	**12**	**3**
Lambata	7	2	3	**12**	**3**
Paiko	7	1	2	**10**	**7**
Sarkin Pawa	7	1	4	**12**	**3**

Source: Author's Fieldwork, 2017.

Table 3 show the summary of products varieties available in all the markets with Beji and Kagara having majority of the products with a total number of 13 products varieties each while Garatu have the lowest products varieties with a total number of 2 of the products types in all. This implies that, most of the markets have diversity of products except Garatu market is with extreme specialty in Yam sale.

Sources of Commodities.

The study pictured as represented in Figure 1 revealed that, the sources of sellers' commodities are from three basic sources namely: directly from their farms, bought from the farmers in the villages and, bought from others places to come and sell. The results depicted that, 66 per cent of the sellers commodities are directly from the farm, 29 per cent bought from farmers in the villages and only 5 per cent of the sellers' commodities were bought from other places to come and resell in places of higher demand.

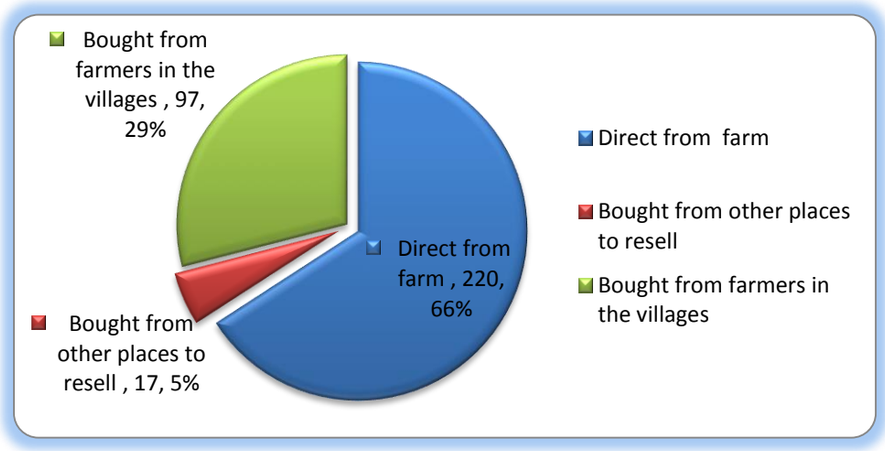

Figure 1: Distribution of Sellers Sources of Commodities
Source: Authors' Fieldwork, 2017

This study result implies that, generally, 95 per cent of the sources of sellers' commodities originated from the immediate settlements within Niger State, that is the sources from farm and those bought from farmers; only 5 per cent are from other places or outside the state, the sources of commodities/products are directly from the farm. This represented a picture that,

the periodic markets are spatially distributed because of the rural farmers and their dominant agricultural produce availability. This further confirms Mulimani and Belgaum (2012) assertion that, rural people lived to wholly depend to a level on the periodic markets within their proximity to sell their produce in exchange for money so as to improve their wellbeing and livelihoods.

Job Opportunities

Table 4 of the markets and people's wellbeing analysis revealed that, the markets created and provided job opportunities that enhance better livelihoods and wellbeing of the people. Probing the situation in providing job opportunities by market, greater percentage of the traders agreed that, job opportunities in the markets changed their living conditions to better or much better as they were engaged. In Kuta market, 71 per cent of the traders said job opportunities in the market makes a better living condition, 28 per cent said it was much better, Kagara, 69 per cent better and 31 much better, Beji, 67 per cent better and 30 per cent much better, Garatu, 64 per cent better and 32 much better and Lambatta, 62 per cent better and 33 per cent much better. This result demonstrated that, the prevailing job opportunities from the markets have greatly impacted the traders' condition positively and also improved their wellbeing as majority of the traders attested they lived better on it.

Table 4: Job Opportunities by Market

Name of Market	Much Worse	Worse	About the same	Better	Much Better	Total
Beji	0	0	3%	67%	30%	100%
Dikko	0	0	0	53%	47%	100%
Garatu	0	0	4%	64%	32%	100%
Kagara	0	0	0	69%	31%	100%
Kuta	0	0	1%	71%	28%	100%
Lambatta	0	0	5%	62%	33%	100%
Paiko	0	0	7%	56%	37%	100%
Sarkin Pawa	0	0	3%	61%	36%	100%

Source: Authors' Fieldwork, 2017

General Wellbeing

The study examined the contribution of the markets to the general wellbeing of the traders and results of the analysis as shown in Table 5.0 demonstrated that, the contribution was positive as all the traders confirmed that, the markets contribution to their general wellbeing was better or much better. In Kuta market, 73 per cent of the traders said their general wellbeing was better representing the highest proportion, 27 per cent said it was much better. Others with greater proportion are Garatu (66 and 34 per cent) better and much better, Kagara(62 and 38 per cent) better and much better, and Sarkin Pawa (61 and 39 per cent) better and much better condition of general wellbeing while Dikko have 43 per cent of better and 57 per cent much better making it the only market with higher proportion of traders with much better general wellbeing condition above 50 per cent. However, greater proportions of traders on average have a better general wellbeing contributed by the markets.

Table 5: General Wellbeing by Market.

Name of Market	Much Worse	Worse	About the same	Better	Much Better	Total
Beji	0	0	0	51%	49%	100%
Dikko	0	0	0	43%	57%	100%
Garatu	0	0	0	66%	34%	100%
Kagara	0	0	0	62%	38%	100%
Kuta	0	0	0	73%	27%	100%
Lambatta	0	0	0	52%	48%	100%
Paiko	0	0	0	56%	44%	100%
Sarkin Pawa	0	0	0	61%	39%	100%

Source: Author's Fieldwork, 2017

CONCLUSION

Rural people lived and depend on agriculture for their food, businesses and jobs so identifying a livelihood opportunity around you and keying into such opportunities for wellbeing is important. From the findings and the results obtained, this study revealed

diverse livelihoods opportunities from selected periodic markets in Niger East Senatorial District with trading activities on agricultural produce as dominant factor for making a living self reliance from these opportunities. This study results concluded that, there are numerous livelihood opportunities from the periodic markets in Niger State with income generation opportunities that people from Niger State, Nigeria and beyond lived to survived and earned their living on. The agricultural products such as Yam, Millet, Melon, Maize, Rice, Groundnut, Beans, Cattle, Goat, Sheep, and other ancillary jobs through the market value chain are ensuring that, most of the people are making safe and sustainable livelihoods, improved socio-economic life style and better wellbeing. This conclusion is in support of UNCHR's livelihood strategies for all, that livelihood opportunities should enable one make a living so as to meets their basic needs, contributes to their dignity and provides for the full enjoyment of human rights (UNHCR, 2014). The study therefore recommended that, Population density and area coverage of the markets are proportional to the markets' hierarchy and choice of patronage by sellers and buyers. Therefore, provision of adequate space for rural periodic markets should be a priority to all stakeholders for proper and standard planning and development of these markets so as to improve the socioeconomic conditions of the people within the host communities and beyond. Also, more efforts should be done to translate these livelihood outcomes generated on agricultural produce in the area to assets building, sustainable market value chain, and community development, among others. These could be through programmes on livelihoods and markets for adequate education and information to the people, especially on Tubers/Grains crops and livestock towards economic diversification and stabilising the socioeconomic life style of the local people and contributing to program of poverty alleviation both in Niger State and Nation at large.

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ANALYSIS OF DO IT YOURSELF (DIY) APPROACH IN A NEIGHBOURHOOD COMMUNITY SANITATION PROJECT IN SOKOTO METROPOLIS

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The undeniable reality regarding the inability of the tiers of government to adequately provide basic urban services has given birth to variety of concepts and ideas suggesting inclusiveness and participation. These concepts include promotion of the private sector participation in the provision of such services, public private partnerships as well as the role of communities. The Do It Yourself (DIY) concept has been promoted particularly under the umbrella of resilience, where individuals and communities are encouraged to device means of providing basic urban services as far as possible by themselves. In this study, the author has evaluated the outcomes of a community sanitation project at Diplomat neighbourhood in Sokoto metropolis, northwest Nigeria. Using a descriptive approach and 112 households to determine willingness to pay for service, a Goal Achievement Matrix has been used to determine the extent to which set objectives of the project are achieved. Among the five (5) core objectives related to spatial coverage, consistency, public trust, job creation and financial sustainability, only two (spatial coverage and job creation) are partially achieved. Key explanations for the failure of the project to achieve considerable objectives after two (2) years of commencement are largely in the area of low commitment from key stakeholders and modifications to original project plan. The initially cordoned area was found to be disrespected and the principal facilitators of the project weaned it prematurely. As the project is still partially functional, recommendations were made regarding the need for institutional support for sustainability in community-driven projects.

Keywords: *Community, participation, resilience, DIY, neighbourhood, evaluation*

INTRODUCTION

The principal questions raised by the 1997 World Bank Experience with the Provision of Infrastructure Services for the urban poor still remain largely unanswered (Mtunge and Mokaya, 2015; Mokaya, 2016). The 1997 World Bank report reviewed some 70 of the Bank-supported projects and a dozen water and sanitation projects with components aimed at the provision of basic urban services to low income communities in urban areas. The two relevant questions to our own discourse have to do with:

a. "What kinds of project appear to be most effective in providing infrastructure services to the urban poor?"
b. "Under what conditions have these services been sustained beyond the project duration?"

These questions summarized the fundamental worry associated with delivery of basic urban services sustainably. In trying to provide answers to these questions, approaches under differing arrangements have been developed and tested to create avenues for effective intervention in the provision of basic urban services. Some of these arrangements relate with the role of community in initiating and sustaining urban projects. This is evident in the area of urban land delivery, as in the case of Community Driven Land Tenure Strategies of the Philippines (Teodoro and Rayos 2009), housing (Peoples' Housing Process in South Africa), urban renewal and a host of other initiatives aiming at involving communities for sustainability in urban service delivery.

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This study is an attempt to contribute in anlysing some perspectives towards providing highlights on city's ability to effectively and sustainably provide basic urban services. Hence, shading some light in the quest to answer the 1997 World Bank questions. The study is a preliminary analysis of outcomes of a community project at Diplomat area, Sokoto South Local Government, Sokoto State. The project is an initiation of a foreign NGO supported by local ones, and based upon an existing social infrastructure (Diplomat Area Community Association). This paper therefore begins with a discussion on the conceptualization of the DiY approach as communities' response to urban services provision issues and the Goal Achievement as an evaluation tool. This is then followed by a description of the study method and the study area. Subsequently, the project in question is examined in terms of its design, scope and objectives. The outcomes of the project are then discussed together with the extent of achievement of its objectives. The paper concludes with a highlight on the implications of the observed pattern and recommendations for DiY approaches as community efforts in responding to urban socio-economic realities.

LITERATURE REVIEW

The Do it Yourself (DiY) approach has several connotations depending on the context of application. Its epistemology is still very loose (Finn 2014). In urban systems however, DiY basically connotes an instance of public or community effort towards providing some services to themselves informally. These services would have otherwise require some sort of skilled or professional intervention. DiY has been one of the response mechanisms to the basic reality regarding the provision of basic urban services by public institutions and challenges associated with access to them particularly as a result of poverty. As demonstrated by a number of studies (Ofori-Mensah (2017), Iveson (2013) and Viglucci (2012)), DiY today embraces other citizen-led place-making activities such as gardens, bus stops and other public spaces.

Communities as well as individuals are creating what Finn (2014) called "spontaneous interventions" with the intent of improving their urban experiences. As a subject, the DiY approach has been dismissed by some authors (Douglas 2011) and commended by others (Fulcoro 2013). Douglass (2011) for example described some of the DiY initiatives as "unauthorized urban design contributions". DiY solutions are usually innovative and low cost solutions to urban issues that are left unaddressed. They are however temporary fixes rather than long term serious solutions (Finn, 2014). The manifestation of DiY approaches as a sort of "vigilante urbanism" is suggestive of a critical challenge in the governance, management and planning of cities (Hackworth 2007). As a parallel to ongoing municipal budget crisis and political gridlock therefore, the enthusiasm and creativity of DiY approach should be harnessed by cities rather than condemning them. This will provide an opportunity for generation of ideas and integration of this innovative community or public efforts with existing participatory devices relevant for creation of more resilience in cities.

As a critical component of basic urban services, sanitation projects received tremendous attention from governmental and non-governmental organizations. As such therefore, it is not uncommon to find a number of community led interventions in sanitation projects. In Ghana for example, the economic incentives associated with some of the urban sanitation initiatives, have generated multiple faces of DiY interventions (Ofori-Mensah 2017). The World Bank as well as the Asian Development Bank have led several Community Driven Urban Sanitation projects in Asian and African countries. Several techniques are used to evaluate successes, efficiency and sustainability of such urban service projects. These techniques according to Lichfield (1970) include the cost benefit analysis, Planning Balance Sheet, Investment Appraisal, Cost minimization, Cost Effectiveness and Goal Achievement.

The Goal Achievement Matrix is family member in the techniques under the Goal Achievement group. Other techniques in the group include Bending on, Policy Evaluation Matrix and Objective Fulfillment Analysis. The Goal Achievement Matrix (GAM) was used by Morris Hill (1968) in the urban transportation and land use in Britain. It was later applied in several areas in urban and regional planning. GAM is the sophisticated version of Policy Evaluation Matrix, with the introduction of weights and scores. Hill and Shechter (1970) further developed the approach by employing weighted indices of GAM in a zero-one Boolean programming model in planning of outdoor recreation facilities. The core idea in the GAM is that costs and benefits in projects are viewed in terms of achievement of objectives.

Although the GAM is more profound in comparing alternative plans, its utility has been demonstrated in analyzing independent projects as in Sager (2003).

METHODOLOGY

The Study Area

Diplomat area is located in Sokoto metropolis which is the headquarters of Sokoto State. Sokoto state is one of seven states that make up the northwest Geopolitical region of Nigeria and Sokoto town is a main hub of Political, cultural and economic activity in the region. The state is bounded to the north by the Republic of Niger, to the east and south by Katsina, Zamfara, Kebbi and Niger States and to the west by the Republic of Benin. The location of Sokoto town is at 13 degrees north and 5 degrees east. There are historical and economic ties that link the city to the trans-Saharan trade routes north and south, but the cultural significance is in the town being the seat of the sultan of Sokoto who is the spiritual leader of Nigeria's Muslim caliphate.

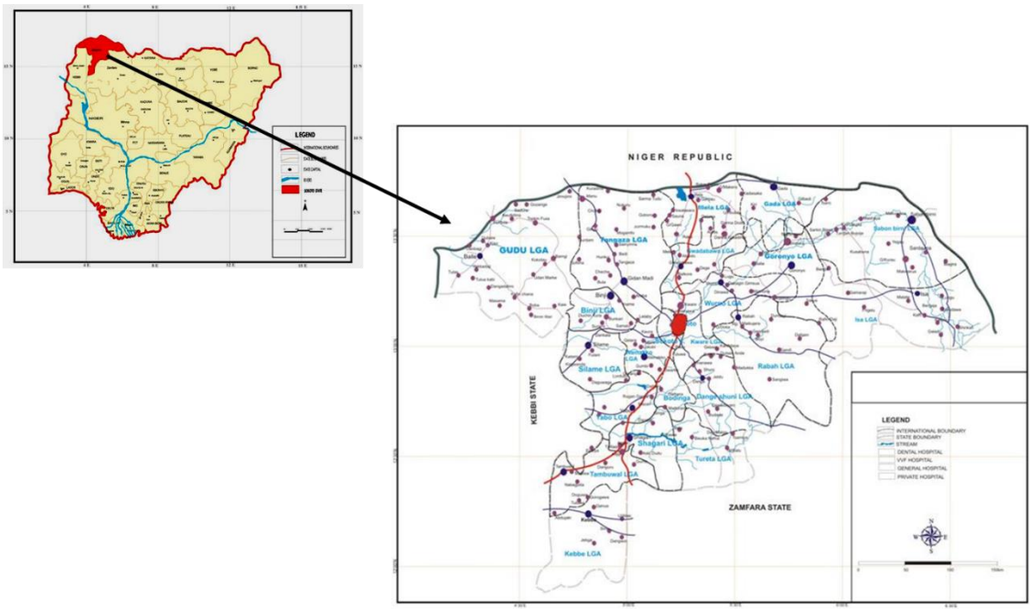

Figure 1: Sokoto State in Nigeria

Diplomat is a small neighbourhood in the city of Sokoto (see Figure 2). It is one of the few known neighbourhoods where the population is quite cosmopolitan in terms of its cultural composition.

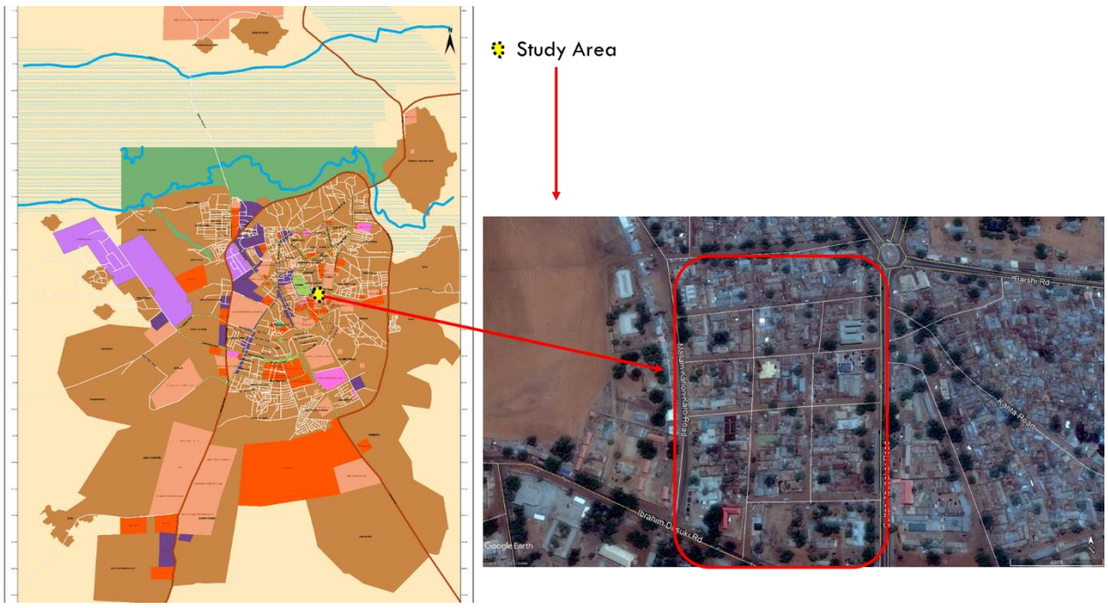

Figure 2: Diplomat area in the context of Sokoto Metropolis

The choice of Diplomat area in Sokoto is purposive. An intervention came from a religious NGO (Catholic Relief Service (CRS)) in response to the recent security challenges in the

northern part of the country (details in the next section). In Sokoto metropolis, two neigbourhoods demonstrated the required characteristics for the receipt of this intervention (Diplomat and Hajiya Halima), and Diplomat area was chosen to kick off the Community Driven Project. With this circumstance and also the existence of a social platform (the Diplomat Area Community Association), this study is thus based in the neighbourhood.

Location and Characteristics of the neighbourhood.

The Diplomat neighbourhood is located along Sultan Abubakar road towards the Sultan's Palace and the area at present forms part of the central section of the city. The neighbourhood sits on approximately 22ha of land with a total of 215 houses including compound types with multiple tenants. Laid out plots (mostly 450m^2) are much less than this number. It is one of the earliest planned neighbourhoods of the city. The Sultan Abubakar road forms the eastern boundary, while the Shehu Kangiwa Square bounds the neighbourhood to the west. To the north and south, the area is bordered by parts of Rijiyar Dorawa area and Sultan Ibrahim Dasuki road respectively (see Figure 2).

Application of the Goal Achievement Matrix (GAM)

In this study, the focus is on one project. Therefore the five goals of the project are defined with some sort of quantification. Thereafter, the extent of achievement is established using the specified definitions as in Table 1.

Table 1: Definition of Project Goals

	Goal/Objective	Definition
1	Spatial Coverage	Number of houses covered out of the total 215
2	Consistency	Months of operation between January 2016 to October 2017 (20 Months)
3	Public Trust	Willingness to pay for service as a percentage of committed residents
4	Job Creation*	Number of employees supported at present as a part of 50
5	Financial sustainability	Surplus from collections as a percentage of the total

*The project was planned to employ a total of 50 youths for waste collection. At the point of implementation, the community was prompted with a large number of interested individuals and jacked the number up to 86 while reducing the allowance from ₦4000 t0 ₦2000.

For the purpose of determining residents' willingness to continue the payment for collection, data was gathered from 112 houses (52%) within the six sections/clusters of the neighbourhood, proportionate to the sizes (number of houses) of each cluster as shown in Table 2. The description of clusters is in Table 3.

Table 2: Selection of houses for interview, based on clusters

Cluster	No. of Houses	No of Selected Houses for interview
1	31	16
2	57	30
3	64	34
4	22	11
5	18	9
6	23	12
Total	**215**	**112**

RESULTS AND DISCUSSION

The project*: Design and Objectives*

The project is titled "Community Environmental Sanitation Pilot Project" which is initiated by Community Collaborative Initiative for Peace-Building in Sokoto State (COMCIPS) and supported by the Catholic Relief Service (CRS), United States. The project idea was triggered by the rising interests from within and outside Nigeria to support community reconstruction following the security situation that has affected many parts of the north. Two cities (Maiduguri and Sokoto) were selected for a pilot project. In each of these city, the intent was to select a neighbourhood that is characterized by a peacefully coexisting multi-cultural population. In Sokoto two candidates emerged: Hajiya Halima area, close to the central market; and Diplomat. COMCIPS evaluated these two neighbourhoods and selected Diplomat having being characterized by series of environmental sanitation issues. The area is originally planned with drainage facilities along almost all streets. With time, residents encroached on the Right Of Way (ROW) and in some cases built on or even beyond the original drainage channels that are filled completely with sand. The only indicator remaining to suggest the existence of drainage channels are culverts across some streets. This scenario

lead to stagnation of storm water during the rainy season, which presents considerable health hazard to the neighbourhood.

Plate 1: Stagnated Rain water between Gumbi and Kauran Namoda Roads
Note: The generator house at the top right corner is directly on a sand covered drainage that is supposed to drain this part of the neighbourhood.

On the 3rd of October 2015, the first meeting was held with some neighbourhood residents, where the COMCIPS representatives introduced the project. It was then pointed out to neighbourhood residents that the project is only to be initiated with the meagre fund from CRS and then the community will continue with it by themselves on a DiY basis. An existing community association (Diplomat Area Community Association) which was initiated in 2009 would be used as the platform upon which the project will be based for sustained monitoring. As highlighted in Table 1 therefore, the initiated project has five (5) key objectives that would aid in attaining a sanitized neighbourhood. They are:

1. Spatial Coverage
2. Consistency
3. Public Trust
4. Job Creation
5. Financial sustainability

Project Scope

The project was designed to incorporate two activities: rehabilitation of culverts and neighbourhood drainage; and refuse collection and disposal. The activity that was planned to be sustained by the community is waste collection and disposal. With the financial support of 7 million naira from CRS, some culverts are to be rehabilitated and then the waste management component will involve conducting a house to house survey to establish total number of houses; purchase of 1000 units of drums for temporary storage at house doors; 50 wheel barrows for collection to temporary dump sites and recruitment of 50 youths to carry out the weekly or bi-weekly collection. The youths are to be paid four thousand naira (₦4000) each on monthly basis. An account would be opened at the Diplomat Branch of First Bank, and then cheques are issued to the participating youths upon certification of work by the community representative. Initially, it was proposed that each drum allocated will attract a monthly payment of five hundred naira (₦500) from residents. The fee was further reduced to two hundred naira (₦200). The idea was for the revenue to be up to three hundred thousand naira (₦300,000) if only 60% of the residents pay. As such therefore, the 50 youth can be paid with a surplus of about one hundred thousand naira ₦100,000 every month.

Project Implementation

The first action plan begins immediately after the 3rd October meeting with assignment of responsibility to residents for houses/household census. Table 2 showed the neighbourhood sections as assigned to enumeration volunteers. The description of neighbourhood sections is well understood by residents.

Table 3: Assignment of Sections for Compound/Household Census

	Section Description	Enumerators
1	Behind the courts, Red Cross office, up to Baker's residence	1. Mazi Chike 2. Sai-Dua'i
2	Old Shehu Adili's house – Sani Super's residence + Maman-Kola – Nahuce's residence	1. Henry Peters 2. Malam Dauda
3	Kauran Namoda, Gumbi and Mai-Kahon Karo roads	1. Lauwali Kairu 2. Yusuf Shuaibu
4	Abarshi Road	1. James Nze 2. Abdulaziz Jimoh
5	Freedom Pharmacy	1. Johnson Eze 2. Ibrahim Sifawa
6	Sultan Abubakar Road	1. Mani Kotu 2. Abdulgaffar Jimoh

COMCIPS provided materials for the rehabilitation of two culverts while the community members provided the labour. Some of the equipment that can be reused are kept with one of the community members.

At the end of the compound/household census, 215 houses were established including several of those containing more than 10 households. 1000 units of drums may therefore not be needed even if some of the houses would require more than 1 drum. 512 drums were then supplied together with 50 manual trucks for house to house collection.

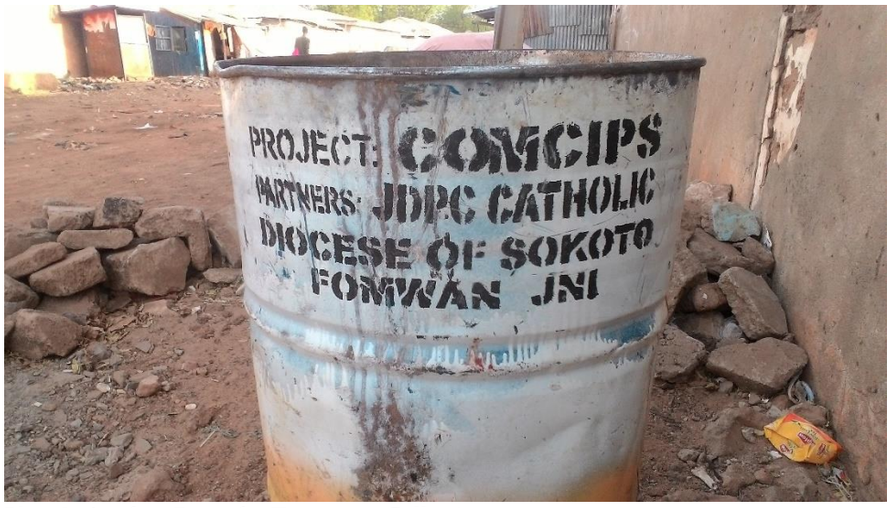

Plate 2: A refuse Drum for Temporary Collection

Five youths were selected to maintain ten of the trucks each and ensure prompt collection and payment of collectors. Several youths came to lobby for inclusion into the collection team, which lead to the reduction of monthly payment to two thousand naira (₦2000) and increase the number of participants to 86.

As it is therefore, even if two hundred naira (₦200) is paid on all the drums the total collection will only stand at one hundred and two thousand naira (₦102,000) from 512 drums. One hundred and seventy two thousand naira (₦172,000) is required to pay the 86 collectors, which means that the project will be running on a deficit of seventy thousand naira (₦70,000). This calls for series of meetings to review the situation. Incidentally, the issue of sanitation has later been left to take care of itself, when issues of security prompted some of the active community members to begin advocating for a gated community.

Plate 3: A community member asking for audience in a meeting

At present, the drum count stood at 480 which is suggestive of even lower returns than the envisaged one hundred and two thousand naira (₦102,000). Furthermore, the cordoned area as shown in figure 2 has not been respected as some of the drums are found outside of the cordoned neighbourhood.

In sections that follow, the extent to which the five objectives of the sanitation project are achieved is shown. It is then followed by attempt to explain the emerging result from the project history that is described earlier.

Achieving the Project goals

In Table 4, the extent of attainment of project objectives is shown.

Table 4: Goal Achievement Matrix for the 5 project objectives

	Goal/Objective	Definition of Objective	Extent of attainment
1	Spatial Coverage	Number of houses covered out of the total 215	208 houses (480 drums)
2	Consistency	Months of operation between January 2016 to October 2017 (20 Months)	5 months
3	Public Trust	Willingness to pay for service as a percentage of committed residents	31% (35 out of 112)
4	Job Creation	Number of employees supported at present as a part of 50	40
5	Financial sustainability	Surplus from collections as a percentage of the total	Nil

It can be seen from Table 4 that only spatial coverage and job creation components of the objectives are somehow achieved. For the second objective, the planned collection style only lasted for 5 months. However, after another 4 months of very poor operation (collection is stopped for most houses), 40 of the original recruits came back on their own to repair the broken trucks and continue to collect the waste and receive their pay directly from households.

Plate 4: One of the Autonomous Collectors

The sanitation project is virtually on its own now. In an attempt to examine possible reasons for the performance of the project, the author looked at the extent of deviation from the original plan by comparing the way the project is planned against how it has been executed. 512 drums were supplied instead of 1000. This has implications on the envisaged revenue. Two hundred naira (₦200) is collected from residents instead of planned five hundred (₦500). Also, 50 youths planned to be recruited suddenly became 86. Because of the number, the youths agreed to take two thousand naira (₦2000) each instead of planned four thousand (₦4000). The payment was planned to be monitored by an elderly community representative, but later left to the youth leaders who kept the trucks in their custody.

Regarding willingness to pay, only 31% of the residents agreed that they will continue to pay if the service is sustained. One of the interviewed residents lamented that why should he pay for garbage collection when he has a lot of kids to do that? 22 of the sampled residents said they do not see the collectors working, why should they pay?

The drainage component has for long suffered abandonment when the question of reviving existing drainage system was raised by some residents. Reviving the original drainage system may require removal of encroaching structures by some of the key members of the community. This is quite difficult with weak urban governance, institutional support and development control.

CONCLUSION

The DiY approach is indeed an automatic response to cities' socio-economic realities. What this report has shown is that without some sort of organized monitoring, very little would be achieved. This is particularly the case if the project is largely relying on communal efforts rather than few committed individuals. The fact that few community members are committed to the newly injected security project, one thousand naira (₦1000) is now being contributed monthly for the vigilante employed to patrol the area on monthly basis. For five months now, that has been consistent. Another important point is that success of initiatives is not determined by the demand from majority. Rather, it is facilitated by the efforts of committed minority as opined by Olson (1965; 2009) and later supported by Newman et al (2003), Mansuri and Rao (2004) and Muhammad (2016). As partially independent as DiY may seem to be, without some sort of institutional support, individual interests are likely to seriously undermine the collective good. This is evident in the drainage issue that is usually silenced at community meetings. Waste collection has partially been sustained as shown earlier, but the initial concern of storm water stagnation is still a character of the neighbourhood in the raining season. Diplomat area is only discussed here because of the project that was initiated in the neighbourhood. The unplanned fringe areas such as Mabera, Tamaje and Nakasari are in more terrible situation than Diplomat when rain falls. No matter how worried some community members are, and therefore ready to lead some projects on DiY basis, without institutional support the only option left for them is to leave the area for those who have no other choices.

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ASSESSMENT OF USER'S PERCEPTION OF OUTDOOR EATING AREA IN ABUJA RESTAURANTS

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Outdoor eating refers to an extension of indoor seating area where people sit and take their meals in a conducive open atmosphere. It is generally located on the footpath mostly in front of a restaurant and adds to the appeal of the environment as a tourist destination. There is no better indication that a restaurant is more open for business than when it makes good use of adjacent footpaths for outdoor eating. Sadly, most restaurants in Abuja tend to neglect the use of outdoor dining spaces. This paper therefore examines the user's perception of the outdoor eating area in Abuja restaurants. The Study used structured questionnaire and observation schedule to elicit relevant information among Two Hundred and Eighty-Three (283) users who dine at Twenty-Eight (28) different restaurants located in different parts of Abuja. The result indicates that the majority of the users perceives outdoor eating as a way of eating in a free natural environment without the psychology of sitting in an enclosed space. The study hereby suggests the incorporation of the outdoor eating area in the design and construction of restaurants in Abuja.

Keywords: Outdoor eating area, Restaurants, Environment, Enclosed space, Design

INTRODUCTION

Outdoor dining area refers to the extension of indoor dining spaces in restaurants where people sit to eat, drink, unwind and socialize, located mostly in the front or side of a restaurant Hartman (2015). Restaurants, on the other hand, are organizations that exist in every part of the world. It is a place for people to come socialize, drink and eat and it's credited to the French revolution (Lorri, 2012). Outdoor dining is becoming more popular in some part of the world; it adds to the appeal of the environment as a tourist destination. Outdoor dining spaces add colour, vibrancy and activity to the street frontages and public place. The use of outdoor dining spaces in restaurants cannot be over emphasized; unfortunately, most restaurants in the Federal Capital City of Nigeria tend to neglect the use of outdoor spaces. This paper examines the user perception of the outdoor eating area in Abuja restaurants. To achieve this the paper, evaluate users' perception of what makes the outdoor dining spaces, convenient for use and to assess facilities that make up the outdoor dining spaces. Similarly, the study tends to provide recommendation to the research with regards to the effective use of outdoor dining spaces in restaurants as an extension of the indoor dining areas.

The Study Area

The study area is Abuja, the Federal Capital Territory of Nigeria located between longitude 7.4913 and latitude 9.0722 (Fig. 1). It has an estimated population of 776 298 people according to the 2006 census figures. Bounded by Kaduna State to the North, Nasarawa to the east, Kogi to the South and Niger to the West.

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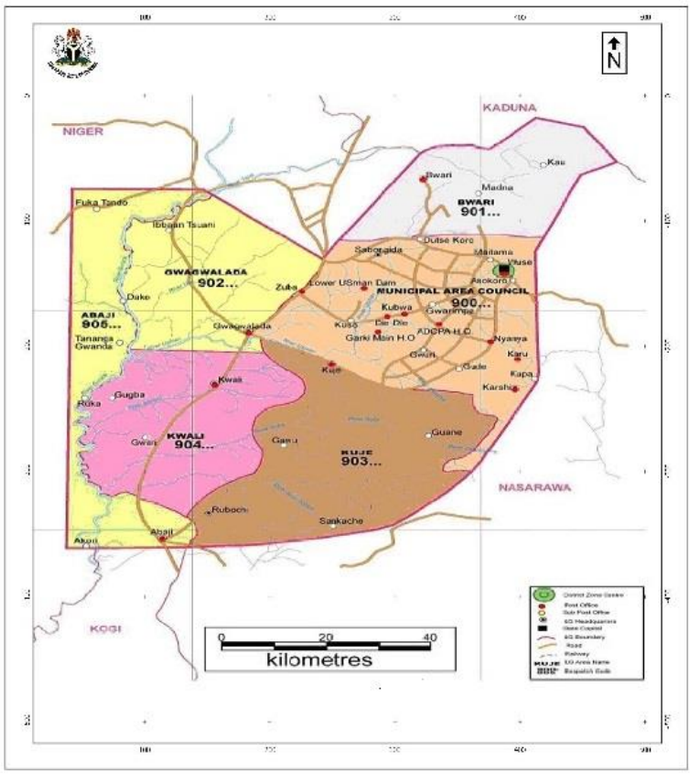
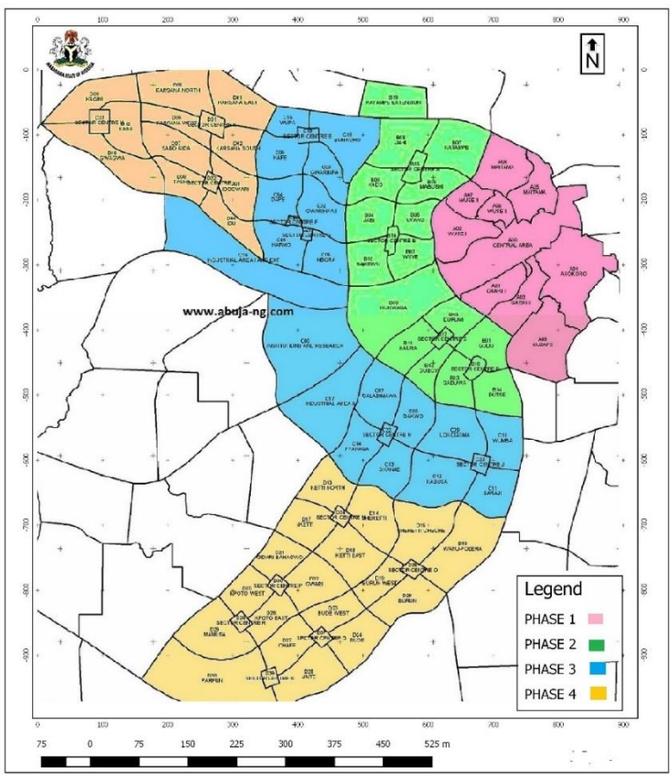
Idris & Abdulrahman (2018). **ASSESSMENT OF USER'S PERCEPTION OF OUTDOOR EATING AREA IN ABUJA RESTAURANTS.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

The estimated known population of the FCT as at 2015 is 2,440,200. By 2018 the population of Abuja at +13.91% rate is 3,607,066 (National Population Commission).



Map of the Federal Capital Territory showing the Federal Capital City
Source: www.abuja-ng.com

The Federal Capital Territory has six (6) area councils, Abuja, the federal capital city is further divided into districts, and the districts are grouped into development phases; There is phase 1, phase 2, phase 3 and phase 4 (see Fig 2). Each phase is divided into districts and cadastral zones. Phase 1 with the exception of Guzape is fully developed with infrastructure and they include; Asokoro, Central Business District, Garki 1, Garki II, Maitama, Wuse and Wuse II District. Phase 2 is highly developed and others are being developed, they include; Gudu, Durumi, Utako, Jabi, Wuye, Kado, Mabuchi, Katampe, Jahi, Dakibiyu, Kaura, Duboyi, and Gaduwa.



Map of Abuja showing the Cadastral Zones and District
Source: www.abuja-ng.com

With the high population of people across the FCT and the high infrastructural drive of the government, many restaurants are being opened across the developed district with high commercial activities. (Obateru, 1995) and The aforementioned formed the study area for the distribution of the research questionnaire.

METHOD OF DATA COLLECTION

A sample frame of different restaurants from 7 cadastral zones of Phase 1 and Phase 2 with high commercial activities was randomly selected, these districts include, Asokoro, Maitama, Wuse, Wuse II, Garki, Garki II, Central Business District and Jabi. This was achieved with the use of Stratified Sampling Technique. This is simply a probability sampling technique wherein the researcher divides the entire population into different subgroups, then randomly selects the final subjects proportionally from the different strata. This technique aided in the breakdown for the selection of restaurants in the study area. As a result, the sample population was broken down into the existing restaurant in each commercial district that make up the Phase 1 and 2 of the Federal Capital territory. Summarily a total of Twenty-Eight (28) restaurants (Table 1) was randomly selected for this study. An average of 30 diners at peak period was use for the sample. In summary, the total population of diners in the restaurants under this study stands at 840 and consequently forms the study population.

Table 1: Name and Address of studied restaurant

S/NO	NAME OF RESTAURANT	LOCATION
1.	Blu Cabana Restaurant	Across Setraco Building, Mabushi
2	Serendib Restaurants	No 29, Umaru Dikki street, Jabi
3	Bukka Restaurants	1 Aguyii Ironsi Str, Maitama
4	Secret Garden	Opp Harrow Park/Abia House, Wuse II
5	Al Basha Palace	No 11 Cassandra Str, off Gana Street, Maitama
6	The Clubhouse	11 Aliyu Moh'd Rd, Jabi, Life Camp,
7	Traffic Restaurants	39 Gana Street, Maitama
8	Salamander Café'	Bujumbura street, Garki, Abuja
9	Zander's Place	Plot 150 F.H.A Phase 1, Karu
10	Classic Rock Coffee	12B Ajesa Street, Wuse II, Abuja
11	Wakkis	Plot 171, Aminu Kano Crescent, Wuse II
12	Nkoyo Restaurant	K-City Plaza, Wuse II
13	Jevinik Restaurants	Opp Rita Lori, Garki II
14	Flamingo Restaurants	Ahmadu Bello Way, Before Next Store
15	Kilimanjaro	Gana Street, Maitama
16	Matsala Wahala	1 Agunyii Ironsi Str, Maitama
17	Charcoal Grill and Restaurants	112, Aminu Kano Crescent, Wuse II
18	Steakhouse and Lounge	38 Osun Crescent, off IBB Way.
19	Cityview Restaurants	Plot 2407, IBB Way, Wuse Zone 4
20	Domino and Coldstone	35 Kumasi Crescent, Wuse
21	Drumsticks	Close to AYA, Asokoro
22	House Cuisine	Queen Elizabeth St, Asokoro
23	Sawadee Oriental Cuisine	Central Business District, Silverbird Galleria
24	Fulani Pool Restaurants	Opp Sheraton, Zone 4
25	Chicken Capitol	Central Business District
26	Spice Platter	Close to NTA, CBD
27	Obudu Grill House	Before Pope John Paul, Asokoro
28	Chez Victor	Alex Ekwueme Str, Jabi

In addition, Questionnaire and Observation Schedule was used as research instruments to gather relevant data. The observation schedule was used to obtain general design consideration and features that make up the restaurants. While the questionnaire was administered to respondents to obtain their perception and level of satisfaction on provisions of outdoor dining spaces in the respective restaurants under this study. A total of 283 questionnaires were administered to respondents from the randomly selected restaurants. The total response rate of 76.6% was generated. The data obtained was analysed using descriptive statistics and the results was presented in tables, charts and plates. Table 2 shows

the summary of the administered questionnaire that was collated and analysed using descriptive frequency.

Total Population = 840

Sample Size = 283 (sample size Calculator by relief applications)

Table 2: Breakdown of Administered Questionnaires

Respondents	Frequency
Valid Response	217
Invalid Response	30
Not Returned	36
Total	283

RESULT AND DISCUSSION

The discussions of results in this section are generated from analysis of the data collated from the field survey on assessment of user's perception of the outdoor eating area in Abuja restaurants in the study area. Structured questionnaire was administered to outdoor users to ascertain the user's perception on the importance of different outdoor spaces required by the diners within each restaurant surveyed. Questionnaire was used to collate data for level of importance of existing outdoor dining spaces in the studied restaurant. This is done to ascertain the level of satisfaction of outdoor dining users in the studied restaurant. Table 3 shows the variables that were examined. The degree of importance was obtained using a four point Likert Scale ranging from

Very Unimportant (VU)= 1

Unimportant (UI) = 2

Important (I) = 3

Very Important = 4

Table 3: Variables of Outdoor Dining Spaces

Access to Outdoor Dining space
Location of Outdoor Dining Area
Size and Form of Outdoor Dining Area
Seating Arrangement
Landscaping Features
Quality of Outdoor Dining Space in Restaurant
Safety of Outdoor Dining space
Aesthetics of Outdoor Dining area

Table 4: Respondent Opinion on Importance of Outdoor Dining Space

OPINION	Very Unimportant (VU)	Unimportant (U)	Important (I)	Very Important (VI)	Total
Accessibility	45	82	74	16	217
Location	32	41	59	85	217
Size	97	65	38	17	217
Seating Arrangement	24	69	53	71	217
Landscape features	17	34	93	73	217
Quality of space	42	24	88	63	217
Safety	14	17	105	81	217
Aesthetics	27	67	88	35	217

Table 5: Sum Of Respondents Of Importance Of Outdoor Dining Space

OPINION	(VU) X1	(U) X2	(I) X3	(VI) X4	TOTAL
Accessibility	45	164	222	64	495
Location	32	82	118	340	572
Size	97	130	114	68	409
Seating Arrangement	24	138	159	284	605
Landscape features	17	68	279	292	656
Quality of space	42	48	264	252	606
Safety	14	34	315	324	687
Aesthetics	27	134	264	140	565

The analysis of respondent's user's perception of outdoor dining area in restaurants among outdoor users was conducted. The values obtained from the Likert rated variables of outdoor dining area elements was used to determine the degree of importance using the formulae

Total Value (TV) = n x LV_____ (1) (According to Abdurrahman 2015)

Where TV is the total value of the rated variables

n, is the number of respondents

LV, is the Likert range value

And the formulae

Mean Score, N = LV/217_____ (2)

Where N is the mean score of Likert rated variables

The equation (1) is used to evaluate the mean score of the rated Likert variables of the responses obtained from the people about their perception of outdoor dining area in Abuja restaurant. The equation (2) is used to evaluate the mean of the score of the Likert rated variables and used to get the range of the Likert scale.

Table 6: Sum of Results Interpretation

Measured Variable	Number Of Respondents	Sum	Mean	Interpretation
Size	217	409	1.88	Unimportant
Accessibility	217	495	2.28	Unimportant
Aesthetics	217	565	2.60	Important
Location	217	572	2.64	Important
Seating Arrangement	217	605	2.79	Important
Quality of space	217	606	2.79	Important
Landscape features	217	656	3.02	Important
Safety	217	687	3.16	Important

Table 6 observed that respondent's opinion on the measured variables; size and accessibility are unimportant to the users of outdoor dining spaces. This is simply deduced based on the ranking from the table that is 1.88 and 2.88 as unimportant. Therefore, it can now be concluded that the variables highlighted have less significance to the design of the restaurant in general. In addition, from the table above shows a strong level of importance for the variables measured within the range of 2.60 to 3.16. These variables are Aesthetics, Location, Seating arrangement, quality of space, landscape features and safety of outdoor dining users are considered important to the respondents and consequently perceived by the outdoor users as a prerequisite in the design of outdoor dining area.

Quality of Outdoor Dining Area

A key factor in user perception of outdoor dining spaces is the quality of outdoor dining area. However, there is a need to make analysis on the data generate on the quality of outdoor dining area in Abuja restaurant. Figure 3 shows the respondent opinion on quality of outdoor dining area within the study area. It can be observed from figure 3 that 29% and 41% are satisfied with the quality of outdoor dining area while 19% and 11% are unsatisfied respectively. The reason for such satisfaction is that most diners prefers the outdoor form of eating and this subsequently led to the high percentage of satisfaction derived on the quality of the spaces from the analysis and data generated.

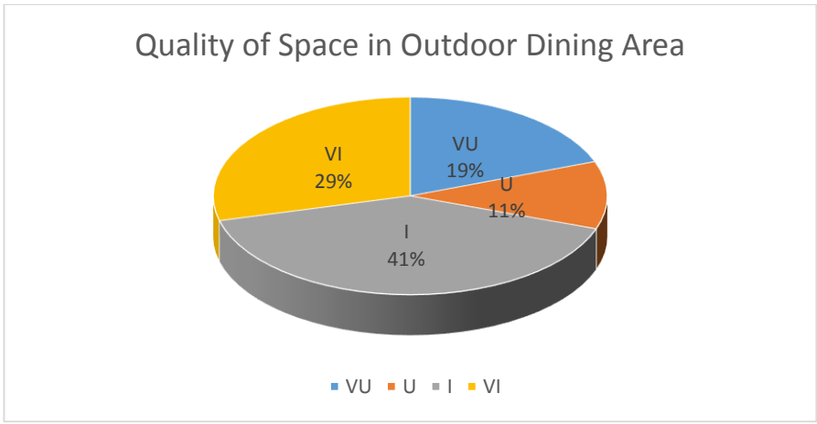


Fig 3: Respondent Opinion on Quality of outdoor dining area
Source: Author's Fieldwork

CONCLUSION

To this end, the outdoor dining spaces are essential factors to be considered in the design of a restaurant. This is because most diners prefer the outdoor form of eating in a free natural environment without the psychology of sitting in an enclosed space and if these spaces are not provided, it can affect the viability and comfortability of the restaurant business that may consequently bring about underutilization of the facilities as a whole. Similarly, the study identified the important spaces that affect the level of usage of outdoor dining spaces based on respondent perception. It can now be recommended that in the design of restaurant, firstly, aesthetics is a vital element that should be given good consideration, secondly the nature of seating arrangement and outdoor space configuration should be carefully and functionally integrated with the indoor spaces in order to achieve good spatial transition in the restaurant, thirdly landscape features create a feeling of comfort and refreshment and therefore should be incorporated in the design of outdoor dining spaces and finally safety is of paramount importance and should be considered in the planning of dining spaces.

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EVALUATION OF SOCIAL INTERACTIVE SPACES OF SHOPPING CENTRES IN ABUJA, NIGERIA

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Commercial activities have always been important in the operation of the built environment throughout the history of urbanisation. Apart from commercial activities, shopping centres are places that promote an inflow of people which can be utilised to serve as a space for social interactions and societal coherence. Meanwhile, significant research effort through various studies also recognized social interactive spaces do relieve stress arising from commercial activities. Yet, this has not been given much attention in shopping centres situated in many municipal areas of Nigeria. This paper investigated the adequacy of social interactive spaces provided in Abuja municipal shopping centres, Nigeria. It adopted a combination of quantitative and qualitative line of inquiry using questionnaire survey, observation schedules and case studies. Purposive sampling method was used; twenty (20) shopping centres were sampled within the Abuja municipal area council (AMAC). Findings arising from the study reveal the inadequacy of interactive spaces in selected shopping centres that could encourage social interaction and cohesion in the community. The recommendations are a need for design interventions to be tailored to the requirements of the users beyond shopping (commercial) activities as well as develop strategies for remodelling shopping centres in Abuja metropolis towards accommodating mixed-use development to facilitate greater social interaction among the users. From this point of view, the paper concludes that there is a need for redirection for designers of shopping centres to integrating social interactive spaces that can successfully generate improved public life.

Keyword: Adequacy, built environment, interactive space, shopping centres

INTRODUCTION

Social interaction is the meaningful contact people have with one another. Meaningful implies an exchange that includes real communication, even if only for a moment, and leaves each party feeling that he has shared something with another human being (Jacobs, 2009). Good places for interaction are places where people often from many parts of the community and diverse backgrounds meet naturally and interact comfortably and often pleasurably because of the nature or attraction of the space and or the activities associated with it. The concept of a space designated to social functions is known as an interactive space, also called public spaces (Morris, 2005). Public spaces including high streets, street markets, shopping precincts, community centres, parks, playgrounds, and neighbourhood spaces in residential areas play a vital role in the social life of communities. They act as a self-organising public service, a shared resource in which experiences and value are created (Mean & Tims, 2005). Public spaces offer many benefits: the 'feel-good' buzz from being part of a busy street scene; the therapeutic benefits of quiet time spent on a park bench; places where people can display their culture and identities and learn awareness of diversity and difference; opportunities for children and young people to meet, play or simply hang out. All have important benefits and help to create local attachments, which are at the heart of a sense of community(Morris, 2005).Retailing and commercial leisure activities dominate town centres, and public space can act as social glue (Holland et al, 2006). The question then beckons if the field of architecture has completely catered for the requirements of Interactive space both for its physical and mental purposes in shopping centres.

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The concept of Interactive Space

Interactive spaces in Architecture has two dimensions to them; spaces that encourages meeting and communication between two people or group of people. They are often referred to as public space because they encourage gathering. So also, interactive spaces are spaces that create real time conversation between itself and its user. This refers to the branch of architecture that deals with buildings featuring the trio of sensors, processors and effectors, embedded as a core part of its nature and functioning. Such type of architecture demands Artificial intelligence which requires two elements namely data storage and some sort of data processing capacity used for processing and memory, only digital technology can facilitate this type of conversation (Tali, 2008). This paper encompasses both but more of the former as the later only deals with embedding of digital mediums which is not much of an Architectural problem. An Interactive space is sometimes called public spaces which is a social space that is generally open and accessible to people, examples are Roads, public squares, parks and beaches (Oldenburg, 2009).

Architecture and Interactive Spaces: Recognizing the Bridge

In many regions of the world, people spend the majority of their time indoors. Americans, for example, spend approximately more than 90% of their time within buildings (Sophie, 2006). Hence, the feeling and interactions of the occupants are highly correlated with the design elements and architectural features of the built environment. In other words, the built environment provides the setting by which we live our lives, and impacts on our senses, our emotions, participation in physical activity and community life, our sense of community, and general well-being. Meanings are generated by buildings and spaces, which we read as we pass through them. Places are created and shaped by those in control of resources and with certain interests, which affects our degree of access to, and the way we use, those spaces (Butterworth, 2000). One of the important issues is the understanding and translation of these psychological and behavioral concepts into the real physical world by environmental designers such as architects, planners and urban designers. In architecture we do not use the terms “psychological needs” (Robert & Russell, 2002). The way a person can express his feelings about a space is by recognizing that it is an exciting space. It is the architect’s responsibility to design required spaces that are exciting and lively. This paper gives a brief explanation of these concepts and their relation to the physical environment.

Types of Social Interactive Space

Indoor interactive spaces include spaces like lounge, gaming arcade, food courts, lobbies, courtyards, restaurants, galleries, open spaces within the building while outdoor Interactive spaces can referred to as public spaces which may be a gathering spot or part of a neighbourhood, downtown, special district, waterfront or other area within the public realm that helps promote social interaction and a sense of community. Possible examples may include such spaces as plazas, town squares, parks, marketplaces, public commons and malls, public greens, piers, special areas within convention centres or grounds, sites within public buildings, concourses, or public spaces within private buildings.

The Importance of a good place for Interaction

According to Register, (2006) the reasons for creating good places for interaction are as follows:

- Interactive spaces help to develop a sense of community pride and ownership. Especially if worked upon together, the user can start to see them as centres of their community that belongs to them.
- It helps build a true sense of community among people of diverse origins, backgrounds, and points of view. By getting to know one another, people with different histories and assumptions can establish relationships and begin to value their differences as well as their similarities.
- Interactive spaces broaden children’s horizons through interactions with people who have different assumptions and expectations. Through contact with friends with different world views, children can broaden their own, and realize there are different ways of looking at and experiencing life, and different paths that people can take. This interaction may also increase the number of positive adult role models in children’s lives.

- Interactive spaces make the community a more pleasant place to live because more people have contact with one another. Especially in a small neighbourhood where everyone is familiar, it creates a sense of community, and leaves one with a feeling recognition.
- Interactive spaces increases safety and security. When people in the neighbourhood know one another from meeting regularly, they are more likely to look out for one another as well. That means eyes on the street, a feeling of ownership of the neighbourhood, and less tolerance of both crime and unsafe situations.
- They can improve the liveability of neighbourhoods. Good places for interaction are also good places to be. They are generally pleasant, close to or linked to services and shopping, and filled with friends or potential friends. That in itself improves neighbourhood liveability, but such spaces may also nurture the kind of neighbourhood solidarity and good feeling that leads to neighbourhood clean-ups, taking back the streets from drug dealers and gangs, and advocating for increases in services.
- Interactive spaces promote individuals' understanding of one another's culture and humanity. The humanity in people is better understood, revealing that we all are equals when it comes to hopes and fears, although these may be expressed in different ways, and our attempts to address them may be different. Diverse culture is embraced with comfort rather than a feel of threat. The exchange of food, traditions, and celebrations help to break down the barriers to the appreciation of diversity.
- Interactive spaces provide a forum for the exchange of ideas. The more people interact, and particularly the more they engage in enjoyable or substantive activities together helps to build a playground in a neighbourhood park, participating in a community celebration, the more they find out about one another, and the more they begin to understand that their goals are similar, even though their ideas about how to achieve them may be different.
- A good place for interaction increase equity. People of different economic levels mix and develop relationships, the interactive spaces in a community can provide low income people with some of the social networking opportunities that people higher up the economic ladder take for granted. The ultimate result, in some cases, may be a neighbourhood or community presenting a united front in a fight for greater equity. It can also lead to employment opportunities and other possibilities that allow lower-income people to change their lives.
- Interactive spaces are known for increasing social capital, particularly bridging social capital. Social capital is the sum totals of the benefit that people build up from their web of relationships. Bonding social capital is the advantage people develop from relationships with those who are essentially similar to themselves. Bridging social capital is that gained from relationships with people who are quite different, whether in culture, race or ethnicity, economic status, political philosophy, or all of these and more besides.
- A good space for interaction gives the chance for concerted community action and social change. The building of a sense of community can also build a sense of shared purpose. It is much easier to mobilize the community to work for change when there exists among community members a sense of fellowship and mutual respect.

Research Approach and Method

The quest for specific strategies and approach to achieve the target of this research led to the use of mixed methods research approach to find solutions to the research problem of providing an efficiently conditioned facility in a shopping centre which will enhance social interaction and cohesion in the community. Using a qualitative methodology, twenty (20) shopping centres were purposefully selected in Abuja Municipal Area Council (Table 1) as samples and case studies that typify certain characteristics of shopping centres in the study area in order to look for observed and illuminating trend in the design of the shopping centres. For more robust findings, the quantitative methodology involved 15 questionnaires administered in each sample area giving a total number of 300 questionnaires administered to randomly selected shop users in the study area. The questionnaire was developed and piloted among the targeted population of the study to note the response of the respondent to the structured question after which ambiguous and complex questions were corrected.

Table 1: showing the selected shopping Centre and their location

S/N	Name Of Shopping Centre	Location
1	Efab	Garki Area 11
2	Exclusive Stores	Wuse 2
3	Dbm Plaza	Wuse Zone 1
4	Worldmart Mall	Garki Area 1
5	Sahad Stores 1	Garki Area 11
6	Grand Square	Central Area
7	Jabi Lake Mall	Jabi
8	Dunes Centre	Maitama District
9	Purplestone Centre	Apo
10	Omega Centre	Wuse 2
11	Cedi Plaza	Central Area
12	Samfa Plaza	Wuse Zone 5
13	Next Cash And Carry	Kado
14	Jinifa Plaza	Central Business District
15	Banex Plaza	Wuse 2
16	Cappador Mall	Maitama
17	Park And Shop	Wuse 2
18	Apo Shopping Centre	Apo
19	Sahad Stores 2	Central Area
20	Silverbird Galleria	Central Area

Four point Likert scale was employed to obtain the perception and the level of satisfaction of the users. The questions were made up of a set of structured closed-ended questions and choices were selected from the given options. Required data were collected at specific periods on the sampled shopping centres to facilitate meeting the respondents at the shopping hour. Of the 300 questionnaires, 285 were returned and of this number 10 invalid questionnaires were recorded (Table 2).

Table 2: *Breakdown of Administered Questionnaires*

Respondent	Frequency
Valid response	275
Invalid response	10
Not returned	15

The data so generated was analysed using SPSS (Statistical Package for Social Scientist) and the result of the analysis were imputed into Microsoft Excel for the design of Charts that would be used for result discussions.

RESULTS AND DISCUSSION

Out of the two hundred and seventy five (275) valid respondents, 17.8% were less than twenty years (<20), 57.5% were between the age of twenty to forty (20-40) while the elderly between the age of sixty one to eighty (61-80) were 20.7% implying that the respondents were vibrant. Table 3 shows the age of respondent in the selected shopping centres.

Table 3: Age of Respondent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<20	49	17.8	17.8	17.8
	20-40	158	57.5	57.5	75.3
	41-60	57	20.7	20.7	96.0
	61-80	11	4.0	4.0	100.0
	Total	275	100.0	100.0	

One hundred and twenty seven (127) of the respondents were males and one hundred and forty six (146) were female, hence majority of the respondents were females which could imply that females go shopping more than male.

Table 4:Gender of Respondent

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MALE	127	46.2	46.2	46.2
	FEMALE	146	53.1	53.1	99.3
	3.00	1	.4	.4	99.6
	4.00	1	.4	.4	100.0
	Total	275	100.0	100.0	

The study revealed that the respondent who spends six to eight hours in the shopping Centre were just six percent (6%), those that spends over eight hours were two percent (2%), 35% spends three to five hours, 57% spends zero to two hours. Figure 2 below reveals the percentage of the time spent in the shopping Centre by the respondents.

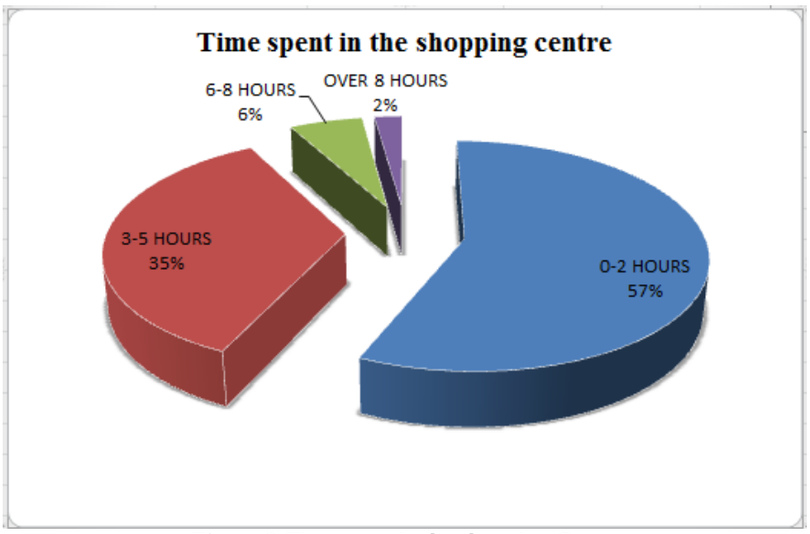

Figure 2:*Time spent in the shopping Centre*

A regimented scoring of 1-4 was given to the varying options for the respondent perception based on the variable being measured. The scoring options are Highly Effective (1), Effective (2), Ineffective (3) and Highly ineffective (4). Table 5.0 shows that majority of the respondents are spread within the effective and ineffective section of the scale of measurement.

Table 5.0: Number of respondent per opinion on Effectiveness of variables that affects interaction that was measured

Measured variable	Highly Effective (X1)	Effective (X2)	Ineffective (X3)	Highly ineffective (X4)	Total
Availability of sitting areas	40	89	67	79	275
Movement within lobbies	45	158	53	19	275
Movement of children, elderly and disabled persons	34	98	103	40	275
Ability to access different products	86	161	22	6	275
Ability to performdifferent activities	50	78	83	64	275
Wide range of dining options	31	90	98	56	275
Availability of basic amenities	38	171	49	17	275
General design of shopping Centre	63	163	40	9	275
Variety of organized events	24	51	115	85	275
Availability of outdoor eateries	27	94	76	78	275
Organization of art exhibition	17	41	79	138	275
Condition of the access road	78	169	20	8	275
Closeness to public transport	94	117	46	18	275
Navigation within the Centre	52	173	37	10	275
Multiple entry into the shopping Centre	24	108	111	32	275
Distribution of lighting	42	174	42	17	275
Background music	19	64	83	109	275

The number of respondents in each section is multiplied by the weighted score allocated to it, the calculation for this is shown in Table 6.0 and the total score across the rows are added up and presented as the total at the end of the table.

Table 6.0: Number of respondent On Effectiveness of variables that affects interaction

Measured variable	Highly Effective (X1)	Effective (X2)	Ineffective (X3)	Highly ineffective (X4)	Total
Availability of sitting areas	40	178	201	316	735
Movement within lobbies	45	316	159	76	596
Movement of children, elderly and disabled persons	34	196	309	160	699
Ability to access different products	86	322	66	24	498
Ability to performdifferent activities	50	156	249	200	727
Wide range of dining options	31	180	294	224	729
Availability of basic amenities	38	342	147	68	595
General design of shopping Centre	63	326	120	36	545

Variety of organized events	24	102	345	340	811
Availability of outdoor eateries	27	188	228	312	755
Organization of art exhibition	17	82	237	552	888
Condition of the access road	78	338	60	32	508
Closeness to public transport	94	234	138	72	538
Navigation within the Centre	52	346	111	40	549
Multiple entry into the shopping Centre	24	216	333	128	701
Distribution of lighting	42	348	126	68	584
Background music	19	128	249	436	832

The interpretation of the results obtained based on the Likert scale calculation is based on the range of scale indicated as Highly Effective (1.00 - 1.49); Effective (1.50 - 2.49);Ineffective (2.50 - 3.49); Highly Ineffective (> 3.50).It can be observed from table 7.0 that half of the Respondent said the variables that affected interaction in the selected shopping centres were ineffective, a proportion of the half said the background music and the organization of Art Exhibition were highly ineffective. The other half agreed to the effectiveness of the variables. This shows that the available sitting areas were insufficient hence showing the ineffectiveness, the lobbies were too narrow to allow for easy movement of children, elderly and disabled persons.The major activities performed in the selected shopping centre is commercial which is shopping hence the response signifying ineffectiveness of the ability to perform different activities so also is the organization of other events.

Table 7.0: Respondents' opinion on effectiveness of variables that affects interaction

Measured variable	Sum	Mean	Interpretation
Availability Of Sitting Areas	735	2.67	Ineffective
Movement Within Lobbies	596	2.17	Effective
Movement Of Children, Elderly And Disabled Persons	699	2.54	Ineffective
Ability To Access Different Products	498	1.81	Effective
Ability To PerformDifferent Activities	727	2.64	Ineffective
Wide Range Of Dining Options	729	2.65	Ineffective
Availability Of Basic Amenities	595	2.16	Effective
General Design Of Shopping Centre	545	1.98	Effective
Variety Of Organized Events	811	2.95	Ineffective
Availability Of Outdoor Eateries	755	2.74	Ineffective
Organization Of Art Exhibition	888	3.23	Highly Ineffective
Condition Of The Access Road	508	1.85	Effective
Closeness To Public Transport	538	1.96	Effective
Navigation Within The Centre	549	2.00	Effective
Multiple Entry Into The Shopping Centre	701	2.55	Ineffective
Distribution Of Lighting	584	2.12	Effective
Background Music	832	3.03	Highly Ineffective

Multiple entries were insufficient in the selected the shopping centres. This analysis shows that the general design of the selected shopping centres were effective apart from the provision of interactive spaces and activities .It is imperative to examine the level of adequacy of the interactive spaces provided in the selected shopping centres, so also it was stated by (Tracy, 2005) that, in order to provide spaces in any building, the knowledge of the users in relation to the building is important. This will aid in reasonable space allocation so as to achieve a functional building, this explains why the analysis on satisfaction of the interactive space should be made before giving a recommendation on its integration in shopping centres. Table 8. Shows Respondents opinion on satisfaction of existing elements that make up the social interactive spaces under this study. The interpretation of the results obtained based on the Likert scale calculation is derived from the range of scale as follows: Very satisfied (1); Satisfied (2); Dissatisfied (3) and Very dissatisfied (4).

Table 8.0: Shows Respondents opinion on satisfaction with the interactive spaces provided

Measured Variable	Very Satisfied (X1)	Satisfied (X2)	Dissatisfied (X3)	Very Dissatisfied (X4)	Total
Restaurant	50	151	42	32	275
Café	8	67	89	111	275
Sitting area	22	90	78	85	275
Open spaces	44	151	48	32	275
Courtyard	13	58	94	150	275
Pool	1	15	59	200	275
Garden	13	38	63	161	275

Concert spaces	6	60	80	129	275
Pedestrian path	14	168	54	39	275
Fitness Centre	10	16	77	172	275
Lounges	14	62	60	139	275
Galleries	12	31	74	158	275
Games room	15	49	46	165	275

In determining the satisfaction of the option for each measured variable the weighted score was also divided by the number of valid respondents for each section and the value is presented. As shown in Table 8, in the same way analysis was made in table 5, 6 & 7 above. It can now be observed that all the measured variables in Table 8.0 are all inadequate based on the interpretations made hereunder.

Table 9.0:Sum of Responses on Opinion of Satisfaction of users on the interactive spaces provided

Measured Variable	Very Satisfied (X1)	Satisfied (X2)	Dissatisfied (X3)	Very Dissatisfied (X4)	Total
Restaurant	50	302	126	128	606
Café	8	134	267	444	853
Sitting area	22	180	234	340	776
Open spaces	44	302	144	128	618
Courtyard	13	116	282	440	851
Pool	1	30	177	800	1008
Garden	13	76	189	644	922
Concert spaces	6	120	240	516	882
Pedestrian path	14	336	162	156	668
Fitness Centre	10	32	231	688	961
Lounges	14	124	180	556	874
Galleries	12	62	222	632	928
Games room	15	98	138	660	911

The interpretation of the results obtained based on the Likert scale calculation is based on the range of scale indicated as Very Satisfied (1.00 - 1.49); Satisfied (1.50 - 2.49); Dissatisfied (2.50 - 3.49); and Very Dissatisfied (> 3.5). The social interactive spaces provided in all the shopping centres studied were not satisfactory. This can be observed from Table 10; most of the users are unsatisfied with the leisure spaces provided. This implies that designing a shopping centre with functional social interactive space becomes very necessary, taking into consideration the interactive spaces needed by users which were analyzed above in table 8.

Table 10.0: Respondents' opinion on satisfaction with the available interactive space data interpretation

Measured Variable	Sum	Mean	Interpretation
Restaurant	606	2.20	Satisfied
Café	853	3.10	Dissatisfied
Sitting area	776	2.82	Dissatisfied
Open spaces	618	2.24	Satisfied
Courtyard	851	3.09	Dissatisfied
Pool	1008	3.67	Very Dissatisfied
Garden	922	3.35	Dissatisfied
Concert spaces	882	3.21	Dissatisfied
Pedestrian path	668	2.42	Satisfied
Fitness Centre	961	3.49	Dissatisfied
Lounges	874	3.18	Dissatisfied
Galleries	928	3.37	Dissatisfied
Games room	911	3.31	Dissatisfied

In addition, measured variables such as Café, Sitting area, courtyard, garden, concert spaces, fitness centre, lounge, galleries and games room were dissatisfactory; however, pool has the strongest value for dissatisfaction from the interpretation in table 10. This could be linked to the fact that there was no predetermined design consideration for the social interactive spaces in the preconceived design stage of the shopping centres. One of the major factors in interaction is the space provided for an individual to socialize and the location of such spaces, because of individual difference in personality. This therefore gives the need to examine the type of interactive spaces provided in the shopping Centre; this is an important tool to be used in determining the adequacy of such space. In the course of this research majority of the respondents stated that the interactive spaces were outdoor.

Figures 3 and 4 revealed that 5% of the shopping centres studied had a well prone garden, gaming arcade, dance class, 15% provided for karaoke band, 20% had an averagely adequate sit out provisions, 15% with lounges and also Cinema, fitness centre, concourses where not provided hence they were 0%. 65% of the selected shopping centres have no interactive

space. This goes to show the gross inadequacy of the social interactive spaces in the selected shopping centres. As regards location of the interactive spaces, figure 5 shows that fourteen of the selected shopping centres incorporated majority of their interactive spaces outdoor, two of them located theirs majorly indoor and three of them made provision for both indoor and outdoor. From the research done, it was observed that users prefer a balance in the location of the interactive spaces; both indoor and outdoor, this will enable buyers easily locate a space for both relaxation and interaction after a stressful shopping experience or after a hectic day at work.

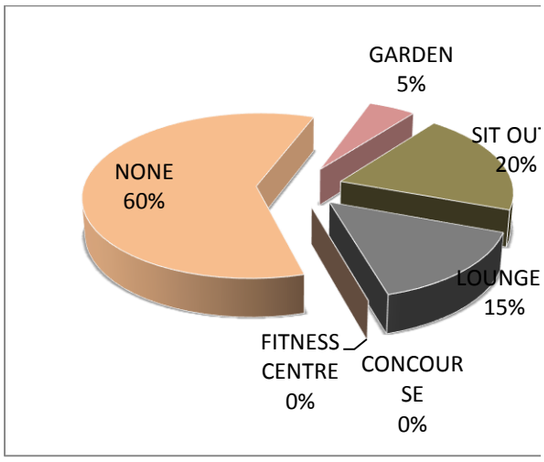

Figure 3: Type of interactive space provided

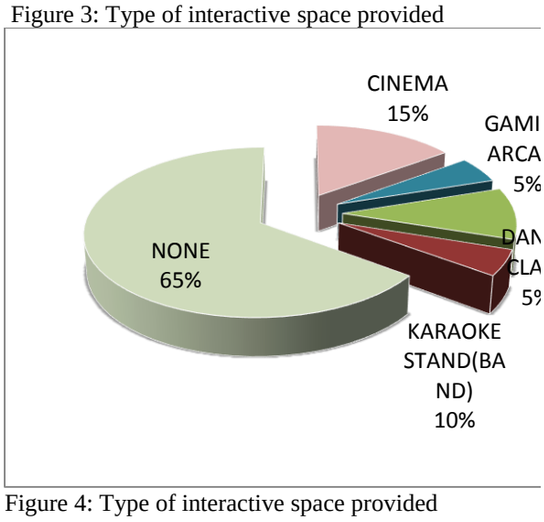

Figure 4: Type of interactive space provided

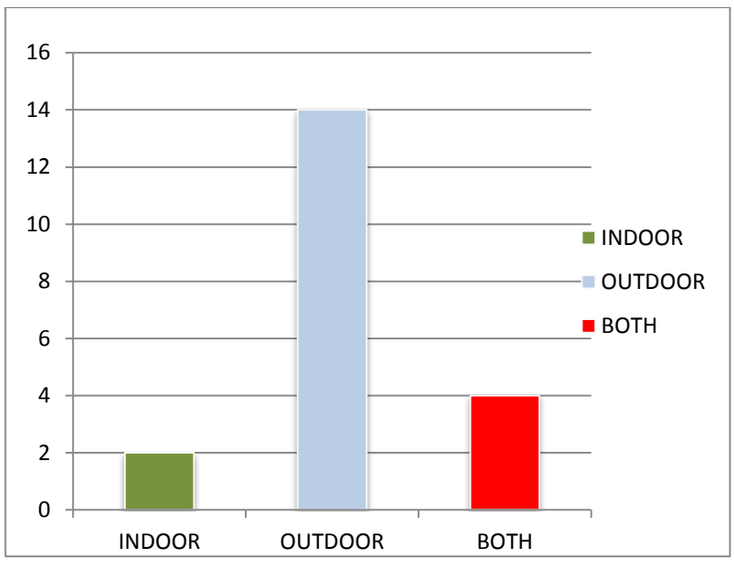

Figure 5: Location of Interactive Space Provided

The productivity of the users would increase with provision of interactive spaces was a premises assumed at the onset of this research, and the figure 6 shows that most of the respondent concurred. Majority of the respondent admitted that the social interactive spaces help them attain a certain level of productivity at work after each visit. 70% of the respondent answered yes to social interactive space being a source of motivation for their productivity at work and 30% answered No.

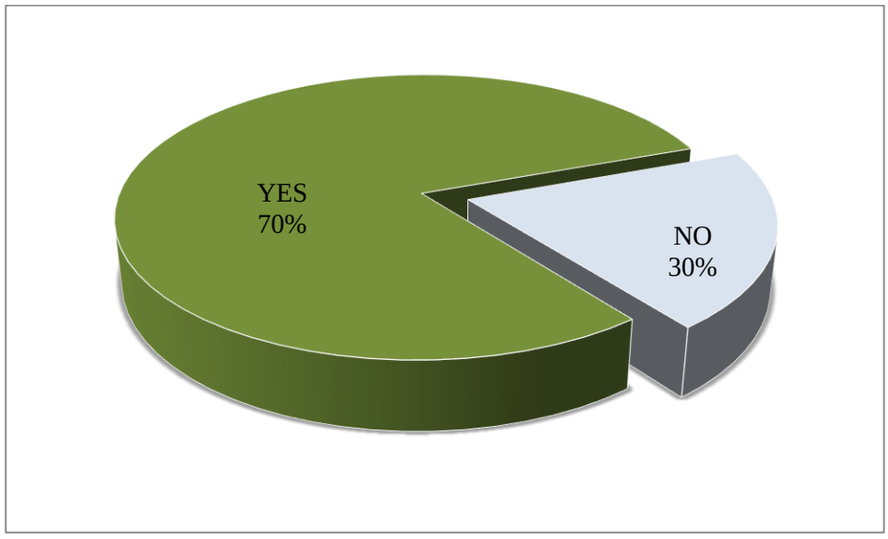

Figure 6:*interactive spaces and user productivity*

Recommendations and Implications for Practice

Evidence from this study suggests that the contestation of spaces, variety and the need for unregulated spaces are inevitable and necessary in the design of shopping centres. This study showed that shopping centres in Abuja municipal area provided places for just the basic and the mundane while important functional (i.e. interactive) spaces are overlooked thus missing out innovative and dynamic-looking places. Thus, this study recommends that cost-effective integration of interactive space should be made to enhance their design simply by breaking up the current trend of monotony found in many shopping centres designs. In spite of the fact that interactive spaces increases safety and security through familiarity gained from constant meet ups, passive security measures should still be considered but done succinctly to ensure maximum relaxation by the users. Furthermore, attention should be given to other interactive elements such as lighting, accessibility, entertainment and other pull factors which will make a huge difference in the enhancement of shopping centres.

CONCLUSION

This study establishes that while there are interactive spaces provided in the shopping centre visited, the interactive spaces provided are grossly inadequate per the wants of the users. The users of the selected shopping centres want social interactive spaces subconsciously;

however the present spaces do not cater for this particular need. It was noticed that there were spaces that were redundant but still not used for social interaction because they were not preconceived at the design stage; the courtyards were let bare without provision of seating. The only forms of interactive space found in many shopping centres observed in the study area were the provision of mini benches along the lobbies. The provision of additional furniture such as couches to support relaxation when users are not shopping would enhance interaction and also improve their comfort level. Individuals are considered different so is their preferences; this is why it is necessary to provide diverse options of interaction possibilities for users. The results indicated that there is need to have more appropriate design that suited integration of interactive spaces. Since the want of the users is beyond shopping activities in shopping centres it is recommended that the development of shopping centres should be accompanied by interactive facilities for the benefit of the users. Spaces such as lounges, gaming arcade, galleries should be provided for interactions which would offer indoor relaxation and socialisation possibilities for the Users. Spaces such as a garden, food courts, pool side, and defined concourses should be provided for outdoor interaction.

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PREFERENCE AND COMPATIBILITY: AGEING IN PLACE LIMITATIONS IN NIGERIA

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Studies have shown that interest of sourcing for better living reduces with growing preference of staying put at same locality as a person grows older. Meanwhile, the peculiarity of ageing process could necessitate the need for modification and/or relocation within the spatial configuration of the house. This study assessed the living standard of the old people by investigating the effect of progressive ageing on the indoor space syntax in Akure core residential area. This was done to ascertain if the preference is in tandem with the concept of ageing in place in Nigeria. Data were collected through structured interview aided by a voice-activated tape recorder to record each respondents' responses. The data collected were then transcribed alongside the observation notes. Descriptive statistic was used to process the data obtained from the close-ended questions and content analysis for the open-ended questions; which were categorised according to their similarity for corollaries The result revealed a contrast between aged preference and the idea of ageing in place concept in Nigeria. The need for regular evaluation performance was proposed among many others.

Keywords: Ageing in place, Indoor space, Nigeria, Old people

INTRODUCTION

Ageing in place policy involves providing an age-friendly environment suitable to support older people to live actively and independently, a practice that has been enormously embraced in the developed countries to tackle ageing issues (DCLG, 2008; Wiles et al, 2011). It is a policy where preference is complimented by compatibility. This policy was formulated due to the growing interest of old people to remain in same locality throughout their stay in life. Some of the possible reasons why old people may prefer to remain in same locality could be long neighbourhood familiarization that has resulted in space attachment, family structure, or personal challenges (Wiles et al, 2009).The world became smaller and the geographical scope of coverage works inversely as people increase in age, thereby affecting the carrying out of their daily activities (Shaw *et al.*, 2007; Oh et al, 2009). As people grow older, they experience frail in strength and agility which are sometimes made worse by physical and health challenges (Okojie, 2010). Thus, eventually result in the need for some form of care, assistance and sometimes special attention from their families to carry out daily functions (Onanuga et al, 2016).However, recent studies have shown that most of these old people live alone due to fiscal challenges. The children are that supposed to care for them have gone out of nest in search for better economic advantages, educational opportunities, and diversity of experiences (Omokaro et al, 2011; Onanuga et al, 2016). In return, living has become challenging as these old people have by their conditions depended solely on the neighbourhood and the house indoor space configuration rather make them more dependent. Familiarity caused by consistent lifestyle over time to augment a challenge could cause old people to rather prefer staying at their present dwelling, and this could have been misinterpreted as they rather enjoying the space. In another word, the old people may not like where they live but be contented since they have mastered the environment to reduce their level of dependency. Thus, this study investigates the living condition of the aged in Akure to understand the reason for their preference for continuous residence in the same locality and how compatible is their housing situation to successful ageing.

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REVIEW OF LITERATURE

The preference to age in place by old people led to widespread adoption of 'ageing in place' policies in most advanced countries (DCLG, 2008). An age-friendly environment has been identified as the aiding force to ageing in place as it supports older people to live actively and independently in their immediate communities. The idea of age-friendly communities was developed by the World Health Organization through the Global Age-Friendly Cities Project launched in 33 cities in 2005 (WHO, 2007).

It focuses on enabling active and healthy ageing by improving the age-friendliness of physical (transport, outdoor spaces and buildings) and social (social participation, communication and information, community support and health services) environments in communities (WHO, 2002; WHO, 2007).

The wellbeing and independence at old age are associated with how active the aged maintain their usual lifestyle in the environment. Inclining with the understanding of activity and continuity theories, it ascertains that optimal ageing involves staying active and managing to resist the contraction from the society through a continuous life pattern across a lifetime (Neugarten, Havighurst, and Tobin, 1961; Havighurst, 1972; Atchley, 1989).

This continuity and the connection to the past are maintained through a furtherance of well-established habits, values and interests that are integral to the present lifestyle in the physical environment lived in. Therefore, ability of an environment to support continuous lifestyle could inform the wish to stay permanently in a locality.

Studies have shown that the challenge posed by the building indoor design at old age has been augmented through family support in fulfilling some of the daily activities (Gilleard, 2007; Golant, 2008; Onanuga et al, 2016). Since the children have flown off the nest, there could be constraint and difficulties in the navigation within the indoor space the aged lives due to the challenges associated with ageing. For instance, there is always increasing sensitivity to the level of indoor illumination, the height of a floor riser, proximity to spaces, among others at old age, which may not have been a subject of concerns at an earlier age.

Thus, it sometime becomes important to also adjust the indoor space syntax to reconcile the disparity between the aged present need and the indoor space arrangement. These adjustments may take different forms, including the revision of housing needs and aspirations or improvement of housing conditions through housing transformation or residential mobility that brings housing into conformity with users' aspirations or needs (Mohit et al., 2010; Aduwo, et al, 2013).

Staying in same locality may also not be a wish, the old aged may be stuck in the locality due to different challenges such as financial incapacity, neglect by family, or health challenges to mention a few. Since the old peoples' preference to stay in same house and or locality could have conceived several assumptions, there is need for investigation that will unveil the true perspective of the aged in Nigeria, hence this study.

METHODOLOGY

An interview that follows a structured questionnaire was adopted to source information from the respondents. The structured questionnaire was in two sections as some of the questions required response to options, while detailed explanations were required for some others. The section with close-ended questions was used to explore the socio-economic characteristics of the respondents and the section with the open-ended question was used to extract information as regards the salient objectives of the study. The study also adopted the review of relevant literature which allowed for an in-depth knowledge of factors underpinning respondent's views to give credible and valid results.

The study was carried out at the core residential areas of Akure, comprising: Isolo, Kajola, Ijomu, Odo-Ikoyi, Oshodi, and Araromi communities (as indicated with red line on the map in figure 1). Akure is the state capital of Ondo in the South Western zone, one of the six geopolitical zones which make up Nigeria. Akure is the economic nerve centre of Ondo State and a leading producer of mineral resources and food crops in Nigeria. It is located on the intersections of Latitude 7^{o} $15^{`}$ N and Longitude $5^{o}$ $15^{`}$ E. (Fig 1).

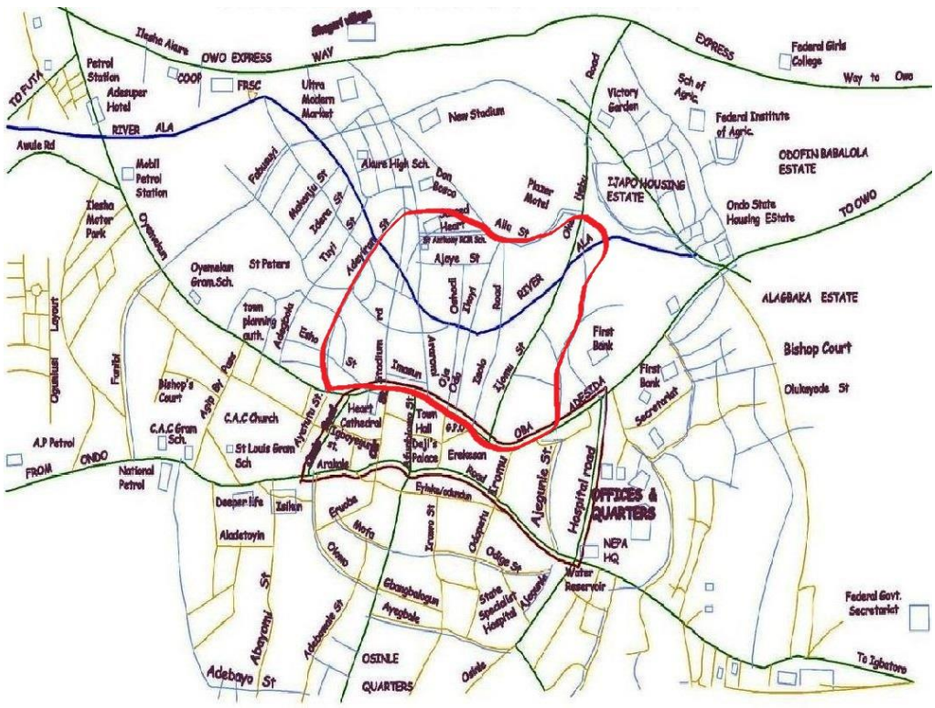

Figure 1: Map of Akure showing the study area
Source: Ondo State Ministry of Lands and Housing, Akure; 2010

All the interviews took place in the residents' homes. Observations of the participant, the activities, the setting for interviews and their expressions were utilised. A voice-activated tape recorder was also used to record each resident's answers so as to capture all the responses. The data was then transcribed along with observation notes. The structured questions encapsulate the participants living condition and wellbeing. Subsequently, a descriptive statistic was used to process the data obtained from the close-ended questions and content analysis for the open-ended questions which were categorised according to their similarity for corollaries.

The residential apartment that houses older adults aged at least sixty years (60 years) within the communities in Akure were targeted. All the streets within the study area were sampled. From the reconnaissance survey, the total number of the apartments housing the older adult aged at least sixty years was ninety-eight (98) buildings. All residents aged at least 60 years in the selected buildings were approached for an interview and 70% of them agreed to be interviewed. Each interview lasted an average of fifteen minutes (15 minutes).

RESULT AND DISCUSSION

Typical of the respondents

Majority of the respondents are indigenes of Ondo state and where also brought up in the locality. Some of the respondents keeps social contact with the world around them through the attached kiosk or shop at the front of their houses. Most of them are not educated, although very few of them still understand a little of English-based pidgin and creole language spoken as a lingua franca across Nigeria. Therefore, the local dialect was used as means of communication to all the respondents.

Demographic statistics of the respondents

Table 1 shows the summary of the background information about the respondents. There were more female (62%) than male (33%) adult in the study area. It was also observed from the table that 32% of the respondents resided alone, while 28% resided either with their spouse or with their extended family. The age distribution of the respondents revealed that majority (78%) were aged more than 65 years, and only 22% were aged between 60 and 65 years.

The respondents' tenure status indicated that only 30% were owner occupiers, 48% were residing in a family house owned by either their spouse's parents (comprising mostly female respondents) or owned by their extended family; while 16% were renters.

Table 1: *Demographic detail of the Aged interviewed in the study area*

Variables	Frequency	percentage
Gender		
Male	19	38
Female	31	62
Total	50	100
Age		
55-65	11	22
66-75	11	22
76-85	15	30
Above 85	13	26
Total	50	100
Household structure		
Alone	16	32
With spouse	14	28
With adult child	06	12
With family	14	28
Total	50	100
House ownership		
Respondent	15	30
Family house	24	48
Adult child	03	06
Rented	08	16
Total	50	100
Impairment		
Bad sight	03	06
Bad sight/disable	17	34
Bad sight/morbidity	15	30
None	15	30
Total	50	100

Source: Field survey, 2016

The house structure and its' state of liveability

It was observed that majority of the residential apartments in the study area were old with 80% of the buildings needing one level of repair or the other (see plates 1, 2 and 3). Table 2 revealed all (100%) sampled buildings were tenement buildings, which usually consists of unit rooms adjoining both sides of a connecting passage, with shared unit kitchens and toilets at the rear. The kitchen and the toilet could either be attached to the building or detached from the building. Since the majority of the population are in the low-income category, they live in tenement properties because of its low rent, though many of such properties lack basic infrastructure. Even the house owners only do occupy two room from like ten (10) to twelve (12) rooms the building usually contain, depending on the design. Other room spaces are mostly let out to generate income. The quality of the housing in the study area is quite low in terms of building materials used, planning standard and construction technology (see plate 1, 2, and 3).

Plate 1

Plate 2

Plate 3

The common type of toilet facilities at the core is pit latrine built side by side with the kitchen space (see plates 2&3). This suggests that the aged in the study area live in housing condition that is characterised by overcrowding, unhygienic and building with a structural defect.

Table 2: Building condition

Variables	**Frequency**	**percentage**
Dwelling type		
Bungalow	31	62
Storey	19	38
Total	50	100
Building type		
Tenement	50	100
Studio	--	--
Two bedroom	--	--
More than 2 bedroom	--	--
Total		100
Available spaces		
Living room	19	38
Bedroom	50	100
Kitchen	50	100
Toilet	50	100
Bedroom positioning		
Ground floor	42	84
Upper floor	08	16
Total	50	100
Toilet/Kitchen positioning		
Attached	16	32
Detached	34	68
Total	50	100
Years spent in apartment		
1-10	11	22
11-20	09	18
20-30	07	14
Above 30	23	46
Total	50	100
Residence perception of their residence		
Stay	09	18
Relocate	14	28
Stuck	27	54
Total	50	100
Building status		
Structurally sound	10	20
Need minor maintenance	24	48
Need major maintenance	16	32
Dilapidated	0	0
Total	50	100
Level of repair		
Renovation	34	68
Rehabilitation	16	32
Demolition	0	0
Total	50	100

Source: Field survey, 2016

The condition of the buildings the aged reside in can, therefore, be said to have a relatively low habitability, which has direct effects on their state of health, socio-economic well-being and emotional stability. Consequently, having the majority of the respondents not satisfied with their living status in table 2 is expected, as 54% of them indicated that they feel rather "stuck in place."

Assessment of the aged space preference and state of satisfaction

Table 3 and Table 4 revealed the respondents' preferences and level of satisfaction to the spaces they most identified with. These spaces are the living room, bedroom, kitchen and toilet spaces. The respondents referenced that most of their daily activities were done in those spaces. The findings in Table 1, as earlier mentioned, revealed that about 70% of the respondents aged above 65 years suffered visual impairment. Meanwhile, the design configuration of their buildings have rooms arranged in a row double banked lobby that could be as long as twelve metres (12m) depending on the number of rooms on each side.

The possible lighting to this lobby comes either from the entrance door from the porch or through the exit door towards the back of the house. Majority of the rooms are not cross ventilated, badly oriented, yet the community is also a victim of erratic electric power supply that engulfs Nigeria as a whole. That is why the respondents' assessment of indoor visual quality for the four spaces are not satisfactory as shown in Table 3. Consequently, the poor quality of lighting in the interior has made it difficult for those adults with poor vision to navigate their indoor environment to perform their daily activities. Therefore, they remain more dependent on their family and neighbours.

Table 3 revealed that all the respondents ranked the kitchen among the space of high importance to their daily needs. From table 2, it is observed that 68% of the houses studied have the kitchen and the toilet detached completely from the building (see also plates 4&5). Table 1 also revealed that only 30% of the respondents neither had bad sight nor suffer any disability. This shows that about 70% of the respondents having an impairment pass through the stress of navigating from their room to the detached kitchen and toilet daily.

This cannot have been stress-free without help from family or neighbours. Apart from the proximity issues, the respondents also express their dissatisfaction towards the numerous number of users of the spaces, the lifestyle of the different users, and level of privacy to their utensils. Although some of the older adult expressed their contentedness with the routine and the use of the space, majority, however, complained that their inability to walk properly poses major challenge. Therefore, having the kitchen and toilet spaces closer to their bedroom would have improved their level of independence and satisfaction.

Plate 4: Kitchen/toilet positioned beside a rear side of the building

Plate 5: Kitchen/Toilet positioned at the residence

The majority (70%) that either live in the family house or rented their apartment are the ones that express dissatisfaction with the bedroom size. They complained that their younger co-residents have many young children that often disturb them with their noise, thus depriving them of good rest required at their age. Close to three-fifth (58%) of the respondents were not satisfied with the size of their kitchen, while 54% found their toilet space only tolerable.

Although, these aged might wish to age in the house they have been conversant with for many years, the condition of the environment does not support ageing in place. Their inability to relocate or rehabilitate to suit their present need at old age due to their tenure status or income capacity make their continued stay in the neighbourhood a result of 'being stuck' in the place rather than ageing gracefully in the place.

Table 3: The Aged view of space importanceVariables	Important	Percentage %	Not important	Percentage %
Bedroom	50	100	--	--
Living room	50	100	--	--
Kitchen	50	100	0	--
Dining	8	16	42	84
Toilet/bath	50	100	--	--

Source: Fieldwork, 2016

Table 4: The Aged level of satisfaction of their interior spaces

	Variables	Satisfactory (%)	Tolerable (%)	Not satisfactory (%)
Bedroom	Space size	30 (60)	18 (36)	2 (04)
	Accessibility	24 (48)	03 (06)	3 (06)
	Functionality	16 (32)	07 (14)	27 (54)
	Visual	0 (0)	12 (24)	38 (76)
Living room	Space size	17 (34)	02 (04)	04 (08)
	Accessibility	19 (38)	0 (0)	0 (0)
	Functionality	0 (0)	08 (16)	11 (22)
	Visual	0 (0)	05 (10)	14 (28)
Kitchen	Space size	14 (28)	7 (14)	29 (58)
	Accessibility	5 (10)	7 (14)	38 (76)
	Functionality	14 (28)	0 (0)	36 (72)
	Visual	0 (0)	12 (24)	38 (76)
Toilet	Space size	14 (28)	27 (54)	9 (18)
	Accessibility	5 (10)	6 (12)	39 (78)
	Functionality	17 (34)	0 (0)	33 (66)
	Visual	0 (0)	12 (24)	38 (76)

Source: Fieldwork, 2016

Summary of findings

This study has helped to unfold the challenges of the old citizen in the resident they aged in. the challenges identified by this study cut across the aged themselves, the housing condition and the interior spaces used by them.

The study showed as regards the respondents that majority of them are well above 65 years of age with only 30% percent of them been without an impairment such as bad sight, morbidity or disability. Also, majority of them lack proper rest, privacy to mention a few due to the type of housing facility they occupy. The study revealed that they all reside in a tenement type of house design due to the inadequacy in their income capacity to get a better accommodation.

Regarding the condition of the house the aged occupy, the study revealed that majority of the houses lack basic infrastructures and requires renovation. The houses were built with low quality materials and construction technology with detached kitchen and toilet, which the majority is pit latrine. In summary, most of the houses are overcrowded, unhygienic, has structural defect and general not habitable.

The interior spaces are characterized by poor visual quality due to the house design type, poor ventilation and interior planning due to bad building orientation, bad proximity to toilet and kitchen facilities made worse by their health challenges and inadequate bedroom size due to space constrain. Most of the respondents were not satisfied with their kitchen and toilet. Prominent among reasons given for their dissatisfaction were lack of privacy, poor state of maintenance and habitability of the spaces.

This suggests they would have preferred a kitchen that improves privacy and a toilet that is closer to their bedroom. However, some of the respondents were of the opinion that although the toilet should be attached to the main house, it should not be close to their bedroom. Most of the respondents in this category use their bedroom for all their activities: lounge, kitchenette and dining. They, therefore, found the idea of the toilet being moved closer to their rooms ‘very repulsive’. However, it may be conclusively stated that the challenge of space constraint compelled their using their bedrooms for multiple uses.

It could, therefore, be conclusively stated that most of the old adults sampled in this study are stuck with the old model houses that will not easily accommodate the changes that

accompanies getting older due to poor construction material used, homeownership status and prohibitive cost the modification could require among many other reasons.

CONCLUSION

The study revealed that most of the buildings in the study area are not designed to support the needs of people over age 65 years. The study has also revealed that the houses sampled need internal restructuring in form of incorporating decent kitchen, toilet and bath facilities within buildings for convenience of the senior citizens. It is also revealed that majority of the sampled residents were in the low-income category, hence, could not adequately provide the required financial resources to do required building amendments.

There is therefore the need to develop a framework for the incorporation of the aged community into urban development. This is proposed with the view of enhancing the older adults' independence and wellbeing by formulating a theoretical and operational framework which will make key decision-makers in the building industry to consider how well the aged can fit into the development of a community and also create the avenue for service delivery of plans designed to assist them.

Also, there is need to develop affordable low cost housing and payment schedule that the people with financial disability can benefit from so as to have a habitable housing to themselves. A regular performance evaluations on provided housing units is highly suggested at close intervals as this could serve as feedback on the extent at which the buildings meet the need of the people, particularly at old age.

Further research can be done on ageing in place limitation through the rigidity of design and its odds considering the material characteristic of the building. Also, this research can be furthered to investigate the extent of modification that can be done on existing structure and its implication on the structural stability of the building.

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ASSESSMENT OF INTERACTIVE SPACES IN HIGH RISE RESIDENTIAL BUILDING IN LAGOS CITY, NIGERIA

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High rise residences cater for different societal issues of which housing a sizeable number of people within a minimum floor area is a major challenge especially where land availability is a problem. However, most designs of high rise residences hardly provide for interaction amongst its users especially within the building complex. Informal interactive spaces such as lounges, swimming pool, outdoor sports arena, gardens and parks are some of the spaces humans interact socially. This research is aimed at assessing the different informal interactive spaces present in different high rise residences and to ascertain how accessible it should be to the users. In carrying out the objectives, five (5) high rise residences were selected from Victoria Island and Ikoyi which are the major hub for high rise residential apartments and data are collected through direct observation while secondary data were gotten from relevant literatures reviewed. The data gathered were thereafter analysed with the use of Microsoft excel and due deductions were made from the findings. Thereafter, conclusion was drawn as to the need for informal interactive spaces to be an integral part of high rise residential design. It is however recommended that interactive spaces should be adequately integrated into high rise residence and be easily and equally accessible to the users of the buildings.

Keywords: community, high rise residence, human life, informal interaction, spaces.

INTRODUCTION

Human beings are social animals and as such they interact with one another either formally in places such as the working environment, official gatherings, lecture rooms or lecture theatres or informally at sport arenas, gardens and parks and most other common public spaces. These public spaces can be called human open living room as they are all around us and they form an important and integral part of our daily lives (Wooley, Rose, & Stuart, 2003). This is a pointer to the fact that the public spaces or rather interactive spaces, create avenues for people to socialize, this in turn improves the social fibre of a community or society as it were. However, recent study by Kaur & Narayan (2017) has shown that these open spaces are hardly provided within high rise residential apartments, thereby reducing effective social interaction amongst the occupants of such apartments in other words decreasing the liveability of the residents. It was further argued that open spaces are the best solution to make the apartments more habitable and liveable. In 1984, the government of Taiwan created policies that promoted more open spaces and indeed courtyards to be designed as part of many floors in buildings and intensifies the frequent use of this idea among builders (Huang, 2006). For instance in Taiwan, 51.67% of residence living in metropolitan high rise complexes are not satisfied with their living environment and top on their dissatisfaction list is the lack of open spaces (Wang & Chien, 1999).. As rightly said by Garling & Golledge, (1989) public spaces in high rise buildings are a very important part of the environment which enhances the establishment of social interaction and recognition among residence of the apartments.

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It is therefore clearly safe to say that interactive spaces should be an integral part of high rise residential designs. Let us take a look at some of the interactive spaces that can enhance healthy relationships amongst residents of high rise apartments:

i. Swimming pool

The value of aquatic centres such as swimming pools to human lives cannot be overemphasized. Aquatic and recreational centres alike are mainly created to address the health and fitness benefits of people using the facilities by providing a range of health and fitness services that basically inspire and encourages users to live a healthy happier lives (John et al, 2014). In their research however, it was further deduced that the users of these facilities felt safe at the centre and were quite trusting of others in the centre. This is of course will enhance a sizeable social interaction amongst users of such facilities.

ii. Parks/gardens

Planning gardens into living spaces is of immerse importance as believed by Kozechian, et al (2012). They also further affirmed that locating these recreational gardens should be planned such that they are easily visible and accessible to their users be it in health care centres or even in residential areas. The design of such facilities when incorporated into residential neighbourhoods, should take account of the age grades of its users and as such there should be varieties of such gardens to cater to the different age needs and privacy alike.

iii. Sport centres

Sport that is undertaken freely such that the participant is not being paid for to perform the sporting activity as a professional can be seen as a part of leisure. Thus, a leisure-sport centre or rather called sport centre is a space within or outside a building where sporting activities and its spectators visit to engage in spectating or in the sporting activity itself (Lee, 2003). These sporting arenas usually create avenues for social interaction amongst its users and as such should be an integral part of the planning and design of residential apartments including the high rise residents.

Other interactive spaces that support social interaction amongst residents of high rise buildings include; Lounges, civic halls, gyms, pedestrian walkways amongst others. All these in one way or the other increases the chances of residents to meet and interact through the spaces created by these facilities.

Study Area

As a major commercial nerve centre of the country, Lagos state boast of a population of about 17.5million people (Lagos Population , 2017) and is also one of the most developed states of the federation. Due to the large water bodies surrounding major parts of the city (especially the islands), it offers a tranquil and serene hub for the erection of high rise buildings as the waters obviously provides great view to occupants of such buildings. It is therefore of little surprise that most of the high rise buildings (including high rise residential apartments) are more commonly situated in the Lagos Islands.

METHODOLOGY

The primary source of data collection was from direct observation gotten from the sites of the various high rise apartments studied. For this study, five high rise residential apartments are researched into and they are:

- Eko court towers, Victoria Island Lagos
- South American Petroleum (SAPETRO) towers, Victoria Island Lagos
- Federal housing complex (a.k.a. 1004 apartments) towers, Victoria Island Lagos
- Tango towers, Ikoyi Lagos
- Bar beach towers, Victoria Island Lagos

The studied apartments were randomly selected from across the main hub of high rise residences in Lagos which are basically Victoria Island and Ikoyi Island. Federal housing complex (popularly known as 1004 towers) and Eko court towers were sampled from the North-Central axis of Victoria Island, while Bar Beach towers stands at the South-Western part of the Island. SAPETRO towers graces the Western Victoria Island while Tango towers

is on Ikoyi Island off the shores of the famous 5 cowry creek. The studies carried out on these towers were documented in an observation schedule as the various informal interactive spaces present were assessed. Secondary data were however collected through the review of related literatures.

DATA AND DISCUSSION OF RESULT

Interactive spaces present at the study area

The table below shows the types of interactive spaces present at the various studied buildings as extracted from the observation schedule

Table 1: Informal interactive spaces present

NAME OF HIGH RISE APARTMENT	SWIMMING POOL	ROOF GARDEN	PARKS/ GARDENS	OUTDOOR SPORT CENTRE	LOUNGE	CIVIC HALLS/SPACES	GYM	DEFINED PEDESTRIAN WALKWAYS
EKO COURT TOWERS	✓		✓	✓	✓			✓
SAPETRO TOWERS	•	•	•	•	•	•	•	•
1004 APARTMENT TOWERS	✓	•	✓	✓	✓	•	✓	✓
TANGO TOWERS	✓	✓	•	•	✓	•	✓	•
BARBEACH TOWERS	•	•	•	•	•	•	•	•
TOTAL	3	1	2	2	3	0	2	2

Source: field survey 2017

From the table 1, it can be deduced that three of all buildings studied has swimming pool and two has either of parks/gardens, outdoor sport centre gym or defined pedestrian walkways. Even though the swimming pool arena hardly allows much people to interact at the same time, it is still one of the most present informal interactive spaces as it is a pretty comforting and relaxing environment to easily unwind and interact. Roof gardens are usually quite expensive to maintain as such, it is however of little surprise that only one of the high rise buildings studied has roof garden. Figure 1 shows the representations of table 1 in a pie chat, indicating the number of informal interactive spaces present at the study areas.

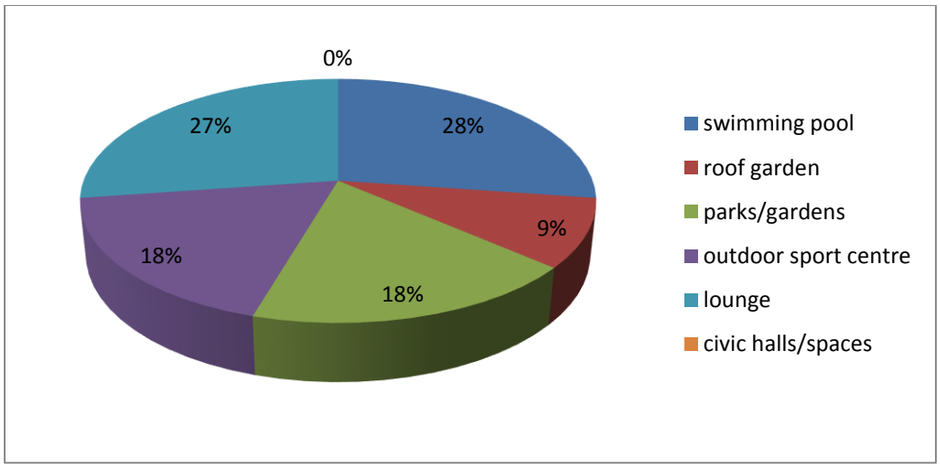

Figure 1: Percentages of interactive spaces present at the study areas *Source: field survey 2017*

It can be deduced from the chart above that swimming pools and lounges are the most common informal interactive spaces present among the studied buildings with a 28% and 27% rate respectively while civic halls/spaces is never present in any of the buildings.

Plate1: Park/garden at Federal Housing complex (1004 towers) V.I. Lagos *Source: field survey 2017*

Plate 2: Lawn tennis court at Eko court Towers, V.I. Lagos *Source: www.hutbay.com*

Plate 3: The gym hall of Tango towers *Source: field survey 2017*

Plate 4: The swimming pool arena in Tango Towers Ikoyi Island, Lagos
Source: www.hutbay.com

Plate 5: A section of the Bar beach towers site V.I. Lagos
Source: field survey 2017

Plates 1-5 have shown the different types of informal interactive spaces in pictures. Most of the spaces shown here have ample spaces for informal interaction except for plate 5 which illustrates a space in bar beach towers with no defined interactive space.

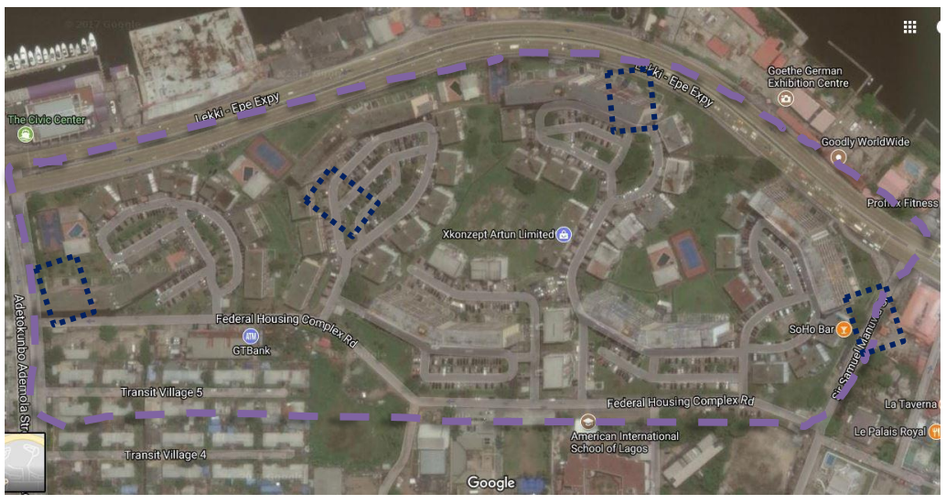

Plate 6: The site layout of Federal Housing Complex (1004 towers) highlighting the swimming pools with proximity to the residences *Source: google map 2017*

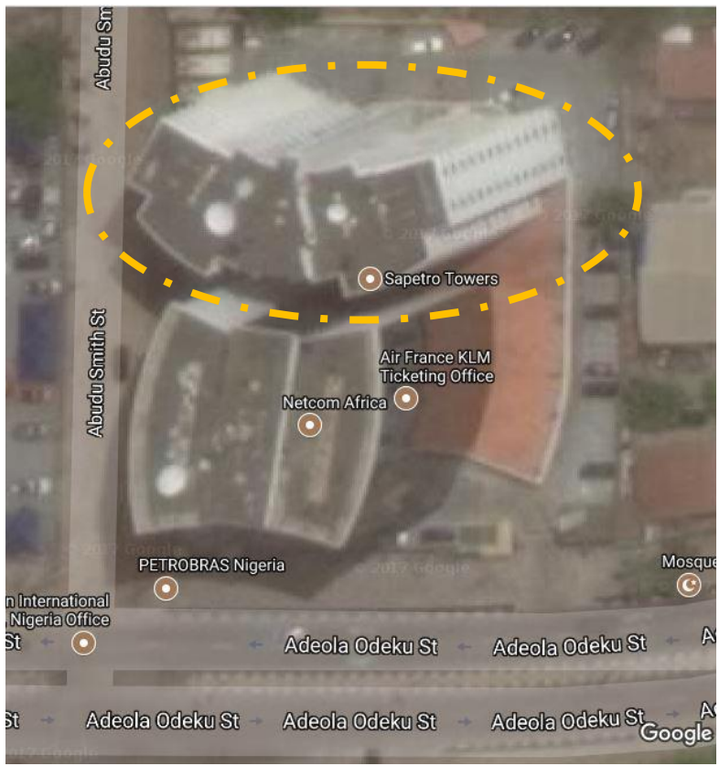

Plate 7: The site layout of SAPETRO towers *Source: google map 2017*

Plates 6 and 7 shows the site layout of two of the study area and illustrates the proximity of the interactive spaces to the building complexes in 1004 apartment towers. Plate 6 shows some highlights of areas (in blue dotted rectangles) for social interaction such as the sports centre and gardens. However unlike 1004 towers, SAPETRO tower barely have any clearly defined interactive spaces which relegates the users to hardly any form of frequent interaction. This of course as mentioned earlier is not healthy for a living community.

CONCLUSION AND RECOMMENDATION

Informal interactive spaces are of immerse importance in the overall well-being of users of any given environment or community. It creates avenues for people to socialize and in turn helps the social fibre of an environment thereby forming a healthy and interactive community. For a given community of high rise residence to interact meaningfully thus, such interactive spaces as have been shown in this research are of paramount importance. This research has pointed out that public spaces are an integral part of a built environment. It is therefore recommended that in the planning of a to-be-built high rise residential environment, the following measures should be taken into consideration as regards interactive spaces:

- The public interactive spaces should be easily accessible to users of the high rise apartments

- Adequacy of the informal interactive spaces should be considered in other to cater to the interactive needs of the population of a high rise apartment
- The interactive spaces should be located in safe spots within the site in order not to discourage users from accessing them.
- Their maintenance should be cost-effective.

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ASSESSMENT OF THE RELATIONSHIP BETWEEN HOUSING AND LIVELIHOOD PATTERN OF URBAN RESIDENTS OF BIDA, NIGER STATE, NIGERIA

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This study assesses the relationship between housing and livelihood pattern of urban residents of Bida South. Cluster Random Sampling method was adopted in selection of wards and households across the entire sample frame in the application of questionnaires. In all, a total of 379 copies of questionnaires were administered for data collection on housing quality and livelihoods of the residents in terms of quality and condition of housing components, basic facilities and livelihood problems encountered by the residents. Pearson Product-Moment Correlation was used to analyse the relationship between housing quality and livelihoods. Spatial relationship was also established using Spatial Autocorrelation (Kriging). It was found out that there is a strong relationship between housing quality and livelihood of the residents, Te correlation between the Occupancy Ratio and Livelihood is significant at 0.955; between the Age of Building and Livelihood is 0.975; between the Structural deficiency and Livelihood is 0.987; between Building Coverage and Livelihood is 0.936 and between Condition of Toilet and Livelihood variables is -0.879. The findings show strong spatial relationship between housing quality and livelihood in the spatial auto-correlation analysis. It was concluded that the housing condition in Bida South in terms of adequacy, quality of structures, safety and habitability fail to impact positively on the livelihood of its residents. It was therefore recommended that there is the need to improve the economy, human capital development, generation of employment opportunities and income that are capable of improving housing quality and living standard. The study also recommends the need for local government to grant housing loans for the interested participants at an interest rate lower than that of similar loans from commercial banks in order to develop quality housings.

Keywords: Housing quality, Basic facilities, Livelihood pattern, Spatial relationship

INTRODUCTION

Housing has profound influence on the health, efficiency, social behaviour, satisfaction and general welfare of the community. It reflects the cultural, social and economic values of a society, as it is the best physical and historical evidence of the civilization of a country (Omole, 2010). Quality housing has always been one of the very basic human needs. Overtime, its provision has been met in the form of dwellings which are temporary or permanent, natural or adapted (Wahab, 1983; Ojo, 1998; Oladapo, 2006; Listokin and Burchil, 2007). However, it has been argued that the efforts of Government in quality housing provision, particularly direct house construction, have largely been unsuccessful because the real needs of the target group (most times the poor) have often been misunderstood by government and thus are not catered for. Also that housing quality is grossly deficient in urban centres in Nigeria. An important criterion in evaluating housing quality is meeting the needs of particular families and therefore the value of a house is determined by the extent to which it satisfies or frustrates the needs of its users. Three basic needs of families (low, middle or high income, are identified as opportunity (proximity to work), security (home ownership) and identity (high quality standards of design and construction), which could be traded off against one another. These needs supposedly have impact upon quality of housing (Olotuah, 2015).

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However, housing quality is measured in terms of its physical components and the related basic facilities that make the houses functional. Quality housing is fundamental to healthy, social, economic and political relationships while poor housing inflicts serious problem on the livelihoods of individuals and the entire community. These, along with others, have been grouped into six categories of indicators by Alkay (2009) as social, economic, accessibility, perceived problems of the housing environment, the satisfaction from the housing environment, and the dwelling characteristics. The Aforementioned problems are peculiar to housing quality phenomena in Bida town. The specific objectives of the paper therefore include examination of quality parameters of housing, determination of carefully selected livelihood criteria and the relationship between housing and livelihood pattern in the study area.

Study Area

Bida is a Local Government Headquarter of Bida Local Government in Niger State, located on the A124 highway (a regional road) which links Ilorin to Minna and Abuja. The LGA has an area of 1.698 km² and a population of 266,008 (NPC, 2006) with 9°05′N, 9.083°N,6°01′E, 6.017°E Coordinates. Bida is the second largest town in Niger State . It is located southwest of Minna, Capital of Niger State. The major ethnic group is the Nupe. Bida is the headquarters of the Nupe Kingdom led by the Etsu Yahaya Abubakar and consisting of many districts, such as Katcha, Lapai, Mokwa, Enagi, Baddeggi, Agaie, Pategi, Lemu, Kutigi, and others. The leadership style of the ancient town of Bida is Emirship, and the head of the town is addressed as Etsu Nupe. The town is known for its production of traditional crafts, notably glass and brassware. Bida is also known for its Durbar festival. It is also the home of the Federal Polytechnic, Bida (Max Lock, 1980). The locational map of the study area is shown in Figure 1.

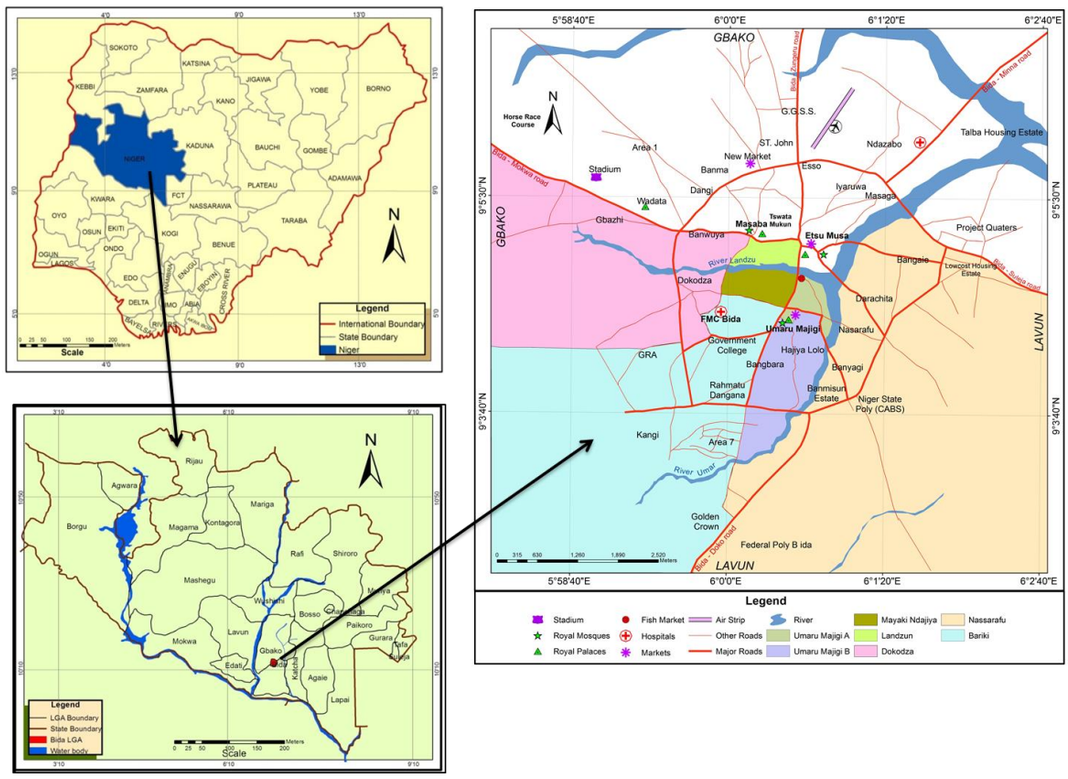

Figure 1: Locational Map of the Study Area
Source: Niger State Ministry Lands and Housing, 2015

METHODOLOGY

Data needed for this research were collected through questionnaire administration, Interview and physical observation. The questions in the questionnaire include wall condition, roof condition, physical structure condition, age of building, sewage facilities, bathroom facilities, kitchen facilities, water facilities and solid waste disposal facilities amongst others. One out of ten houses was served with questionnaire.

The study area (Bida South) covered seven (7) Wards i.e. Bariki, Umaru Majigi A, Umaru Majigi B, Nassarafu, Dokodza, Landzun and Mayaki Ndajiya respectively. Total estimated number of households in the study area is 29,667. However, a total of 379 households were adopted as the sample size of the residential buildings for the study. Descriptive statistical techniques used include percentages, charts, tables and cross tabulation to analyse the socio-

economic characteristics of residential dwellers. Also Pearson product-moment correlation coefficient was used to examine housing quality and livelihood pattern. The spatial relationship between housing quality and space; livelihood and space was established through spatial auto-correlation (kriging). Weighted score of housing quality attributes of houses in the study area which forms group of X variables and space forming Y variable were interpolated with filled contours to show areas with higher housing quality. Also, weighted score of livelihood attributes of houses in the study area which forms group of X variables and space forming Y variable were interpolated with filled contours to show areas with better livelihood.

RESULTS AND DISCUSSION

Housing Quality in the Study Area

Age of Buildings

The study considered age of buildings within various ranges. Figure 2 revealed that majority 151 (43.0%) of the buildings in the study area were in age range of 31 – 50 years, followed by 27.9% whose age were above 50 years. The buildings with age below 5 years, 6 – 15 years and 16 – 30 years were 6.6%, 10.8% and 11.7% respectively. This is expected because most part of Bida south is occupied by traditional buildings. The implication is that most of the buildings are old and require more attention in terms of maintenance which may require high financial implications.

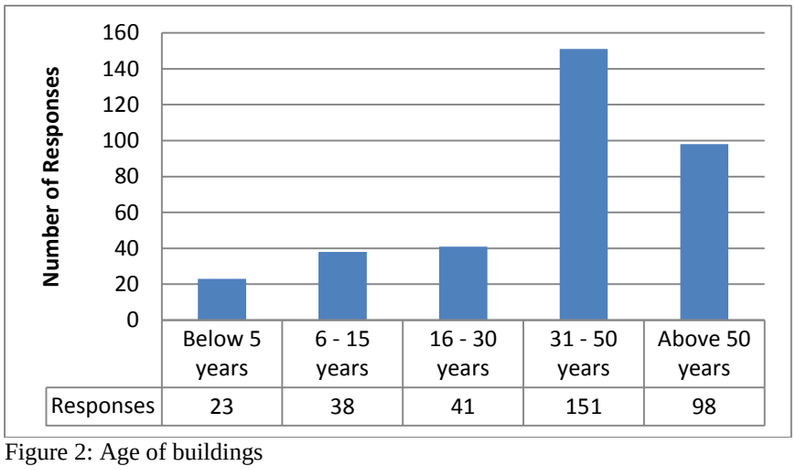

Figure 2: Age of buildings

Source: Author's fieldwork, 2015

Condition of Buildings

The responses on condition of buildings in the study area are shown in Table 1. Five building components were considered in this section, which include: roof, wall, doors, windows and floors.

The study revealed that 153 (43.6%) of the respondents considered condition of their roof to be fair, followed by 86 (24.5%) which considered their roof condition to be poor as shown in Table 1. Respondents who considered their roof conditions to be very good, good and very bad are 32 (9.1%), 51 (14.5%) and 29 (8.3%) respectively. From the study, it is also revealed that majority 102(29.1%) of the respondents considered wall condition to be very good, followed by 89 (25.4%) which considered wall condition to be good. Respondents who considered their wall conditions to be fair, poor and very poor are 71 (20.5%), 59 (16.8%) and 29 (8.3%) respectively. The study also revealed that door conditions were considered to be very good by the majority with 129 (36.8%) responses, followed by 103 (29.3%) who considered door conditions to be good. This shows that most of the doors in the study area were in good condition which may not be strange because door is a very important component of a house in terms of security.

The study also revealed from Table 1 that 83 (23.6%) respondents considered window conditions to be good while 78 (22.2%) considered it to be fair. More so, floor conditions were considered to be good by 88 (25.1%) respondents. However, 72 (20.5%) of the respondents considered their floor to be poor, this shows that there are mixed opinions regarding the nature and conditions of floors in the study area. This implies that there is variation regarding condition of major building components in the study area, which means that general conclusions cannot be made without considering the conditions of all other components.

Table 1: Condition of Buildings

Building components	Very Good		Good		Fair		Poor		Very Poor	
	Frequency	%	No	%	No	%	No	%	No	%
Roof	32	9.1	51	14.5	153	43.6	86	24.5	29	8.3
Wall	102	29.1	89	25.4	72	20.5	59	16.8	29	8.3
Doors	129	36.8	103	29.3	52	14.8	50	14.2	17	4.8
Windows	39	11.1	83	23.6	78	22.2	84	23.9	67	19.1
Floors	72	20.5	88	25.1	61	17.4	72	20.5	58	16.5
Total	374	106.6	414	117.9	416	118.5	351	99.9	200	57

Source: Author's fieldwork, 2015

Plate I: Building With Collapsed Wall in the Study Area
Source: Author's fieldwork, 2015

Plate I shows a mud building that is partly collapsed and cracked in the study area.

Building Occupancy Ratio in the Study Area

The number of persons who stays per room is one of the tools used in assessing housing quality in this study. The study considered 1 – 2 persons/room, 3 – 4 persons/room, 5 – 6 persons/room and Above 6 as occupancy ratio range in the study area.

The study revealed in Figure 3 that 111 (31.6%) of the respondents have occupancy ratio of 5 - 6 persons per room, followed by 96 (27.4%) of respondents who have above 6 persons per room. However, 61 (17.4%) and 83 (23.6%) have 1 – 2 persons and 3 – 4 persons per room respectively. This shows that the occupancy ratio is high in the study area, which in one way or the other may have relationship with the livelihood of the residents.

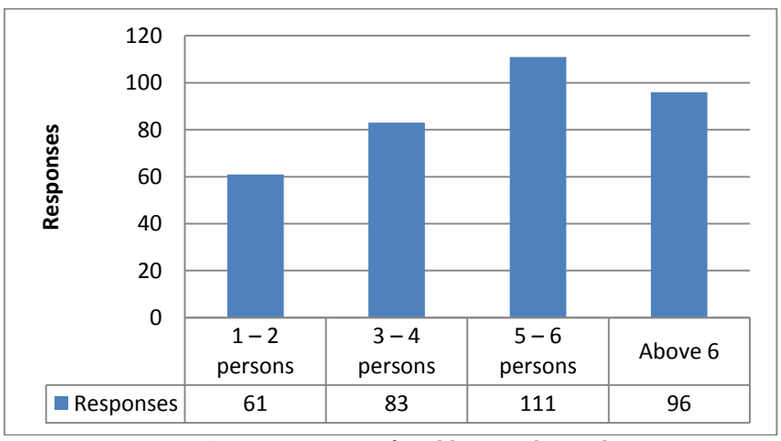

Figure 3: Occupancy Ratio of Buildings in the Study Area
Source: Author's fieldwork, 2015

Number of Windows/room

The study revealed in Figure 4 that close to 3/4 of the houses in the study area have two windows with 249 (70.9%) responses, while 98 (27.9%) of respondents have 1 window in their house Finally, only 1.1% of the respondents do not have any window in their house

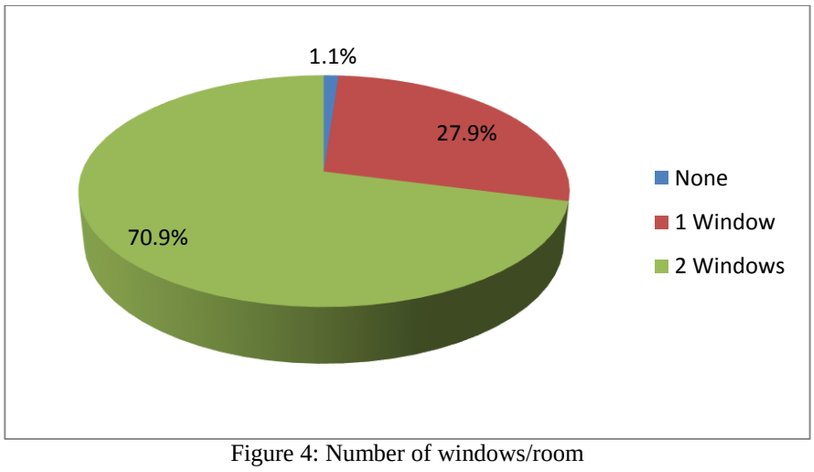

Figure 4: Number of windows/room
Source: Author's fieldwork, 2015

Types of Toilet Facility Used by Respondents

The study revealed in Table 2 that 138 (39.3%) of respondents used squat flush type of toilet, followed by 112 (31.9%) who used pit latrine type of toilet. For those households who used water closet were 98 (27.9%), while those that do not have toilet in their house were only 3 (0.9%) of the respondents.

Table 2: Type of Toilet Facility Used by Respondents

Type of toilet facility	Number of Respondents	Percentage
Water closet	98	27.9
Squat Flush	138	39.3
Pit latrine	112	31.9
None	3	0.9
Total	**351**	**100.0**

Source: Author's fieldwork, 2015

Sources of Water for Domestic Use

Provision of water is one of the functions of a good housing, therefore the study looked into various sources to which households sourced their water for domestic uses. This is shown in Table 3.

The study revealed in Table 3 that out of 351 respondents, 214 (61.0%) sourced their water for domestic uses from borehole. This is followed by 87 (24.8%) who sourced their water from well. However, 9 (2.6%), 13 (3.7%), 23 (6.6%) and 5 (1.4%) of the respondents sourced their water from pipe borne inside the house, pipe borne outside the house, water vendor and pond/stream respectively. The high utilization of borehole sourced water is as a result of increased number of boreholes drilled in recent times in the study area. However, it was observed the supply of water from Niger State Water Board was not regular.

Table 3: Sources of Water for Domestic Use

Source of water	Number of Respondents	Percentage
Pipe borne inside the house	9	2.6
Pipe borne outside the house	13	3.7
Well	87	24.8
Borehole	214	61.0
Water vendor	23	6.6
Pond/Stream	5	1.4
Total	**351**	**100.0**

Source: Author's fieldwork, 2015

Plate II: Public Motorised Borehole in the Study Area
Source: Author's fieldwork, 2015

Overhead tanks connected with a motorised borehole in the study area are shown in Plate II. This is one of the major sources of water for domestic uses in the study.

Livelihood Characteristics of Respondents

Households Opportunity to Improved Social Well-being

Household's opportunity to improved social well-being is assessed through access to formal education, access to healthcare, improved perception of safety and security.

The study revealed in Table 4 that 334 (95.2%) of the respondents have access to formal education while only 17 (4.8%) of the respondents do not have access to formal education in the study area. In terms of access to healthcare, 198 (56.4%) of the respondents have access while 153 (43.6%) do not have access. Table 4 also shows that 223 (63.5%) of the respondents do not have improved perceptions on safety and security while 128 (36.5%) have improved perceptions on safety and security. In the study area 209 (59.5%) of the respondents claimed to have access to strengthened social networks while 142 (40.5%) of them did not have access.

Table 4: Households Opportunity to Increased Social Well-Being

Increase social well-being	Accessible		Not Accessible	
	No	%	No	%
Access to education	334	95.2	17	4.8
Access to healthcare	198	56.4	153	43.6
Improved perceptions of safety and security	128	36.5	223	63.5
Strengthened social networks	209	59.5	142	40.5
Total	869	247.6	535	152.4

Source: Author's fieldwork, 2015

Households Opportunity to Improved Environmental Conditions

Access to basic services, adequate and effective solid waste disposal, low exposure to pollution and low disaster vulnerability are used in assessing improved environmental conditions.

Table 5 shows that 262 (74.6%) of the respondents do not have access to basic services while only 89 (25.4%) of the respondents have access to basic services**.** According to the Table 5, 319 (90.9%) of the respondents do not have adequate and effective solid waste disposal while only few have access with 32 (9.1%) responses. The Table 5 also reveals that 258 (73.5%) respondents are highly exposed to pollution while 93 (26.5%) have low exposure to pollution. In the same vein, majority of the respondents are highly vulnerable to disaster with 250 (71.2%) of responses, while 101 (28.8%) of the respondents have low disaster vulnerability.

Consequently, the result implies that households' opportunity to improved environmental conditions is very low and provides an indication that this has contributed to the poor livelihood condition of the residents.

Table 5: Households Opportunity to Improved Environmental Conditions

Improved environmental conditions	Accessible		Not Accessible	
	No	%	No	%
Access to basic services (water and sanitation)	89	25.4	262	74.6
Adequate and effective solid waste disposal	32	9.1	319	90.9
Low exposure to pollution	93	26.5	258	73.5
Low disaster vulnerability	101	28.8	250	71.2

Total	315	89.8	1089	310.2

Source: Author's fieldwork, 2015

Households Opportunity to Enhanced Living Conditions

There is enough evidence no doubt that enhanced living conditions contribute to livelihood of households. Therefore, the study considers good quality of housing, access to public transport and access to open/communal space to assess households' living conditions.

The study revealed in Figure 5 that 248 (70.7%) of the respondents do not have good quality of housing, while only 103 (29.3%) have access to good quality of housing. In terms of access to public transport, 226 (64.4%) do not have access while 125 (35.6%) have access. In the same vein 299 (85.2%) of the respondents do not have access to open/communal space while 52 (14.8%) have access to open/communal space.

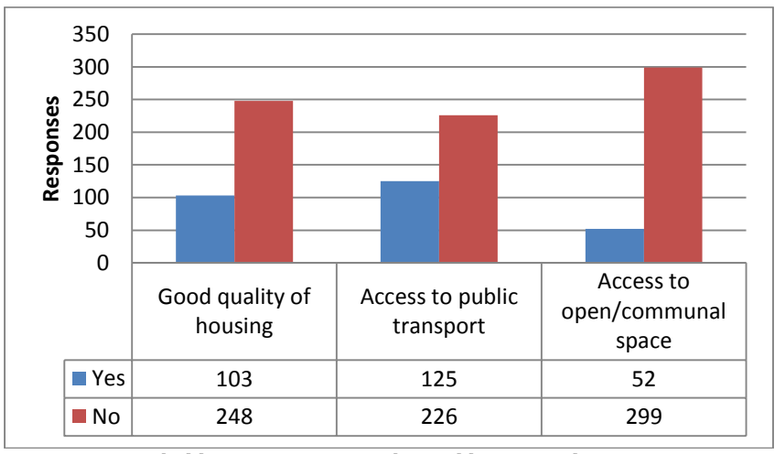

Figure 5: Households Opportunity to enhanced living conditions

Source: Author's fieldwork, 2015

Relationship between Housing Quality and the Livelihood of Urban Residents

Pearson's r is used to determine the relationship between the housing quality and the livelihood of the residents in the study area. In Table 6, Pearson product-moment correlation coefficient was computed to assess the relationship between five livelihood indicators and five housing quality variables. It was found out that all five livelihood indicators have significant positive correlations with housing quality variables. The empirical analysis result is that Pearson's r for all five livelihood indicators and five building conditions are close to 1. For this reason, it can be inferred that there is a strong relationship between Building Conditions and Livelihood of the residents.

Table 6: Relationship between Housing Quality and Livelihood

		Livelihood Indicators				
Housing Quality		Enhance Living Conditions	Improve Economic Condition	Greater Political Recognition	Increase Social Well-being	Improve Environmental Condition
Occupancy Ratio	Pearson Correlation	.985**	.814	.958	.921**	.985
	Sig. (2-tailed)	.002	.093	.010	.026	.002
	N	5	5	5	5	5
Age of the Building	Pearson Correlation	1.000	.809	.911**	.870	1.000
	Sig. (2-tailed)	.000	.097	.032	.055	.000
	N	5	5	5	5	5
Structural deficiency	Pearson Correlation	.809	1.000	.882	.915	.809
	Sig. (2-tailed)	.097	.000	.048	.029	.097
	N	5	5	5	5	5
Building Coverage	Pearson Correlation	.733	.870	.927	.949	.733
	Sig. (2-tailed)	.158	.055	.023	.014	.158
	N	5	5	5	5	5
Condition of Toilet/Bathroom	Pearson Correlation	1**	.809	.911**	.870**	1**
	Sig. (2-tailed)	.000	.097	.032	.055	.000
	N	5	5	5	5	5

Source: Author's fieldwork, 2015

The correlation between the Occupancy Ratio and Enhanced living Condition is 0.985, between Age of Building and Greater Political Recognition is 0.911, between Structural Deficiency and Increased

Social Well-being is 0.915, between Building Coverage and Increased Social Well-being is 0.949. The result reveals that all housing quality variables and livelihood variables are strongly correlated.

Spatial Relationship between Housing Quality and the Livelihood

The essence of this approach is to examine the performance of each area with respect to relationship between housing quality and livelihood of the residents in respect to space.

Spatial result shown in Figure 6 indicate that houses that are located within the filled contour value of 2.8 – 3 are better in terms of their quality, those that are located within the range of 1–1.2 filled contour value are poor in terms of their qualities.

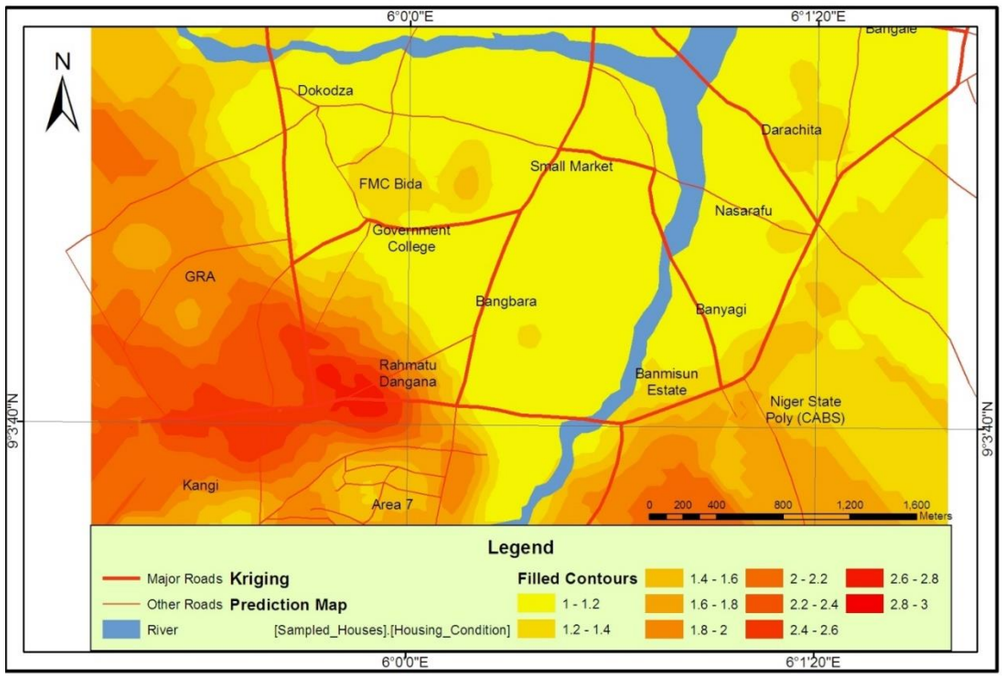

Figure 5: Auto-correlation of Housing Quality

Source: Author's fieldwork, 2015

Figure 6 revealed that people who live in the houses that are located within the range of filled contour value of 2.8 – 3 have better livelihood, likewise those people that live in the houses that are located within the range of filled contour value of 1 – 1.2 have poor livelihood.

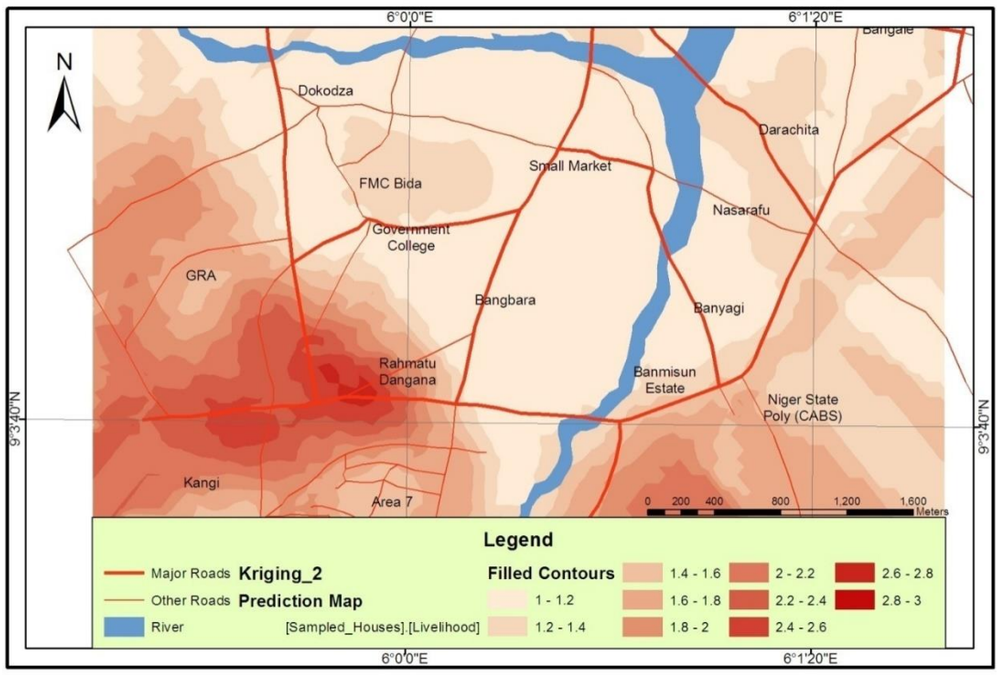

Figure 6: Auto-correlation of Livelihood of Residents

Source: Author's fieldwork, 2015

However, Figure 5 and 6 have similar characteristics in terms of their filled contour. Both maps have their highest filled contour values mostly in south western parts. This established a strong

relationship between the areas with better housing quality and the areas that have better livelihood in the study area.

CONCLUSION

It was concluded that the housing condition in Bida South in terms of adequacy, quality of structures, safety and habitability fail to impact positively on the livelihood of its residents. However, there is a strong relationship between livelihood and housing quality, with the former affecting the latter.

The following recommendations are put forward as policy guidelines toward a sustainable management of housing in the study area.

i. Maintenance of residential housing should be encouraged in order to keep quality attributes of the houses and avoid failure before the designed life of such buildings.

ii. Residential housing owners should use specified standard materials during construction of houses and thereafter make funds available for their periodic and corrective maintenance in order to achieve quality housing.

iii. Efforts should be made by the residential housing owners to adhere to building codes and regulations in order to achieve quality housing.

iv. There is the need to improve the economy, human capital development, generation of employment opportunities and income that are capable of improving housing quality and living standards of the residence of the area.

v. Housing loans should be granted to interested house owners at an interest rate lower than that of similar loans from commercial banks in order to encourage development of quality housing that will improve the living standard of the people.

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THE IMPACTS OF MICROFINANCE ON LIVELIHOODS OF WOMEN – A STUDY OF LAPO MICROFINANCE WOMEN CLIENTS IN MINNA, NIGER STATE, NIGERIA

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Lift above Poverty Organization (LAPO) is one amongst many Microfinance banks in Minna licensed by the central Bank of Nigeria, saddled with the responsibility of providing credit facilities to the active poor and low income women with the expectation of boosting the livelihoods of the beneficiaries. The research focused on measuring the impact of Microfinance credits on the livelihoods of LAPO women Clients in Minna Niger State. The study adopted a quasi-experimental strategy creating two independent groups known as treatment and control group to investigate the causal relationship between Microfinance as (Independent Variable) and Livelihoods as (Dependent variable).The difference between the two groups created is that one uses microfinance(Treatment group) and the other is without Microfinance (Control group). Quantitative methodology was adopted leading to dissemination and return of 120 closed ended questionnaires which represented 100% response rate. The respondents were examined based on their physical, human and financial assets in the periods before and after Microfinance intervention. The research findings were analyzed through the use of an independent T-test of SPSS package to investigate a comparison between the two groups. The P-value of > than 0.05 level of no significant differences between the two groups showed that they were comparable. The research showed a slight improvement on some of the selected household assets of the respondents in treatment group .However, the improvement was too minimal to have triggered positive impact of microfinance on the beneficiaries. Interestingly, it was discovered that additional income earned by the clients was what contributed to why their assets survived over the years. It was concluded that LAPO microfinance has no impact on the livelihood of the women.

Key words: Control group, Livelihoods Assets, Microfinance, Treatment group, Quasi-experiment

INTRODUCTION

Micro finance scheme has been operating in Nigeria as a poverty alleviation initiative since 1990's. It has been functioning mainly through informal financial activities with no established government policies and mechanisms for regulating and supervising the sector. The scheme was formally developed under the watch of central bank of Nigeria (CBN) in 2005 as a response to the failure of commercial banks and formal financial facilities to serve the needs of low-income households and small micro enterprises (Ikechukwu, 2012)**.** The central bank of Nigeria in 2005 confirmed that the formal financial system provides services to about 35% of the economically active population, while the remaining 65% are excluded from access to financial services. It is on this note that the National Microfinance Policy Framework was reviewed in 2011 to enhance provision of diversified services on a sustainable basis for the economically active poor and low income households specifically targeting women (Josephine, 2011)**.** Microfinance is one initiative that people assumes provide the poor, especially women with better opportunities to improve on their livelihoods as many of them have business ideas that requires capital to transform the idea into reality. The underlying assumption is that when loan is giving to the active poor, their income generating activities will be enhanced and by extension improve on the assets of the beneficiaries.

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Statement of the Problem

Many women in Minna have little or no access to credit in formal financial institutions due to low level of education or lack of inheritance which could serve as collateral .This has placed the economic condition of some of the women in a difficult state. Despite all odds, the women are known to be engaged in several income generating activities such as small businesses, menial jobs and any other unskilled jobs available. These efforts are part of their contribution in building the assets of the household. Their meager incomes are sometimes used for assisting their spouses in paying children school fees, health care, feeding, supplementing husbands' income as well as building other household's assets.

They are also found to be engaged in some type of savings and credit organized by informal financial institution known as *Esusu or ROSCA* which involves periodical contribution of a fixed amount with rotation of the funds among the members in the cycle, direct borrowings from friends and relations, daily contribution amongst others. ROSCA members make regular contributions which are usually given in whole or in part to each contributor in turn (Kabuya, 2015). These forms of savings and borrowings are very popular in many communities and cities in Africa. People use it as coping strategies in hard times and also to take care of lifecycle events.

In addition to the informal money lending organization listed above, a Micro finance bank named Lift above poverty organization (LAPO) amongst many other microfinance institutions assist the active women in small scale businesses through savings and credit facilities so they can be self-reliance. The bank offers loans to the active poor and low income households especially women who are easily reached in groups. The Studies conducted on Grameen bank's clients in Bangladesh shows that children of microfinance clients are more likely to go to school and stay longer in school than the children of non-clients. In addition it is also evidently stated in the work of (Khandker, 2005) that Microfinance scheme helps in the development and growth of the local economy and resulting to individuals and families being able to move beyond subsistence living and increase disposable income levels. Microfinance programs reaches out to the poor and they are able to reduce poverty by increasing individual and household income levels, as well as improving healthcare, nutrition, education, and helping to empower women. When standard of living increases, eradication of extreme poverty and hunger would both at individual and household levels be achieved as a result of microfinance programs (Ibid).

It is with these assumptions that the research was conducted to investigate the impact of LAPO Microfinance on the livelihoods of the women who benefits from their credit facilities. The objective of the study is to measure the impacts of the Microfinance on the livelihoods of the women. This was carried out by examining their various household assets to ascertain any changes that could be attributed to Microfinance intervention. It was also to check whether the Microfinance bank performs in accordance with the organizational goals and objectives or otherwise. The study gathered useful information from the findings which shall serve as inputs for future academic research on the topic of microfinance and a point of relevance and at policy level.

LITERATURE REVIEW

The concept of livelihood depicts 'the capabilities, assets which includes (both material and social resources) and activities required for a means of living' Carney 1998 cited in (Rakodi, C., 2002). This gives an understanding about how people use their resources and how assets can be used to sustain a livelihood.

Livelihoods approach is a holistic and flexible framework adopted for understanding, measuring, and analyzing poverty and how to alleviate poverty. It is a realistic concept which recognizes the need for multiple activities which poor households can engage in to ensure their survival and wellbeing through the use of assets (Rakodi, C., 2002). It a classical theory that recognize the influence of institutions, policies, processes amongst others on Livelihood assets of the poor and suggest coping strategies which households adopt in times of shocks and stress that may stems from changing environment or economic problem. The theory understand the term Poverty from the perspective of poor people themselves and it is considered useful in this research.

Livelihood Assets

The summary of assets in the livelihood framework was put together by Carney, 1998 cited in (Rakodi, C., 2002). Other description of the assets is also drawn from the work of (Moser, 1998) to explain their importance and the opportunities they offer to the poor. The livelihoods Assets as described by the scholars are shortly explained below.

Human Capital

This refers to labor resources that households have. This represents the skills, knowledge, access to labour and good health that enable people to achieve positive livelihood outcomes. These have both quantitative and qualitative dimensions. The quality of household labour is improved through education and skills development and also the health status of household members. While the quantity aspect deals with number of household members and time available for income generating activities. It is also noted that health status determines the capacity of people to work as well as skills and education which determines the return to their labour. (Moser, 1998)

Social capital

Social capital is described as the rules, norms, obligations, reciprocity and trust embedded in social relations, social structures, and society's institutional arrangements, which enable its members to achieve their individual and community objectives Rakodi, C., (2002) It is also defined as reciprocity within communities and between households base on trust deriving from social ties (Moser, 1998).

Physical capital

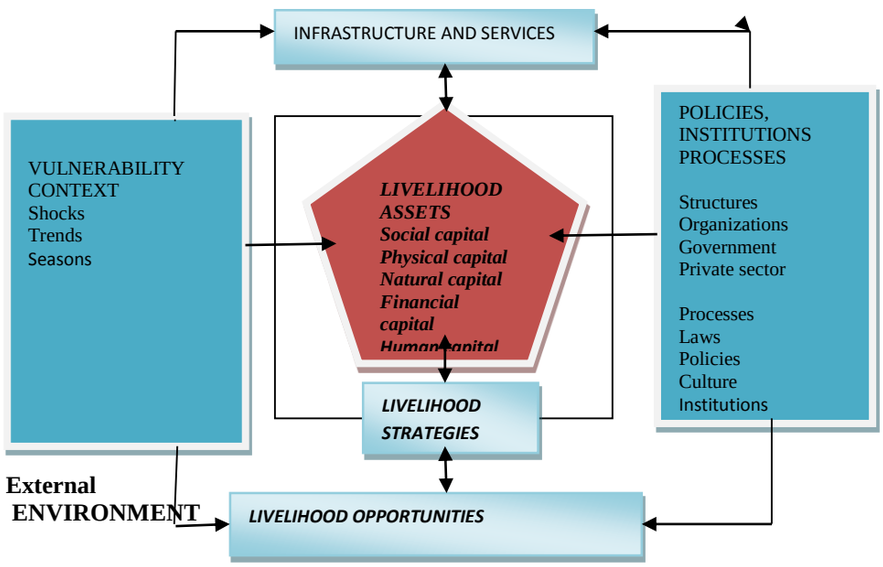
Physical capital refers to productive and household assets that include equipment, housing, water, energy and communications. The ability to invest in production equipment may directly generate income and enhance labour productivity.

Financial Capital

Finance refers to financial resources that are available to people which provide them with different livelihood options. These include cash, credit/debt, savings, remittances, pensions and other economic assets.

Natural capital

Natural capital are the resource stocks from which resource flows useful to livelihood are derived, including land, water and other environmental resources especially common pool resources (Rakodi, C., 2002). An analysis of the livelihood assets is crucial for this research because assets are considered to have strong roles to play in the life of the poor. Change in income levels could be seen in the change in consumption patterns, ownership of assets as well as access to assets. The livelihood framework below diagrammatically shows the model of the livelihoods approach which explains livelihoods and its understanding of how complications can be managed. It makes the recognition of objectives as well as interventions in the effort to improve livelihoods as discussed earlier.



The livelihood framework
Source: DFID Sustainable livelihoods guidance sheets, in Rakodi (2002).

Debates and Impact Assessment of Microfinance

In every part of the world today, there is an assumption that microfinance is successful in reducing poverty. Advocates and critics of Microfinance have shared different views, opinion about what ways have microfinance programme affect the lives of the poor. Some notable scholars in the field came up with arguments in support of the programme based on the research they conducted while others gave opposing comments about problems surrounding the financial scheme.

The work of Collins, Morduch, et al., (2009) confirms that microfinance represents tremendous steps in the effort of bringing reliability to the household of the poor who may have witnessed some financial disappointment from other financial providers. They maintained that financial life of the poor is often uncertain, the income that provides the stuff of their financial transaction is small and often irregular, unpredictable and most of their financial partners – ROSCAS and ASCAs are not reliable as they would like. Therefore, irrespective of how loans were used, microfinance was valued by most women in their study as the women claimed microfinance has helped in addressing pressing issues and by extension assist them in coping with emergencies like medical expenses, school fees amongst others. (Collins, Morduch, et al., 2009).

Adjei, (2009) also stated that microfinance can provide a number of pathways to reduce vulnerability among poor people through income generating activities for consumption smoothing, to react to emergencies and lifecycle events such as sickness, death, marriage etc. He buttressed further that Microfinance promotes asset-building among the poor by avoiding distress through unplanned sales of assets and replacement of existing productive assets destroyed in Disaster. Since assets are central to the livelihoods of the poor, microfinance should then enhance their accumulation so as to cushion the people during shocks.

Otero, (1999) described various ways in which microfinance, at its core fight poverty. She states that microfinance creates access to productive capital for the poor and that together with human capital, addressed through education/training, and social capital which is achieved through local organization building, enables people to move out of poverty. She went further to stress that by providing material capital to a poor person, their sense of dignity is strengthened and this can help to empower the person to contribute to economy and the society where he /she lives. The aim of microfinance is not just about providing capital to the poor to combat poverty in an individual level, it also play a role at an institutional level. It seeks to create institutions that deliver financial services to the poor, who are continuously ignored by the formal banking sector (Otero, 1999)**.**

Similarly, Mahjabeen (2008) conducted a study on Grameen clients in Bangladesh and also found out that Microfinance raise income of all households, increase consumption of commodities by households, generate employment, reduce income inequality and enhance social welfare. He went further to suggest that microfinance is one of the required critical interventions for empowering the poor people who need financial services. Sayed Samer et al (2015) also maintained that the financial services provided to the active poor motivates them, enhance their ability to Participate in the competitive economic market and by extension they take a feat in various entrepreneurial opportunities.

Kabeer, (2001) observed in the study conducted in Bangladesh that women access to credit and the enhanced income may improve their efforts and capability to contribute to their household's economy, improve their assets and sponsors children's education. She argued that microcredit assist poorer women whom prior to their membership were confronted with financial difficulties and could barely send their children to school. In addition women are able to buy household furniture and business equipments like refrigerators, rickshaws, sewing machine or transformation of their houses for home based enterprises through Microfinance credit which is considered a huge contribution for the household as the assets could be used to generate income.

In spite of all the above positive claims, some scholars are not convinced that access to microfinance automatically saves people from poverty. The idea of belonging to a group where assistance is sure to be rendered or received is not always the solution to poverty judging from the studies conducted differently by (Brett, 2006, Hanak, 2000).

In their various investigation of microfinance clients in Bolivia, Uganda and Kenya respectively, they recognized that although loan and services are usually extended to

beneficiaries especially women through group formation which serve as social collateral for people to access loan. However, they both noted that default in repayment by a member could cause conflicts in a group when members are either to repay the loan on behalf of the defaulter or the defaulter loses private properties and assets to the group, neighbours and friends depending who stand as guarantor. Studies from these countries have also shown how people's private life could be made open as groups visits new members home to access their household assets like sewing machine, refrigerators amongst others.

Evidence from the study conducted by Brett, (2006) revealed that participation of women in microfinance and high cost of repayment has negative effects on household income. He buttressed further that microfinance does not promote assets accumulation but rather draws from household resources. In a quest to pay for loan, children drop out of school to work and support family business, food quantity/quality is reduced which could expose them health related issues. Microfinance is known to be successful at the institutional level as it tends to have shifted most of the risk and transaction costs to borrowers. (ibid)

Hanak (2000) argued also that Microfinance institutions are not particularly concerned about the socio economic context of their clients rather they are mostly concerned about how loan can be paid back.

The Link between Livelihood and Microfinance

Earlier in the discussion, access to finance was mentioned as one of the assets recognized by the livelihood theory. This research has its focus on understanding access to credit and its impact on livelihood. Livelihood theory deals with assets and mentioned accessibility to credit and its importance in helping the poor maintain their livelihoods. It is important to state that social capital as an asset is linked to microfinance through the use of group based lending that covers for asymmetric information of microfinance clients and reduce the stress of tracing the credit history of clients. Instead of using physical collateral, poor borrowers use social collateral to guarantee each other for loan collection**.** In reality, it is expensive for the poor to survive in urban environment as it is highly monetized. Therefore direct access to credit is part of livelihood strategies undertaken by the poor to address their financial constraints hindering them from carrying out their income generating activities. There is also a link between livelihood and microfinance in the aspect of human capital as credit impacts be it negative or positive could be felt on education, health and food consumption of the beneficiaries and their households. Physical capital is also linked to microfinance as impact of credit could have effect on household assets and business stocks.

RESEARCH STRATEGY/METHOD

A Quasi experimental design was employed for the research to test and describe the causal hypothesis or the manipulable causes on effect of LAPO microfinance intervention on the women beneficiaries. In the process of this research, it was quite imperative to concentrate on creating a factual situation measuring and ensuring that what was supposed to be measured was really measured within the context and attribute the changes in welfare of the beneficiaries as well as their assets to the intervention of Microfinance.

As contained in Ravallion, (2001), when an effect of a programme is to be studied, enquiring directly about a programme's effect from the participants is valuable. However, such step may not provide all the needed information for strong evaluation of such programme. Example of such scenario could be a probing question directed towards the programme participants asking what they would have done without such intervention. To overcome this challenges, a counterfactual situation known as control group was created. Control group was described by Diaz, Buedo-Jimenez, et al., (2015) as a methodological device that corrects a confounder in an experiment. The people in the control group are those who never benefited from the microfinance intervention, hence deemed useful in assessing the effects of the intervention by comparing them with the beneficiaries known as treatment group. In quasi experiment the use of Pre-testing and post testing design is ideally used for creating baseline information and for investigating current situation of two groups in an experiment. The advantage of the pretesting and post testing design is that it is notably easier to derive and understand. However, such design has been argued to also have a very important drawback as the method implies that the differences between the pre-test and post-test observations to be made could be due to one or more factors besides the treatment or the intervention (Reichardt, 2009). It is important to mention that there were no baseline data

available when the research was conducted and the study did not carry out a pre-test before the intervention of microfinance. It was in the absence of baseline data that the study made use of a recall data which deals with the investigation of events that occurred before an intervention of a programme. The study was carried out by careful selection of the control group based on the same distribution of observable characteristics with the treatment group.

To verify the outcome of the beneficiaries' livelihood due the intervention, the two groups compared were independent but subjected to before and after investigation at same interval. This method is known as "Double Differences" as contained in the work of Ravallion, (2001).The study adopted a survey as a data collecting tool in the quasi experiment to give the study a statistical motive in the evaluation of the intervention effects. This was done by making sure that the same questionnaires were distributed to both the treatment and control group.

As much as all the shortcomings of the quasi- experimental design are known and identified, it was still considered a necessary tool needed and most effective for the effects that the research was to measure. Quasi experiment was appropriate for the research experiment as it was used before the effect was said to be completely measured. It helped the researchers to analyze the impact of the programme which was achieved through the counterfactual situation created where it was clear how situation would have been without microfinance. The year 2012 was the period which the respondents in the treatment group became members of the LAPO Microfinance Scheme. To assess the programme's impacts, the years selected for the investigated period were 2011 (before) and 2015 (after).

Table 1.0: summary of the research design

Groups	Intervention of microfinance (in year 2012)	The investigation periods.	
Treatment group	Received microfinance	2011	2015
		Before microfinance intervention	After Microfinance intervention
Control group	No microfinance	2011	2015
		Before microfinance intervention	After Microfinance intervention

Source: fieldwork, (2015)

The quantitative research method used gave the researchers the opportunity to define variables to investigate and it is the best method when examining effects of a programme (causality as it is known). In any explanatory and experimental research, establishing whether there is a relationship between variables can be best described through a quantitative method (Muijs, 2011).

The selection of the respondents in treatment group was determined by representative sample of microfinance clients who mainly resides in Chanchaga local government. The control group was derived from a few selected areas in Bosso local government where the women never engaged in Microfinance. Stratified random sampling as one among the probability sampling methods was used in the survey to identify and select both the respondents in treatment and the control group. The sample for Microfinance participants was carried out using their details collected from microfinance institution and their names were drawn using random sampling techniques. A total of 120 copies of closed ended questionnaires were administered to respondents in treatment and control groups respectively. The questionnaires were all returned which represented 100% response rate.

FINDINGS AND ANALYSIS

The data collected was analyzed using the statistical package for social sciences (SPSS). Figures generated were later transferred to an Excel which was used for graphs formulation, tables and other visuals. To compare the two groups in the survey, an independent T-test was employed to detect if there was a significant difference between them in the periods (before and after) the intervention of microfinance. The acceptable cut off was measured by

95% confidence interval of difference to show whether there is significant difference between the two groups or not.

Brief analysis of the socio- economic profile of the respondents

This section covers the description of the respondents' socio economic characteristics based on the findings generated from the survey. The two separate but independent respondents constitutes indigenous and non-indigenous members of each neighbourhood with different cultural and religious beliefs. Below is the description of the age of respondents as well as their employment status.

Table 1.1: Age and employment status of respondents

Age of respondents	**Treatment group**		**Control group**	
	Frequency	**Percentage%**	**Frequency**	**Percentage%**
7	11.7%		9	15%
30-39	28	46.7%	20	33.3%
40-49	21	35%	23	38.3%
50-59	3	5%	8	13.3%
60 and above	1	1.7%	-	-
Total	60	100%	60	100%
Occupation Status	**Frequency**	**percentage**	**Frequency**	**Percentage**
Housewife	5	8.3%	7	11.7%
Civil servants	4	6.7%	7	11.7%
Working with private company	10	16.7%	4	6.7%
Self employed	41	68.3%	38	63.3%
Unemployed	-	-	4	6.7%
Total	60	100%	60	100%
Marital Status	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Married	41	68.3%	40	67.3%
Divorced	10	16.7%	7	11.7%
widowed	7	11.7%	10	16.7%
Single	2	2%	3	5%
Total	60	100%	60	100%

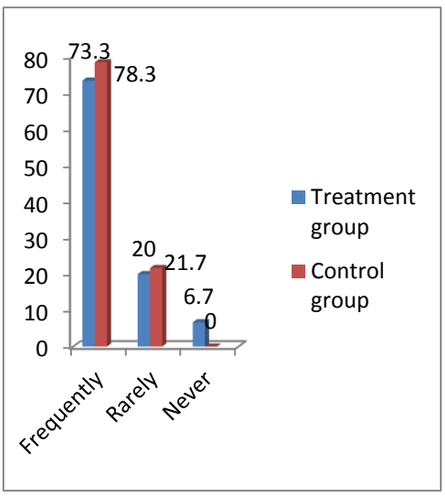
A statistical test conducted to check if there was a difference in the age and occupation of respondents produced the result below.

Age of respondents = T-test result, 2tailed sig. (.464) where the P-value is > 0.05 means there is no significant difference between the two groups in terms of their age.

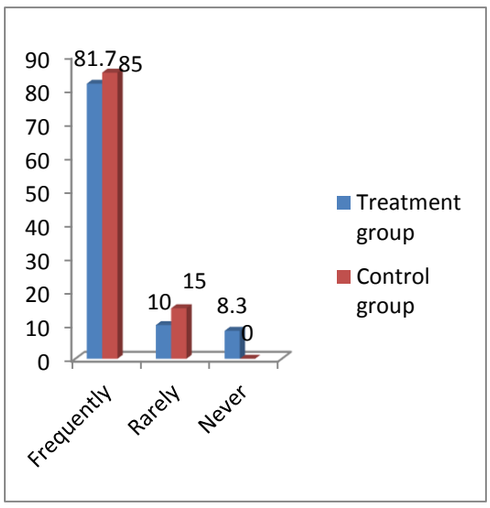
Occupation status and Marital status= T-test result, 2tailed sig. (.863) and (.649) where the P-value is > 0.05 means that there are no significant differences between the two groups in terms of their employment and marital status. Therefore, the two groups studied are comparable.

Savings for Daily Expenditure (An Indicator of Financial Capital)

The study examined how the women in microfinance manage their financial expenditure. The results gathered from the treatment and control groups were analyzed to see how people manage their emergency events and daily expenditure through savings as an example of financial capital.



Savings for daily expenditure before 2012 (%)



Savings for daily expenditure in 2015(%)

The chart on the left shows a fair competition among the two groups on their level of savings for daily expenditure before the year of intervention. To give this descriptive analysis a strong back up, further investigation was conducted with a T-test to investigate if there were significant differences between the two groups before the intervention of microfinance.

- Before the intervention: The result of the T-test, 2tailed sig. (.219) where the P-values is > 0.05 shows that no significant difference exist between the two groups before the intervention of Microfinance. Therefore, they were both comparable.

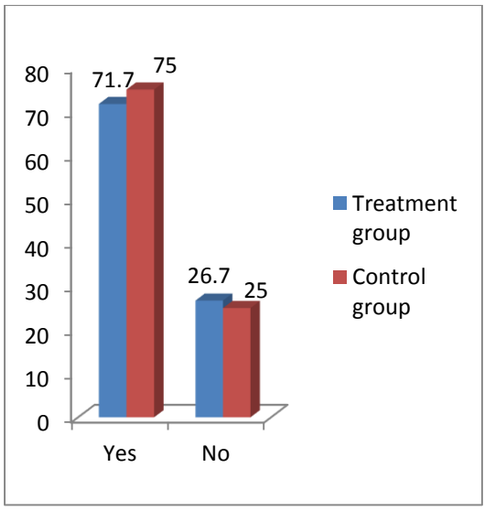
The chart on the right shows the present scenario and how the two groups responded in the survey as regards to their ability to save for daily expenditure. This helped in creating an understanding about the present situation of the two groups and ascertains if there is a change in their ability to save for daily expenditure.

- After the intervention: The result of the T-test, 2tailed. (.203) where the P-value is greater than > 0.05 means that no significant difference exists between the two groups after the intervention. There is an improvement recorded in the present year among the two groups as seen in the graph but not enough to trigger a significant difference.

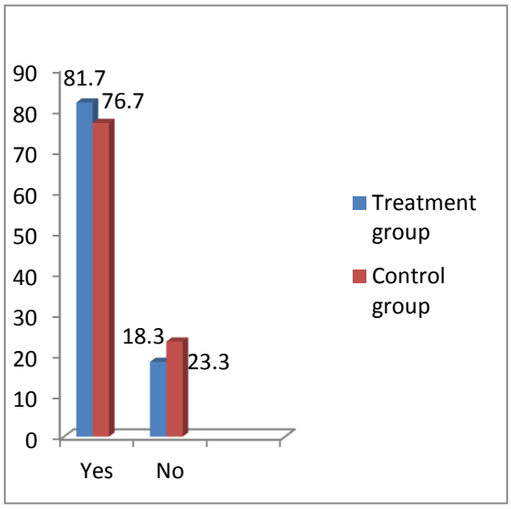
On this aspect of the analysis, no huge changes were recorded on the path of microfinance that could be attributed to microfinance. There could be other events that would have improved their savings capacity slightly.

Emergency Savings *(An Indicator of Financial Asset)*

The two groups were investigated to see their ability to save for emergency situation before 2012. The result from the survey conducted to establish the fact is illustrated in the graphs below.



Emergency savings before 2012(%)



Emergency savings in 2015(%)

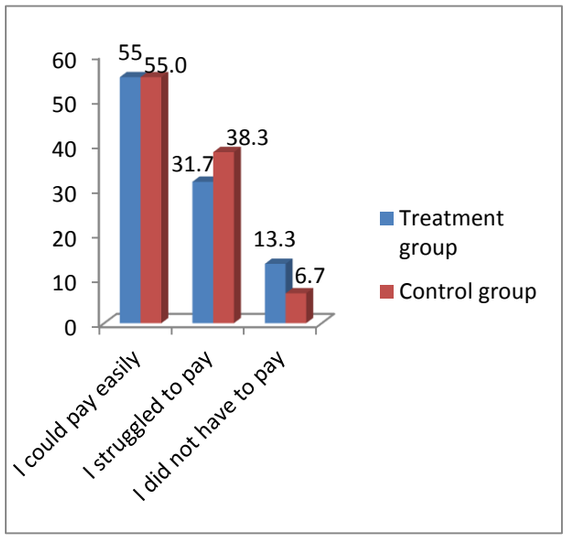
The result from the T-test conducted is here below to explain their comparison before and after the intervention of the programme in regards to emergency savings.

- Before the intervention = The T. test result, 2 tailed sig. (.843) where P-value is > 0.05 shows that no significant differences exist between the two groups in regards to their savings ability for emergencies before the intervention of microfinance. There were therefore comparable at this stage.
- After the intervention = T- test result, 2tailed sig. (.270) where the P-value is > 0.05 shows that even after the intervention of microfinance, there is no significant difference between the two groups. This is to say they are comparable.

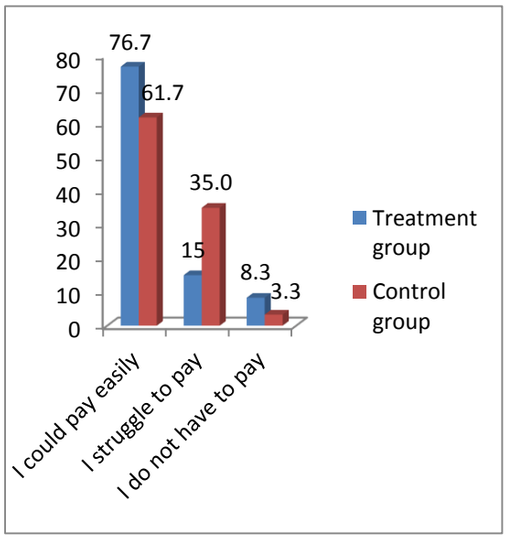
The improvement in the after time on the microfinance clients is little and did not amount to what could trigger a big difference between them and their counterparts in control group. On this note, microfinance has no impact on its clients regarding the level of savings for emergency. They could be having other means of saving for emergencies outside microfinance.

ABILITY TO PAY CHILDREN SCHOOL FEES (*an indicator of human asset*)

One of the indicators of human asset used for verifying if the two groups were comparable is education of their children measured by their ability to pay school fees.



Ability to pay children school fees before 2012 (%)

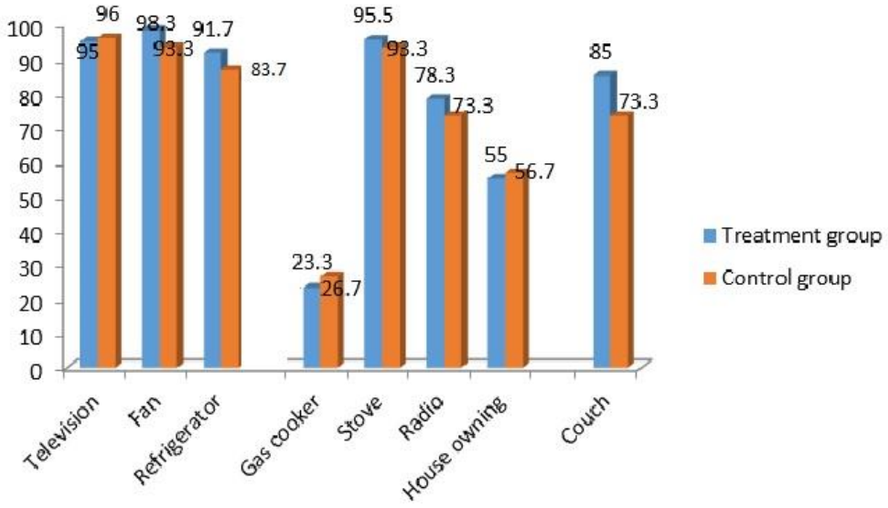


Ability to pay children school fees in 2015(%)

- Ability to pay children school fees before= T-test result, 2tailed.Sig (.426) where the P-value is > 0.05 means there was no significant difference between the two groups. From the description on the graph which was verified by the test, it means they were comparable before the intervention.
- Ability to pay for children school fees after= T-test, 2tailed.Sig (.725) where P- value is > 0.05. It implies that no significant difference was found between the two groups regarding their ability to pay for children school fees after microfinance intervention. They were therefore comparable. We could see in the after scenario the increase on the part of microfinance especially on those who could pay easily but such development is minimal and could not make any big changes that could be attributed to microfinance. The improvement could have happened as a result of something different from microfinance credit.

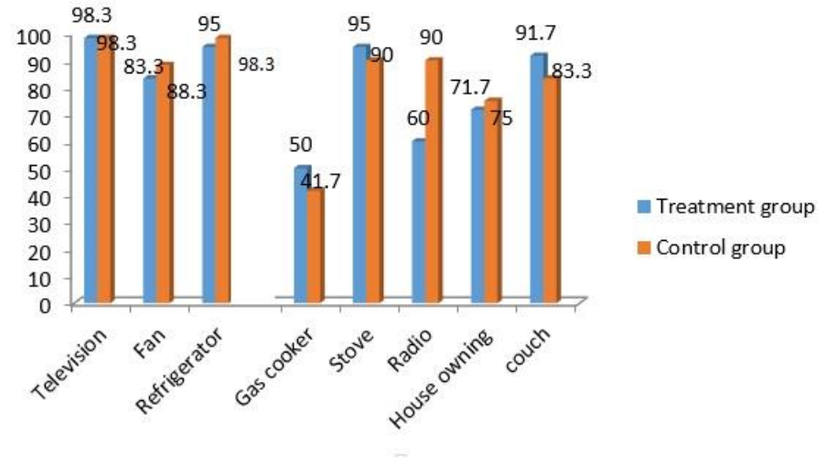
PHYSICAL ASSETS

This section covers the analysis of physical assets acquired by the respondents in the two groups before and after the intervention. This will also help in establishing the effects of the programme on the users.



Physical assets before 2012(%)

The graph above shows the physical assets owned by the two groups before the intervention. Judging from the graph, the findings indicates that there exists a fair distribution of physical assets between the control and treatment group in the before scenario. The data illustrates that across the groups there was an average distribution of Air conditioner and gas cooker. The diagram below shows the condition of their physical assets in 2015.

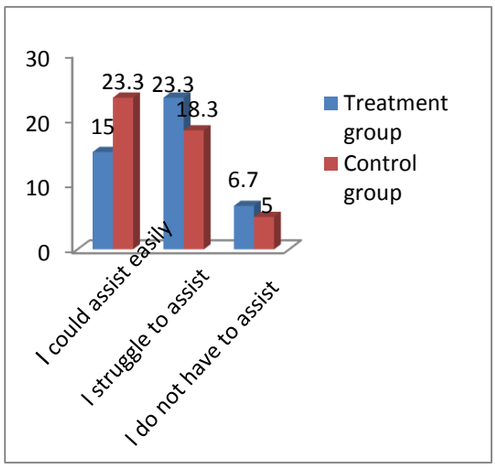


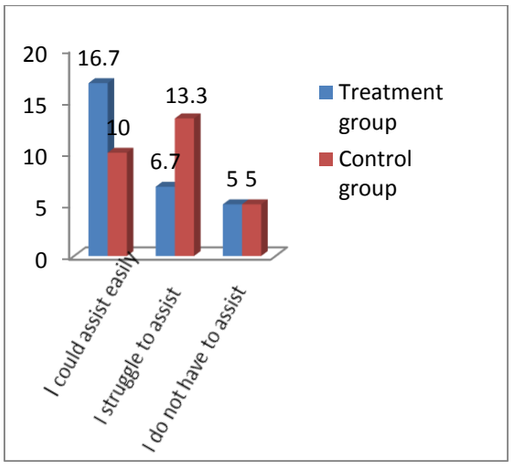
Physical Assets in 2015 (%)

This analysis indicates the performance of the two groups in terms of asset acquisition as both group compete tightly at the scenario before intervention and also have some improvement recorded in acquisition of air conditioner, gas cooker and home ownership at the after scenario period. The two groups as shown in both before and after scenario seemed to have maximum priorities for asset acquisition. There were no significant differences between the treatment and control group in regards to improvement of assets.

Ability to Assist in Payment of House Rent

During the research, questions were developed specifically for some of the respondents whose supports may be required by their husbands in regards to house rent payment. Further investigation was also conducted to see if they live in family houses with relatives where they may not be paying house rents. The questions about house rent payment contribution were for before and after scenario to establish the difference between the two groups studied.





House rent payment assistance before 2012% House rent payment assistance in 2015%

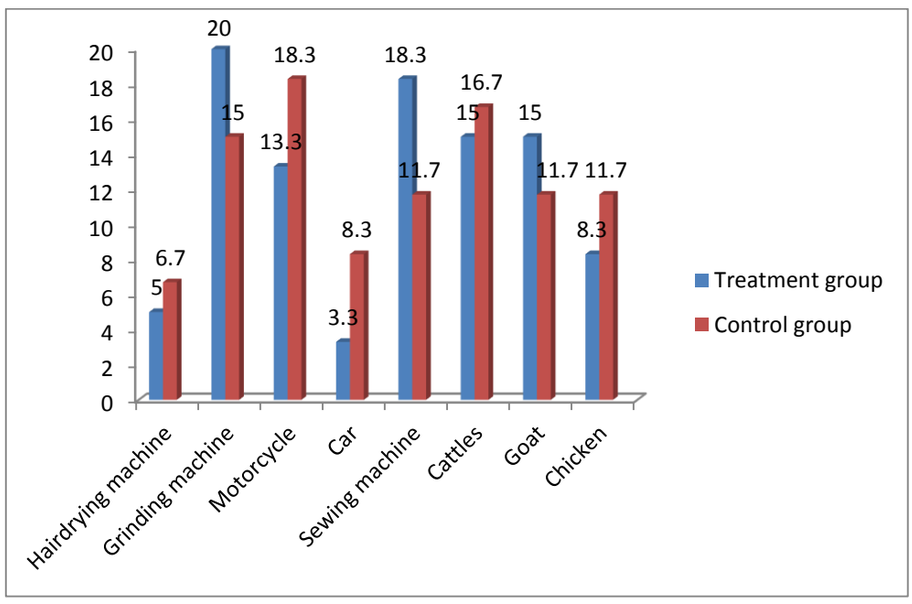
The study presents result of the test conducted to investigate the respondents' ability to assist in house rent payment. The T-test was conducted for the before intervention and after the intervention periods between the two groups to ascertain any difference. The results generated are below.

- House rent assistance before intervention=T-test result sig.2 tailed (.340) where the P- value is > 0.05 implies that no significant difference exist between the two groups. Therefore, they were comparable at the situation before the intervention of Microfinance.
- House rent assistance after intervention = T-test result sig.2 tailed (.539) where the P value is > 0.05 means that no significant difference is recorded between the two group. Although, from all indications, we noticed a slight increase on the number of people who could assist their spouses easily and a decline in the number of respondents who struggles to assist among the treatment group in the present year. However, the improvement is not enough to prompt a significant difference that should be attributed to microfinance.

The analysis here indicates that microfinance has no influence on the ability of its clients to assist their husbands in regards to payment of house rent as something else may have contributed to the little improvement noticed on the chart.

Business Items and Stocks

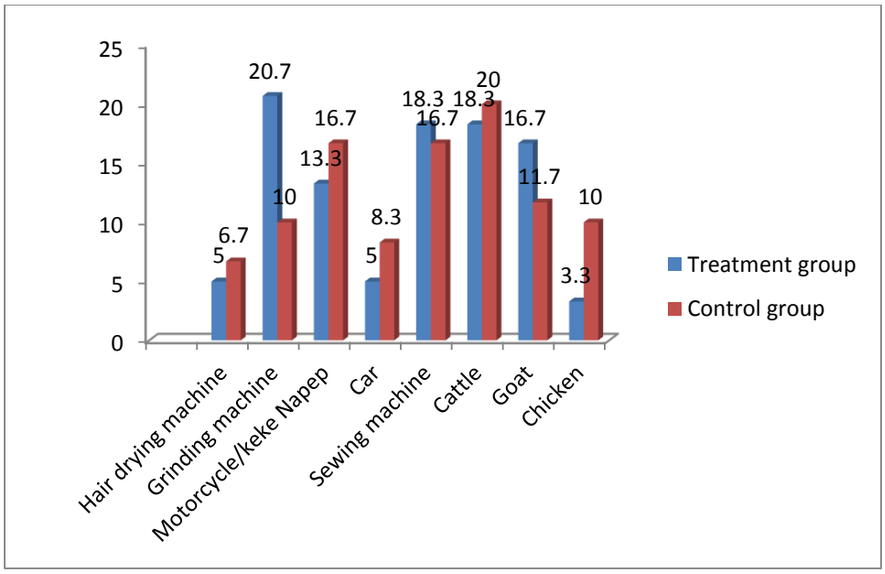
Having income generating items and stocks are ways of improving livelihoods. It is considered a strategy in preparing for hard time as such stocks provides income needed to cover households expenses when the need arise. The respondents were investigated to find out if they had business items and stocks before and after the intervention. The analysis below was done through the responses given.



Business items and livestock before 2012(%)

The analysis here entails the level of business items and stocks under the possession of the women in the two groups before 2012. What explains their differences was the test conducted which gave the results below.

Before the intervention = T- test result, 2 tailed sig. (.747) where the P-value is > 0.05 means that no significant difference exist between the two groups in terms acquisition of business items and stock before 2012. Therefore they were comparable.



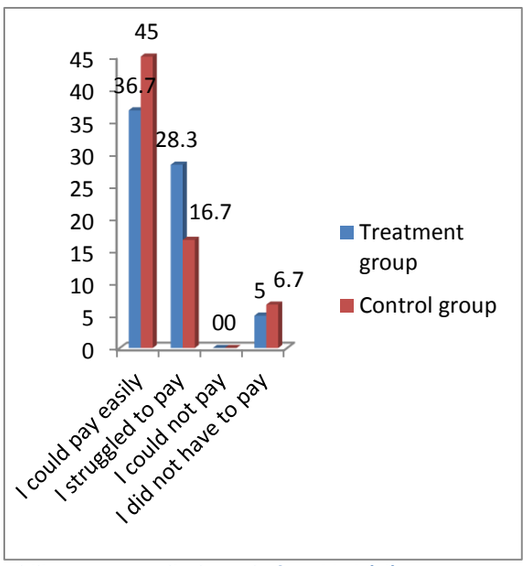
Business Items and Livestock In 2015(%)

The finding shows the situation among the two groups after the intervention. There are slight increases on some of the assets as well as decreases on other few as indicated on the chart. The result below explains the comparison between the two groups in the present time.

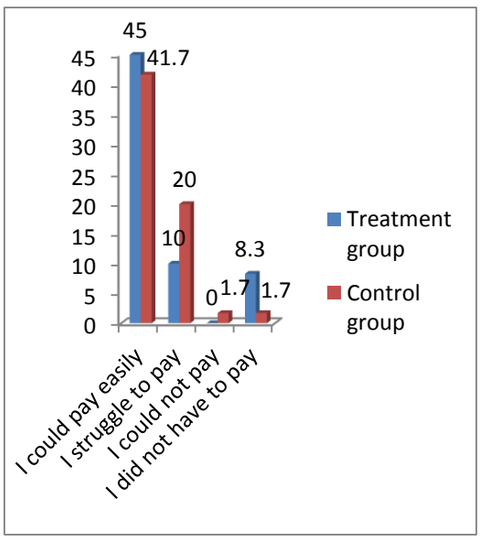
- After the intervention = T- test result shows 2 tailed sig. (.506) where the P-value is greater > 0.05. No significant difference between the two groups and they are therefore comparable. This analysis means that no changes or remarkable improvement is recorded that could be attributed to the intervention. Microfinance has no impact on the level of business items and stocks acquisition of its clients.

ABILITY TO PAY FOR MEDICAL TREATMENT (*as an indicator of human asset)*

Health is one of the major components of human capital. Respondents were also subjected to questions in relation to their ability to pay for medical care whenever the need arise.



Ability to pay medical care before 2012 (%)



Ability to pay medical care in 2015 (%)

Findings from the study conducted to investigate the ability to pay for medical treatment before the year of intervention was put to test for comparison between the two groups. The T- test results revealed the following.

- Before intervention= T-test sig. tailed (.561) implies that the P-value is > 0.05: This means that they were comparable and no significant difference exists between them before the intervention year.
- After intervention=T-test sig. tailed (.670) means that the P-value is > 0.05: This result indicates that they are both comparable and no significant difference exists between them at the present situation after the intervention had occurred.

ADDITIONAL INCOME AND SOURCE

The study also included questions that sought to investigate the respondents extra income and sources. This was to understand other contributing factors behind the improvements observed among them.

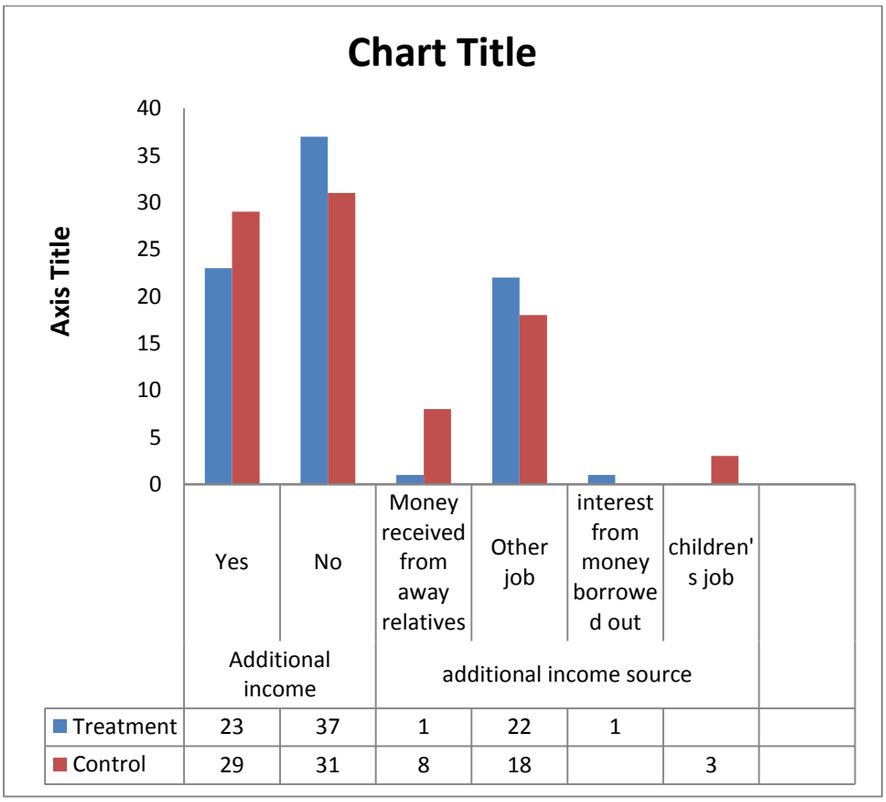


Chart 35: Additional income and source

Both the respondents in treatment and control group were found to be engaged in extra work apart from the business that earns them income. This analysis create an understanding that most improvements noticed in their assets was prompted by other job they do which serve as an additional income

SUMMARY OF FINDINGS

Influence of Microfinance on financial, Human and Physical Assets

The findings reveals that Microfinance had no impact on the clients' income as the women had access to credit but still involved in other jobs which provide them extra income. It is important to also state that household members of the women had jobs that contribute to the household income. The fact that they survived in their business may have emanated from these factors. This observation is in line with livelihood theory where it was explained that that Poor households are sometimes forced to make different choices by engaging in extra source of income depending on the level of vulnerability at any given time. (Rakodi, C., 2002)

Other important observation noted was their effort in ensuring that assets were secured through investment in business stocks and emergency savings. This observation correspond with portfolios of the poor by Morduch, Collins et al who stated that financial constraints

confronted by the poor who had small and irregular income pushes the poor to develop a life surviving strategy which assists them in managing livelihoods in order to handle their household expenses from various income source (Collins, Morduch, et al., 2009). It would have been a different dimension of hardship for the clients if they had no other additional income and assets would have eroded from the observation made from the survey.

Physical capital was measured by household items, home ownership/rental as well as business items and stocks. There was little improvement on the rate at which people could afford some of the household items and ownership of to some extent. Little improvement was also noticed on the area of medical bill affordability as situation got slightly better than how it was before the intervention of microfinance.

It was confirmed in the study that tangible assets like education, health and skills never eroded. Situation would have been worst if the women could not attain all these mentioned despite access to credit. This is in line with livelihood theory where it was stated that household ability to manage their labour assets in order to take advantage of opportunities created for economic activities is determined by education, skills and health status of household members (Rakodi, C., 2002).However, this is not say that they have done a lot as the improvements on education and health according to the study were too little to have triggered a great change that could be attributed to Microfinance intervention.

CONCLUSION AND RECOMMENDATION

The results showed insignificant effect of microfinance intervention on the livelihoods of the LAPO Microfinance clients as they were compared with the non-users of microfinance at all levels through their various assets investigated independently. It was concluded that the examined microfinance have no impact on the livelihoods of the women. The study recommend the need for a policy that will capture tangible improvement on business orientation and business development strategies. These should be an added benefits to the credit facilities rendered to the active poor.

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SUSTAINABLE BUILDING MATERIALS DEVELOPMENT

EARLY-AGE PROPERTIES OF SORGHUM HUSK ASH AND CALCIUM CARBIDE WASTE BINDER IN MORTAR

C. I. Egwuda, I. O. Hassan, B. J. Olawuyi, and M. O. Enejiyon
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Portland cement (PC) is a binder that is most commonly used as construction material in the production of mortar in masonry and concrete. The manufacturing process of PC during clicker production is however noted to contribute to CO2 emission which makes it a non-eco-friendly material. Notwithstanding, reports on total replacement of PC are scarce in literature. Sorghum husk ash (SHA), which is an incinerated ash from agricultural by-product consisting majorly of amorphous silica (SiO2), when combined with calcium carbide waste (CCW) an industrial by-product generated from an acetylene gas production process with major component of lime (CaO) in the presence of water forms compounds possessing cementitious properties. This paper reports on the early-age properties of SHA (as SiO2 source) and CCW (as CaO source) binder in mortar. Paste from different binder combinations of SHA/CCW were studied for setting time while the mortar samples were used to study the rate of hydration and strength development. The study revealed the SHA sample to be of high SiO2 (84%) and CCW is majorly CaO (66% content). The results obtained showed improvement in the performance of binders with superplasticizer formulated from 70/30, 60/40 and 50/50 SHA/CCW respectively, having 28days compressive strength of 7.6 N/mm2 [MPa], 7.0 N/mm2[MPa] and 5.7N/mm2[MPa] representing 36%, 34% and 28% of cement type I (CEM I) strength. The study showed that addition of superplasticizer reduced the water demand and improved the rate of hydration. The binder combinations of 70/30, 60/40 and 50/50 SHA/CCW with water-reducing admixture can be adopted for use in masonry works as it conforms to type N of ASTM C270 mortar.

Keywords: Binder; Calcium carbide waste (CCW); Mortar; Sorghum husk ash (SHA); Superplasticizer.

INTRODUCTION

The process of concrete and mortar production uses Portland Cement (PC) as binder for strength development and other desired properties and this has been noted to be the prominent global practice (Mehta and Monteiro, 2014). The manufacturing process of PC is however noted to contribute around 5% of global CO_2 emission resulting from clinker production and the fossil fuel used for pyro-processing (Rubenstein, 2012). Clinker production involves heating calcium carbonate ($CaCO_3$) in the kiln at temperatures of above 900ºC resulting in lime (CaO) and CO_2 as shown in equation 1.

$$CaCO_3 \xrightarrow{heat\ (>900\ oC)} CaO + CO_2 \quad (1)$$

The quick lime CaO is further made to react with materials containing silica (SiO_2), alumina (Al_2O_3) and iron (Fe_2O_3) at higher temperatures of about 1450ºC. This is then removed from the kiln, allowed to cool, ground to fine powder and mixed with about 5% gypsum to control the setting process (Neville, 2012; Mehta and Monteiro, 2014). The major components of PC is stated as CaO, SiO_2, Al_2O_3 and Fe_2O_3 with strength determinant being the CaO in combination with SiO_2 which forms hydrated lime – $Ca(OH)_2$ in the presence of water resulting in formation of CaO-SiO_2-H_2O – Calcium Silicate Hydrate (C-S-H) which is the final product for strength development as cement hydration progresses after water contact.

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Egwuda, et al., (2018). **EARLY-AGE PROPERTIES OF SORGHUM HUSK ASH AND CALCIUM CARBIDE WASTE BINDER IN MORTAR.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

Research and development of alternative binders to Portland Cement (PC) is continuously in the forefront in recent years due to the increased awareness on climate change attributable to global warming. Stratospheric ozone depletion and climate change resulting from emission of greenhouse gases (GHG) due to human and industrial activities with chlorofluorocarbons (CFC) and non-CFC gases such as carbon (IV) oxide (CO_2), adjudged the primary gas emitted (Waterloo News, May, 2013; US National Climate Assessment (NCA), 2014; US Environmental Protection Agency, 2016). This coupled with constant excavation and depletion of lime stone ($CaCO_3$) from their natural sources has resulted in research for alternative materials with focus on re-use and recycling of the abundant agricultural and industrial waste materials.

Previous studies on the search for alternative binders centred on utilisation of natural Pozzolan such as volcanic ash (Hossain 2003 & 2005; Hassan, 2006; Olawuyi, 2011) or ashes from agricultural wastes (agro-wastes) such as rice husk ash [RHA] (Okpala, 1987; Chaowat, 2001; Abalaka & Okoli, 2013), corn-cob ash [CCA] (Raheem, 2010), sawdust ash [SDA] (Elinwa & Mahmood, 2002), millet husk ash [MHA] (Jimoh *et al*, 2013;) Palm Oil Fuel Ash [POFA] (Hassan et al., 2013) and palm kernel nut ash [PKNA] (Joshua *et al*, 2015) amongst others as partial PC replacement in mortar or concrete.

Attempt on total cement replacement in concrete brought about studies into geo-polymer concrete which involve alkali activation of Pozzolanic materials with the use of chemical based hydroxide [NaOH] at elevated temperatures or ambient temperature (Ul. Haq*et. al*, 2014; Turner and Collins, 2013). Some studies on total cement replacement with Pozzolan in combination with alternative CaO source (calcium carbide waste [CCW]) include the works of Rattanashotinunt *et. al*., (2013) – baggase ash combined with CCW; Makaratat *et. al*., (2010) – combination of fly ash (FA) and CCW. Joshua et al (2016), combination of pulverized calcined clay (PCC) with CCW, both sourced within Nigeria and reported a hydration reaction with a 28 day strength of 11 MPa without any treatment to the CCW.

Incinerated ashes from agro-wastes at controlled temperature have been found to be pozzolanic with major components been amorphous silica which combines with lime in the presence of water to give cementitious properties. Pozzolan by definition is siliceous or siliceous and aluminous material which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperature to form compounds possessing cementitious properties (ACI Terminology of Concrete, 2013 in ACI Manual of Concrete, 2016; Neville, 2012).

The concept of pozzolanic reaction according to Mehta and Monteiro (2014) is based on the fact that Portland cement react using Tricalcium Silicate (C_3S) with water to give Calcium-Silicate-Hydrate (C-S-H) and Calcium Hydroxide (CH)

$$C_3S + H \rightarrow C - S - H + CH \quad (2)$$

and the Portland-Pozzolan cement reaction follows as

$$Pozzolan + CH + H \rightarrow C - S - H \quad (3)$$

Where C = CaO, S = SiO_2 and H = $(OH)^-$

The reaction in Equation 2 is known to be fast and lime producing while the reaction in Equation 3 is rather slow or latent depending on the properties of the pozzolanic material. The pozzolanic reaction in (Equation 3) is basically lime-consuming and does not necessarily require presence of cement but an active source of lime, hence the thought for alternative source of lime to enhance pozzolanic reaction with an agricultural waste ash as Silica source. Sorghum husk ash (SHA) is the focus of the present study as silica source (SiO_2). The CaO source in this study is an industrial waste material (calcium carbide waste (CCW)).

Calcium carbide waste (CCW) is a by-product of acetylene gas generated from calcium carbide used in the production of Polyvinyl Chloride (PVC) and in welding steels especially in the auto industry. CCW in Nigeria is reported to be 70-80% calcium hydroxide ($Ca(OH)_2$) with the impurities in it listed as copper, lead, iron, manganese, nickel and zinc (Chukwudebelu *et al*., 2013). SHA is an ash gotten from open-air burning of the husk of sorghum, which popularly serves as major staple food in the northern part of Nigeria. The drive towards food security and sustainability by the Nigeria Government with cereals grains like sorghum, maize and millet being the central focus and Niger State known as a major contributor to cereals production in Nigeria is an indication that the husk of the crops will ever be in abundant supply. Thus, utilization of these agricultural and industrial waste materials in concrete and mortar production should be seen as a welcome development. Previous attempt reported by Olawuyi *et al*., (2017) on SHA – CCW binder showed slow hydration process, high water demand, slow setting time and strength development. A research into early-age properties of SHA – CCW binder in mortar will surely offer contribution towards improving knowledge in concrete technology and infrastructural development.

EXPERIMENTATIONS

Materials

The materials used for this study are Sorghum husk for production of SHA as sources of SiO_2, CCW (an Industrial waste from automobile oxy-acetylene welding) as CaO source at varied combinations (70/30, 60/40, 50/50, 40/60 and 30/70 of SHA/CCW respectively) which formed the alternative binder; CEM I 42.5N (Dangote 3X) from Obajana factory of Dangote Cement Company served as the binder for the control mortar mix and Master Gleniun ACE 456 as superplasticizer. The fine aggregate used is the simulated reference sand (size range 1.18 mm [Sieve No. 16] to 75 µm [Sieve No. 200]) sieved out from the available natural sand in consonance with BS EN 196-1:2016 reference sand prescription for strength test on cement (binder), while potable water available at the Building Laboratory of the Federal University of Technology, Minna was used for mixing.

Sorghum husk were collected from Bosso Local Government Area, in Niger State, Nigeria. The husks were burnt in open air with a locally fabricated incinerator presented earlier in Abalaka & Okoli (2013). This was ground to finer particles in a local mill at Gidan-Mongoro Village of Minna and sieved with a 75 µm sieve and the particles passing were used as the SHA for the experiment. The CCW on the other hand was obtained from a local automobile Welder's (i.e. "Panel-beater" using oxy-acetylene gas) workshop in Minna as sludge. It was sun-dried and sieved with 75 µm sieve and the particles passing were used as the CCW sample in this study.

Methods

The study involved the evaluation of the physical and chemical properties of the constituent materials for proper characterisation of the materials used. Also determined were the fresh properties of the binder pastes and mortar before an examination of the strength properties and degree of hydration of the hardened mortar samples.

Mortar samples of 1:3 (c/s) and 0.5 water/cement (w/c) ratio specified by BS EN 196-1:2016 were used as control and for the alternative binders of varying proportion combinations of SHA/CCW respectively as stated in Section 3.1 were prepared and tested for strength and degree of hydration at different curing ages (3, 7, 14 and 28 days).

Physical and chemical Properties

Particle size distribution of the available natural sand was conducted using the dry-sieve approach in accordance with BS EN 933-1:2012 specifications for proper classification of the available natural sand. The reference sand required for mortar production in strength determination test specified in the standard (BS EN 196-1:2016) was then extracted using an arrangement of sieve size 1.18 mm and 75 µm. The particles passing the 1.18 mm sieve but retained on the 75 µm sieve was used for the mortar mixture for the strength test. The 1.18 mm sieve was adopted as the upper limit value for the simulated reference sand instead of the 1.6 mm sieve specified by BS EN 196-1:2016 because of non-availability of the 1.6 mm sieve in the laboratory. Figure 1 of Section 3.1 present the particle size distribution of both the natural sand and the simulated reference sand.

The physical properties determined for all the materials used for this experiment is the specific gravity test carried out in accordance with BS EN 1097: 1998 while fineness test was also conducted on the CEM I 42.5N and the varied combination of SHA/CCW via dry-sieving method as prescribed by BS EN 196-6:2010 using a 75 µm sieve available in the Laboratory.

X-Ray Fluorescence (XRF) analysis for determination of the oxide composition was conducted on the cementitious materials (CEM I 42.5, SHA and CCW) at Ewekoro Works Department of Lafarge Cement using XRF Analyser connected to a computer system for data acquisition.

Setting time and soundness of cement and the SHA/CCW binders

The initial and final setting times and the Le-Chatelier soundness tests for the binders (CEM I 42.5N and the various proportion combinations of SHA/CCW) were determined using neat pastes of standard consistency in accordance to BS EN 196-3:2016. This involved determining the water content of the paste which produced the desired standard consistency (Neville, 2012). Vicat apparatus Model No EL 38 - 2010 by ELE was used for measurement of the consistency and both the initial and final setting times following the procedures as outlined in the standard (BS EN 196-3:2016). The soundness test was also carried out on the respective binders using a Le Chatelier apparatus Model No EL 38 – 3400 by ELE.

Determination of strength and degree of hydration of the binders

Determination of strength and degree of hydration of the binders was conducted using 50 mm [2 in.] mortar cubes as mentioned in Section 3.2. Production of the mortar samples involved weighing out the appropriate constituent materials and ensuring that the SHA was thoroughly mixed with CCW in an head-pan before it is poured on the measured quantity of the simulated reference sand already spread into the steel mixing platform. The sand and binder was then mixed thoroughly before the

weighed mixing water was added and mixing continued until a uniform mix was achieved before casting into the 50 mm [2 in.] cubes moulds. The control mortar sample on the other hand, has the CEM I 42.5N mixed as described above with the simulated reference sand and requisite quantity of mixing water before casting into the cube moulds. Based on observation from the setting times tests as reported in Section 3.2, the samples were left covered with jute bags and cured by water sprinkling until 72 hours before demoulding and water curing by immersion made to continue until testing age.

The procedure for the strength test and degree of hydration determination thereby adopt similar approach reported in Hasholt et al. (2010) as cited in Olawuyi (2016). The procedure is as highlighted below:

i. The mortar cubes were cast and crushed at the different curing ages (immediately after demoulding – 3, 7, 14, and 28 days) in the Digital Universal Testing Machine (DUTM – 20) to assess the strength development.
ii. The remains of the sample in (i) above was then milled properly using the 150 mm [6 in.] x 150 mm Θ [6 in.] cylindrical moulds available in the lab and 25 mm [1 in.] Θ bar as mortar and pestle. The milled sample was then vacuum-dried for 1 hour to stop further hydration.
iii. A known weight of the vacuum-dried sample, about 25 g from the particle passing 75 µm standard sieve [Sieve #200] was measured and oven dried for 24 hours at 105ºC [221ºF] and weighed again (to determine the evaporable water i.e. the capillary water + gel water)
iv. This sample was then placed in the furnace [Model No SNOL 8,2 /1100 – 1LZ] set to 900ºC [1652ºF]. At one hour time after the furnace temperature reads 900ºC [1652ºF], the furnace was switched off, allowed to cool and the sample weighed (to determination of the amount chemically bound water i.e. the non-evaporable water).

All calculations were then based on ignited weight basis to give the following:

Loss on ignition (LOI) of the binders (CEM I 42.5 N, SHA and CCW) and hydrated mortar pastes calculated by

LOI (%) = 100 x (as received weight – ignited weight)/as received weight (4)

Non-evaporable water content w_n of the hydrated mortar pastes were determined to evaluate the degree of hydration as provided for in literature (Lam *et al*., 2000; Neville, 2012; Olawuyi *et al*., 2017). This is the difference in mass measurement of the crushed paste at 900ºC [1652ºF] and 105ºC [22ºF], to calculate the degree of hydration (α) on the basis that 1g of anhydrous cement produces 0.23g ofw_n, hence thew_n is calculated by using the following formula

$$w_n\% = \frac{100\ x\ (dried\ \ weight\ of\ paste - ignited\ weight\ of\ paste)}{(Ignited\ weigth\ of\ paste - loss\ on\ ignition\ of\ cement)} \quad (5)$$

The degree of hydration (α) is then:

$$\alpha = 100\ x\ \frac{Wn}{0.23} \quad (6)$$

The degree of hydration in the SHA/CCW binders at the various combinations (70/30, 60/40, 50/50, 40/60 and 30/70 of SHA/CCW respectively) were however calculated with consideration for the LOI of the SCM and their proportion made to adjust for their $w_n\%$ as appropriate.

RESULTS AND DISCUSSION

Characterisation of the Constituent Materials

Figure 1 presents the particle size distribution (PSD) of the available natural sand and the simulated reference sand used for the experiment. The PSD revealed the simulated reference sand to have a C_u and C_c values of 2.06 and 0.86 respectively and a Fineness Modulus (FM) of 2.56 indicating a fine sand classification of Shetty (2004) and the result is similar to that observed in earlier study (Olawuyi*et al*., 2017).

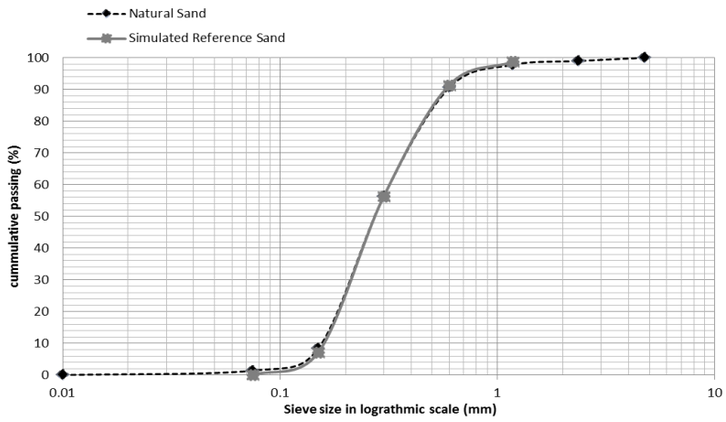

Figure 9: Particle Size Distribution of Fine Aggregate

Table 1 however present PSD of the CEN reference sand for determination of strength of cement as compared to the simulated reference sand used. It was observed that the simulated reference sand was compliant to three of the six size requirements of the CEN reference sand as prescribed in BS EN 196-1:2016.

The simulated reference sand was used for the study despite the shortcomings of not meeting the other three requirements since the study is basically a comparative study on strength development of the alternative binder developed and the CEM I, but not product validation and certification of the cement. The strength of the mortar samples from CEM I used in this study serve purely as a reference to which the strength of the alternative SHA/CCW waste binder was compared.

The specific gravity for the constituent materials is presented in Table 2. The result shows the values is similar to that observedearlier in the study as reported by Olawuyi*et al.*,(2017). The pH value for the constituent materials is also presented in table 3. The result shows that the values are alkaline (Fereshte et al., 2015).

Table 1: Particle Size Distribution of Fine Aggregate

Sieve opening (mm)	CEN Reference Sand (%)	Simulated Reference Sand (%)	Remark
2.00	0	0	√
1.60	7 ± 5	0	
1.00	33 ± 5	3	
0.50	67 ± 5	16	
0.16	87 ± 5	92	√
0.08	99 ± 1	99	√

Table 2: Specific Gravity of Constituent Materials (kg/m^3)

Materials	Specific gravity
CEM 1	3.15
SHA	2.32
CCW	2.29
Sand	2.58
Superplasticizer(Master Glenium)	1.06

Table 3: pH value of Constituent materials

Materials	pH value
CEM I	10.8
SHA	10.29
CCW	11.9

The oxide composition of the various cementitious materials obtained through XRF conducted at Lafarge Cement in Ewekoro is as presented in Table 3. The SHA samples are majorly silica having 83% SiO_2 contents respectively. The Table reveal the SHA as Class N Pozzolan with total SiO_2+Al_2O_3+Fe_2O_3 above 70%, SO_3 below 4% and loss on ignition (LOI) of less than 10%. The

CCW was observed to contain 66% CaO, a similar value to the CaO content (64%) of the CEM I sample. The CCW was however noted to be of lower SiO_2 and Al_2O_3 when compared to the PC sample. The LOI of CCW was noted to be above the specified 10% maximum, an indication that some heat treatment might be required for more effective performance of the material.

Table 4: Result of XRF Analysis for Oxide Composition of Cementitious Materials

SAMPLE	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	Na_20	K_20	TiO_2	P_2O_5	Mn_2O_3	Cr_2O_3	AR	SR	LOI	$SiO_2+Al_2O_3+Fe_2O_3$
SHA	83.0	2.9	2.7	1.3	0.8	0.0	0.2	2.8	0.2	0.5	0.0	0.0	1.1	14.7	5.6	88.6
CCW	3.6	1.6	1.3	65.8	0.2	0.0	0.1	1.0	0.1	0.0	0.0	0.0	1.2	1.2	26.4	6.5
CEM	21.5	5.2	1.2	64.0	2.9	4.5	0.6	0.0	0.1	0.2	0.0	0.0	4.5	3.4	0.0	27.8

Setting Times and Soundness of Binders

Table 4 presents the result of the consistency and soundness test conducted on the binder combinations with superplasticizer and the control (CEM I). The result shows that the water demand of the SHA/CCW binder was about twice that of the CEM I as against the triple value reported in Olawuyi*et al.,* (2017). The SHA/CCW binders reflect a high water demand trend for similar penetration values. The higher the SHA content, the higher the water demand and this was accounted for in the mortar production process for strength test of the binders.

The result of soundness test presented in Table 4 is similar to that observed earlier by Olawuyi*et al*., (2017). The resultrevealed that all the binder combinations conform to the 10 mm maximum expansion specified by BS EN 197-1:2011. Figures 2 and 3 present the plot of the setting times (initial and final) for the SHA/CCW binder combinations respectively.

Table 5: Fresh Properties of Binders with Superplasticizer

Specimen		Consistency		Soundness Expansion (mm)[0.04 in]
		SHA/CCW		
`	Superplasticizer (g)	Water Demand (%)	Penetration (mm)[0.04 in]	SHA/CCW
CEM 1	0	36.8	5.0	0.0
70/30	3.71	59.2	6.0	0.0
60/40	3.71	56.8	5.0	0.5
50/50	3.71	53.2	5.0	0.5
40/60	3.71	50.4	5.0	1.0
30/70	3.71	49.6	5.0	1.0

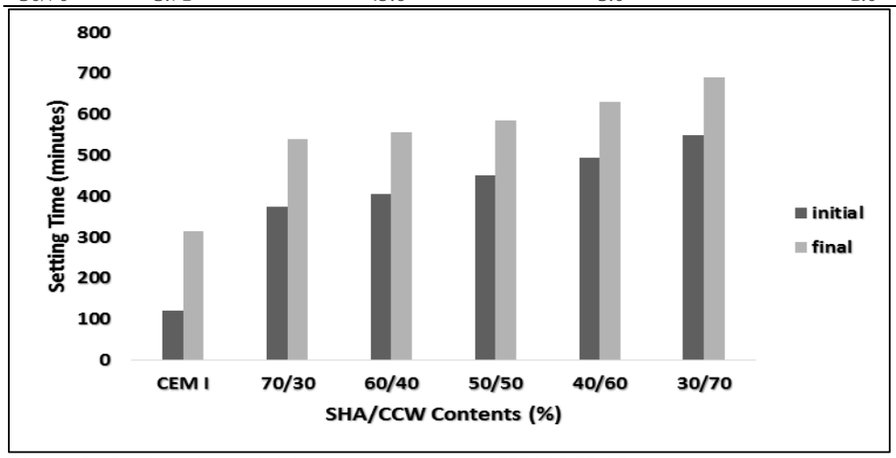

Figure 2: Setting times (initial and final) of the SHA/CCW Binder

The results revealed that the initial setting times of SHA/CCW binder combinations with superplasticizer is three multiple that of the CEM I which has similar trend to that reported by Olawuyi*et al*., (2017). The final setting times of SHA/CCW binders also show similar trend to that of the work of Olawuyi*et al*., (2017) which is also about three multiple of the final setting time for CEM I. This affirms literature postulation that Pozzolans are of latent setting in nature and improvement on the binders can be geared towards accelerating the setting times which is believed will enhance their strength development trends.

Degree of Hydration and Strength of SHA/CCW Binders

The plot of degree of hydration of the binders are presented in Figures 5, while the rate of hydration (RH_{28}) with reference to the 28 day value for the control sample (CEM I) is further shown in Table 5.

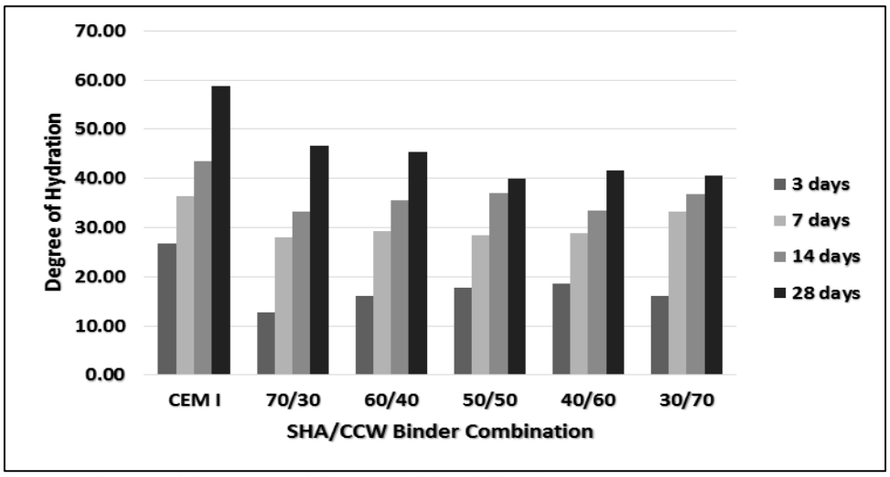

Figure 3: Degree of Hydration of Hardened SHA/CCW Mortar

The result revealed 70/30, 60/40 SHA/CCW combinations as the best of the SHA based binders with 47% and 45% levels of degree of hydration respectively by the 28 day curing age. This amount to RH_{28} values of 0.79 and 0.77 respectively with reference to the 28 days value of CEM I which is slightly higher than that of the work of Olawuyi*et al*., (2017). Hydration was observed to improve as the curing age increased and the binders are expected to show good long term strength development.

Table 6: Degree of Hydration and RH_{28} Factor of the SHA/CCW Binders

Binder Type	Specimen	Degree of Hydration				RH28 Factor			
		3 days	7 days	14 days	28 days	3 days	7 days	14 days	28 days
Control	CEM I	26.83	36.41	43.48	58.75	0.46	0.62	0.74	1.00
SHA/CCW	70/30	12.80	28.08	33.25	46.64	0.22	0.48	0.57	0.79
	60/40	16.02	29.21	35.53	45.34	0.27	0.50	0.60	0.77
	50/50	17.77	28.45	37.05	39.88	0.30	0.48	0.63	0.68
	40/60	18.64	28.93	33.38	41.61	0.32	0.49	0.57	0.71
	30/70	16.00	33.23	36.84	40.50	0.27	0.57	0.63	0.69

The early age (3 days) hydration values for the SHA/CCW binders was observed to be about half that of the PC. The plot of the compressive strength of the binders (Figures 6) was observed to follow similar trend as the inference drawn from the degree of hydration results. SHA/CCW (70/30, 60/40 and 50/50) gave 28day compressive strength values of (7.6, 7 and 5.7) N/mm^2 [MPa] which corresponds to 36%, 34% and 28% of CEM I strength respectively. The low strength can be attributed to the setting time of the mixture and also the additional water used for the binders established from the result of the consistency test.

Despite the low strength development of the SHA/CCW binders as observed in this study, the samples were noted to bind effectively with the fine aggregates after de-moulding at 72 hours (3 days) after casting. The mortar made from the SHA based binders did not dissolve in the immersed water in the curing tank all through the curing ages in this experiment. The SHA/CCW binder when improved upon possibly through the use of water reducers, keeping the water/binder ratio same as that of the control or by using set accelerating mixtures.

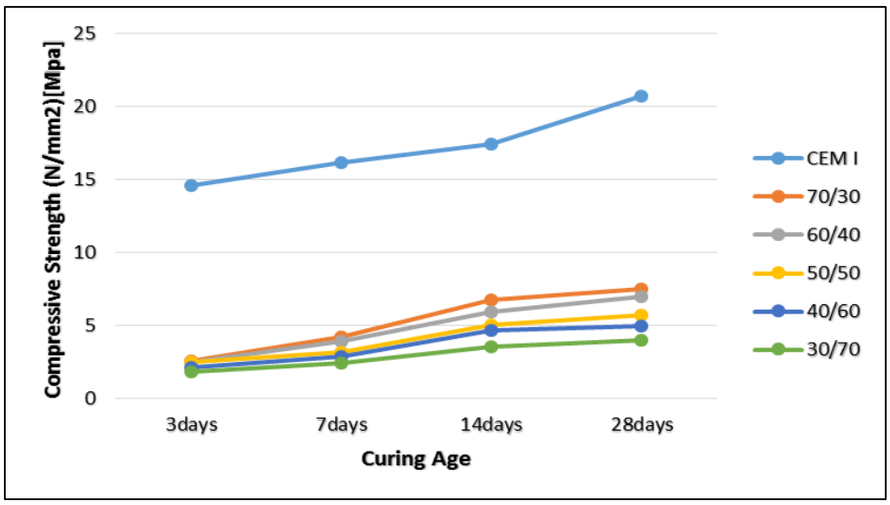

Figure 4: Compressive Strength of SHA/CCW Mortar with Superplasticizer

CONCLUSION AND RECOMMENDATIONS

The results of the study showed that the alternative binders from the SHA (an agricultural waste material) in combination with CCW (an industrial waste material) possess binding properties. The chemical analysis revealed that SHA is a Class N Pozzolan of high SiO_2 content (83%) while CCW is a good CaO source of similar percentage concentration (66%) as the CEM I used for the study. The study further revealed that the water demand was greatly reduced due to the addition of superplasticizer as well as slight improvement on the rate of hydrationof the mortar from the respective binder combinations. Further studies to be targeted at set acceleration and improved early strength development of the binder combinations through the use of set-acceleration with high range water reducer. This may hold a promise towards the desired breakthrough in early-age properties of sorghum husk ash and calcium carbide waste binder in mortar. The following are thereby recommended based on the findings of this study.

i. Further studies on the SHA/CCW should focus on set acceleration and early strength development through the use of set acceleration admixtures with high range water reducer.
ii. Further studies on heat treatment should be conducted due to high loss of ignition (LOI) of CCW.
iii. Investigation into the influence of temperatures slightly above the ambient temperature (40 – 90ºC) on the initial and final setting of the SHA/CCW binders should be carried out.
iv. Future studies on product of hydration should be conducted using scanning electron microscopy and X-ray diffraction analysis.
v. SHA/CCW (70/30, 60/40 and 50/50) in 1:3 binder/sand mortar at 0.5 W/B with water-reducing admixture can be adopted for use in masonry works as it conform to type N of ASTM C270 mortar.

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EFFECT OF REVIBRATION ON THE FLEXURAL STRENGTH OF CONCRETE, USING LOCUST BEAN POD EPICARP ASH AS PARTIAL REPLACEMENT FOR CEMENT

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This study examines the flexural strength of reinforced and revibrated concrete beams using locust bean pod epicarp ash (LBPEA) as partial replacement for cement. Chemical analysis of LBPEA contains the major oxides found in cement: Al_2O_3 (12.046%), SiO_2 (49.054%) and Fe_2O_3 (8.925%). Beams of sizes 150mm x 150mm x 600mm numbering fifty (50) in total were reinforced with 12mm diameter steel bars (Y12) and 8mm diameter steel bars (Y8) as links and cast for each percentage (0%, 5%, 10%, 15% and 20%) replacements of cement for LBPEA: thirty-five (35) revibrated; fifteen (15) non-revibrated; and were cured for 28 days. Revibration was done after initial vibration for 20 seconds at an interval of 10 minutes successions up to 1 hour. Revibrated beams were seven (7) each for every percentage replacement and for non-revibrated, three (3) each for each percentage replacement of cement for LBPEA. Flexural strength test carried out on each beams after 28-days curing shows that the maximum flexural strength occurred at 30^{th} minutes revibration time interval for both 0% and 5% replacements, 9.2N/mm^2 for 0% and 9.0N/mm^2 for 5%. while for the non-revibrated beams 9.17N/mm^2 and 8.33N/mm^2 at 0% and 5% replacements were attained. The flexural strength test result shows that revibration has improved the strength of the hardened concrete beams produced and thus, 5% to replacement of LBEA for cement can be used.

Keywords: Flexural strength, reinforced concrete beam, revibration, LBPEA.

INTRODUCTION

Ever since the introduction of concrete, researchers have not ceased to improve on the qualities of concrete production. Properties of concrete such as the compressive strength, fatigue strength, impact strength, abrasive strength and the flexural strength are very important in the construction of concrete structures. These therefore have inspired engineers/researchers to explore possible ways to improve upon these properties of concrete. In order to improve on the properties of hardened concrete produced, it has been found that revibration (this is the process of mechanically, intentionally and systematically vibrating a placed concrete after its initial setting-time) of the fresh concrete can improve greatly the strength of concrete (AMR, 2013; Auta, 2011; Krishna *et al*., 2008). Revibration as an aspect of concrete technology studies has the advantage of bonding layers of concrete in those that are preceding them. Examples are in deep walls, beams and columns where placing of concrete are done by layers. Revibration helps to improve the surface finishing of concrete wall and also improve the abrasive resistance of surface wall (Auta, *et al*., 2016). Furthermore, due to increase in the cost of concrete production for most concrete works, alternative options of partial substitutes for ordinary Portland cement (OPC) are also being explored. Such materials should be pozzolanic in nature, such as locust bean pod extract (LBPE), saw dust ash (SDA), rice husks ash (RHA), coconut ash (CA) etc., which are classified as agro-wastes. These agricultural wastes are processed into useful forms for concrete production. This has added advantage of environmental cleanliness compromising strength of the concrete (Elinwa, and Mahmood, 2002).

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The African locust bean tress with scientific name: *parkia biglobosa*, is a deciduous tree that grows 20m in height.

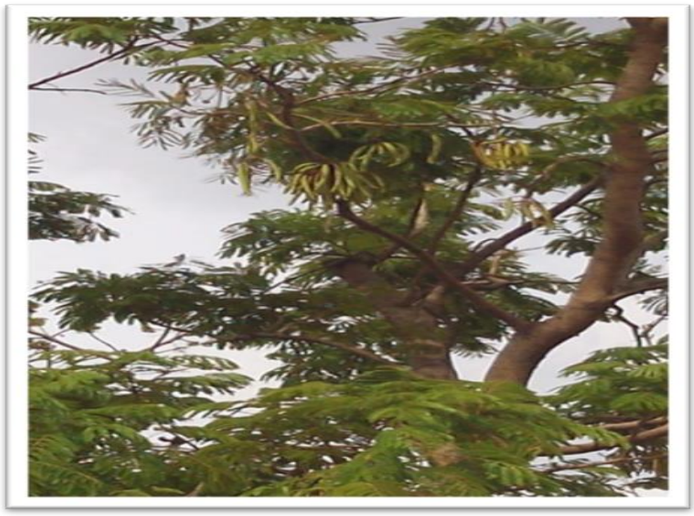

Plate I: Fresh locust bean pods (Auta, Tsado, Adebisi and Shiwua, 2016)

Plate II: Ripe locust bean pods (Aguwa and Okafor, 2012).

The tree grows in most of sub-Sahara Africa, but commonly in Nigeria (Plate I). It has a large fruit pod that contains both sweet yellowish pulp and valuable black seed that is mostly used in food seasoning- and is of medicinal value. The pod epicarp (Plate II) of the locust bean is an agro-waste which constitutes nuisance when not disposed properly. However, it can be harnessed as a building material (Ndububa and Uloko, 2015).

According to the ASTM C 618 (2005), a pozzolana is a siliceous materials which when in finely divided form, and in the presence of moisture, reacts with calcium hydroxide which is liberated during hydration of ordinary Portland cement (OPC) at ordinary temperature to form a compound that possess cementious properties. Pozzolanas have the characteristics of combining with free lime liberated during cement hydration to produce stable insoluble calcium silicate that reduces the process of mortar and concrete attack from sulphate, salts and chlorides.

In this study, focus is made to assess the effect of revibration on the flexural strength of reinforced concrete beams, using locust bean pod epicarp ash (LBPEA) as partial replacement for cement.

MATERIALS AND EQUIPMENT

Materials

The materials used for this study include the following:

Cement: Dangote brand of Ordinary Portland Cement was used as a binder. It conforms to type 1 cement BS EN 197-1 (2000).

Coarse Aggregate: The gravel that was used was also clean from particles and the gravel particle size falls between 10mm to 14mm B.S sieve. Quarry gravel was bought from Kpankugu in Minna, Niger state, Nigeria. It conforms to BS EN 12620 (2008).

Fine Aggregate: The fine aggregate (sand) used was clean sharp river sand that is free of clay, loam, dirt, and any Organic or chemical matter. It sand is passed through 5mm British Standard Test Sieves. It conforms to BS EN 12620 (2008).

Steel Reinforcement: For each specimen, two numbers of steel bars of size 12 mm (Y12) were used as the tension bars and also two numbers of 12 mm steel bars as compression bars and 8 mm links was used.

Water: Fresh, colourless, odourless and tasteless potable water that is free from organic matter of any kind was used. This complies with the specification in BS EN 1008 (2002).

Locust Bean Pod Epicarp Ash (LBPEA): The locust bean epicarp was sourced from Gombe state. It was burnt at a temperature of about 800^{o}C to produce the locust bean epicarp ash (LBPEA) that was used in this work.

Equipment

The equipment that was used for the experiment are: A weighing machine, British standard sieves, Concrete mixer, 150mm x 150mm x 600mm beam moulds, Head pan, Hand trowels, Tamping rod, Buckets, Vibrator and Universal testing machine.

EXPERIMENTAL PROCEDURE

Procedure

Chemical analysis of LBEA: A sample of the locust bean epicarp ash (LBPEA) was taken to chemical laboratory where the Oxides composition was determined using the X-Ray fluorescent (XRF) test.

Aggregate Characterization: The aggregates were tested for the physical properties such as: specific gravity, Particle distribution (sieve analysis) test and bulk density.

Preparation of the reinforced concrete beam specimen: Absolute volume method was used to carry out the concrete mix design using a mix ratio of 1:2:4 with water cement ratio of 0.5 for every replacement of OPC for LBPEA. Fifty concrete rectangular beams of sizes 150mm x 150mm x 600mm were produced for this study. 12mm tensile steel bar (Y12) was used as the main reinforcement and 20mm concrete cover was used for the beam specimen. The size of the links provided was 10mm (Y10) steel bar each at regular spacing of 125mm c/c. The beam specimens were produced for revibrated (35 beams) and non-revibrated (15 beams). Seven (7) beams were cast and revibrated for each percentage replacements (0, 5, 10, 15 and 20 %) of OPC for LBPEA. For the revibrated beams, revibration of 20seconds duration at 10 minute successions through 1 hour was achieved using poker vibrator after initial vibration, while that of the non-revibrated beams only three (3) beams were produced for each percentage replacement (0, 5, 10, 15 and 20 %). The beams were de-moulded after 24 hours and then cured for 28days after which were tested flexural strength using the universal flexural testing machine.

RESULT AND DISSCUSION

The results of the laboratory tests which include: chemical composition of the LBEA, aggregate characterization and test on concrete (fresh and hardened properties) are presented in Tables 1, 2, 3, 4, 5, 6, 7 and Figures 1, 2 and 3.

Chemical analysis of LBPEA

The chemical composition of LBPEA used in this study is presented in Table 1. The chemical compound of Silicon dioxide (SiO_2 = 49.054%), Iron oxide (Fe_2O_3 =8.925%) and Aluminium Oxide (Al_2O_3 =12.046%) which constitute a total sum of 70.025% of pozzolanic materials which is approximately 70%, but greater than 70%. According to (ASTMC 618-9, (1991), pozzolanic classification is based on the summation of percentage composition (SiO_2+ Fe_2O_3 + Al_2O_3), if the sum is greater or equal to 70% then the ash is classified as

Class F, while if it is greater than or equal to 50% it is class C. From this result, the LBPEA is a pozzolanic material and falls under class F.

Table 1: Chemical composition of LBPEA

Element	Concentration
Na_2O	1.012
MgO	6.905
Al_2O_3	12.046
SiO_2	49.054
P_2O_5	2.017
SO_3	3.212
Cl	2.412
K_2O	1.224
CaO	11.125
TiO_2	1.562
Cr_2O_3	0.000
Mn_2O_3	0.198
Fe_2O_3	8.935
ZnO	0.209
SrO	0.125

Aggregate Characterization

The aggregates were tested for physical properties according to specifications such as: specific gravity, particle distribution test and bulk density.

Particle size analysis for fine, coarse aggregates and LBPEA: The results of particle size analysis of LBPEA, fine and coarse aggregates used in the study are presented in Table 2, Figures 1 and 2 respectively.

Table 2: Particle size analysis LBPEA

Sieve size (mm)	Sample weight retained (g)	Percentage retained (%)	Cumulative percentage retained (%)	Cumulative percentage passing (%)
0.850	0.00	0.00	0.00	0.00
0.600	0.00	0.00	0.00	0.00
0.425	0.00	0.00	0.00	0.00
0.300	25.42	12.71	12.71	87.29
0.150	99.32	49.66	62.37	37.63
0.075	44.68	22.34	84.71	15.29
Pan	27.72	13.86	-	-
Total			159.79	

Table 3: Slump test result of fresh concrete

Percentage replacement (%)	slump value (mm)
0	28
5	20
10	17
15	12
20	No slump

Table 4: Compacting factor test result of fresh concrete

Percentage replacement (%)	Compacting factor value
0	0.90
5	0.87
10	0.87
15	0.85
20	0.83

From Table 2, the fineness modulus (FM) of 1.6 is less than fineness modulus of 2.3 -2.1 for fine aggregate suggested by American Society for Testing and materials (ASTM) C 33, hence LBPEA is finer than fine aggregate.

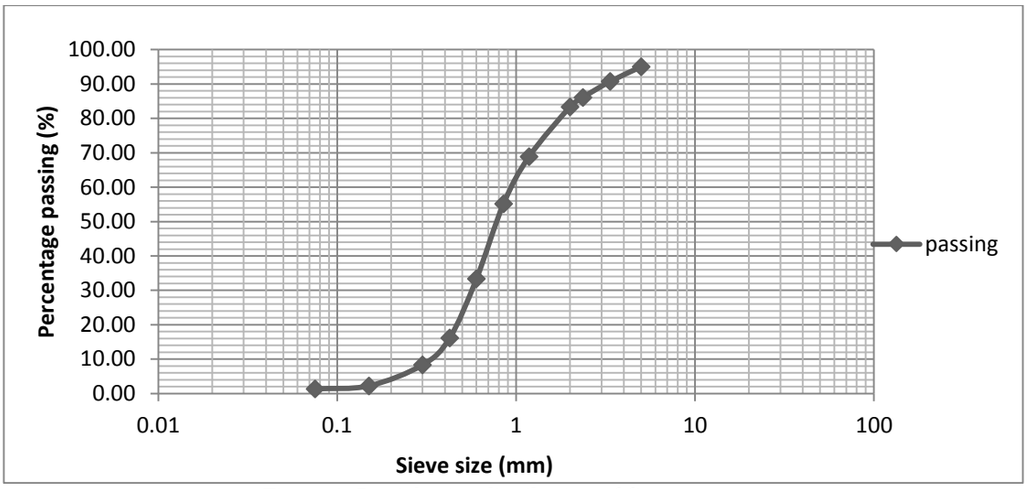

Figure 1: Particle size distribution of fine aggregate

From the particle size distribution curve in Figure 1, the uniformity coefficient (CU) is calculated as equal to 6.0, while the coefficient of curvature (CC) is calculated as 1.63. Hence the aggregate is well graded gravel since the result agrees with the Unified Soil Classification System (USCS) of well graded sand with less than 5% fine has $1 \leq Cc \leq 3$ as stated by Arora (2010).

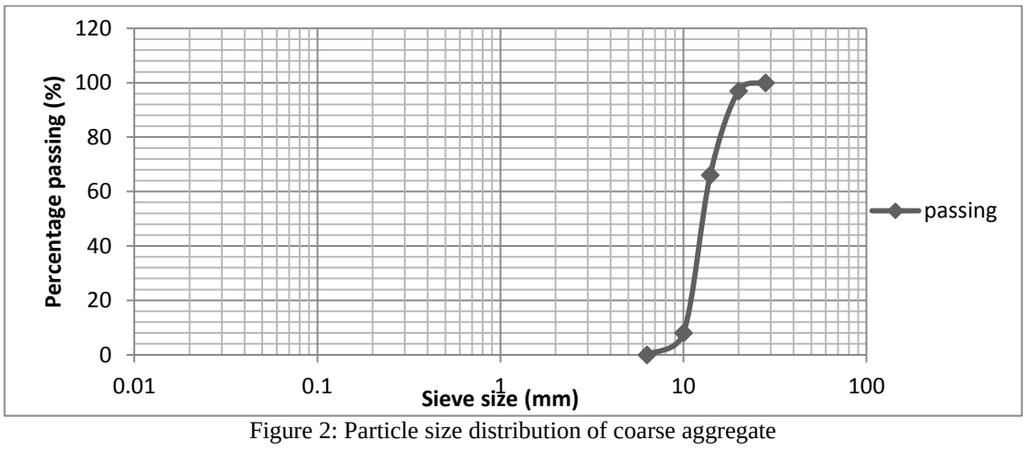

Figure 2: Particle size distribution of coarse aggregate

From the particle size distribution curve in Figure 2, The uniformity coefficient C_U is calculated as equal to 1.5, while the coefficient of curvature C_C is calculated as 1.12. Hence the aggregate is well graded gravel because the result complies with the Unified Soil Classification System (USCS) of well graded sand with less than 5% fine has $1 \leq Cc \leq 3$ as stated by Arora (2010).

Specific gravity: The fine aggregate specific gravity value is 2.62; and that of coarse aggregate is 2.65. The specific gravity of both the coarse and fine aggregates is within limit of 2.5 to 3.0 for natural aggregate as specified by BS812: part 107, 1995. The specific gravity value of LBPEA was found to be 2.14. All this values were gotten on an average of three trials.

Bulk density: The value for compacted and uncompacted bulk densities of LBPEA are 562kg/m^{3}and 490kg/m^3. The compacted and uncompacted bulk densities of the sand are 1669g/m^{3}and 1590g/m^3 while that of coarse aggregate is 1352kg/m^3 for the uncompacted and 1534kg/m^3 for the compacted. This values correspond to the range of 1200-1800kg/m^{3}specified by BS 812, part 2: 1975 for aggregates

Slump Value and Compacting Factor Test

Slump test: From the result of slump test shown in table 3. It is seen that there is a decrease in the slump value as the LBPEA content is increased. It can be inferred therefore that the amount of water for concreting will increase to get a workable concrete at higher percentage replacement forLBPEA.

Compacting factor test: A decrease in the compactor factor from 0.9 to 0.83 as shown in table 4 depicts a decrease in the workability of the fresh concrete as the percentage

replacement for LBPEA increases from 0% to 20%. This also means that more water is need for the fresh concrete flow well as the percentage of LBPEA increases in the concrete mix. The high demand for water as the LBPEA content increases is due to increased amount of silica in the mixture. This is typical of pozzolana cement concrete as the silica-lime reaction requires more water in addition to water required during hydration of cement (Bui *et al*. 2005).

Table 5: Flexural strength of revibrated concrete beams for 28 days of curing

Percentage of cement for LBPEA (%)	Revibration time interval (minutes)	Weight (kg)	Flexural strength (bar)	Flexural strength (N/mm^2)	Average flexural strength (N/mm^2)
	0	34.41	100	10.0	
	10	34.53	105	10.5	
	20	33.94	105	10.5	
0	30	33.01	90	9.0	9.2
	40	32.98	85	8.5	
	50	33.75	80	8.0	
	60	33.73	80	8.0	
	0	35.75	90	9.0	
	10	36.54	100	10.0	
	20	36.60	95	9.5	
5	30	36.72	90	9.0	9.0
	40	36.81	90	9.0	
	50	36.31	85	8.5	
	60	36.06	80	8.0	
	0	34.53	75	7.5	
	10	34.95	75	7.5	
	20	35.28	80	8.0	
10	30	35.54	80	8.0	7.79
	40	36.68	85	8.5	
	50	34.97	75	7.5	
	60	35.70	70	7.0	
	0	34.95	65	6.5	
	10	35.56	70	7.0	
	20	35.90	70	7.0	
15	30	35.24	70	7.0	6.57
	40	36.82	65	6.5	
	50	36.21	60	6.0	
	60	36.63	60	6.0	
	0	35.59	35	3.5	
	10	35.69	40	4.0	
	20	35.77	50	5.0	
20	30	35.47	50	5.0	4.5
	40	35.32	50	5.0	
	50	36.19	45	4.5	
	60	36.37	45	4.5	

Table 6: Flexural strength of non revibrated concrete beam after 28 days

S. No.	Percentage of cement for LBPEA (%)	Weight (Kg)	flexural strength (Bar)	flexural strength (N/mm^2)	Average flexural strength (N/mm^2)
1	0	34.30	95	9.5	9.17
		35.10	90	9.0	
		33.25	90	9.0	
2	5	35.24	80	8.0	8.33
		34.97	85	8.5	
		35.12	85	8.5	
3	10	38.00	80	8.0	7.77
		36.57	75	7.5	
		38.05	78	7.8	
4	15	35.06	60	6.0	5.50
		33.50	50	5.0	
		34.00	55	5.5	
		36.77	50	5.0	5.17
5	20	36.84	50	5.0	
		35.89	55	5.5	

Table 7: Summary result of mean flexural strength of non-revibrated and revibrated concrete beams

Description	0	5	10	15	20
Flexural strength of revibrated beams	9.2	9.0	7.79	6.57	4.5
Flexural strength of non-revibrated beams	9.17	8.33	7.77	5.50	5.17

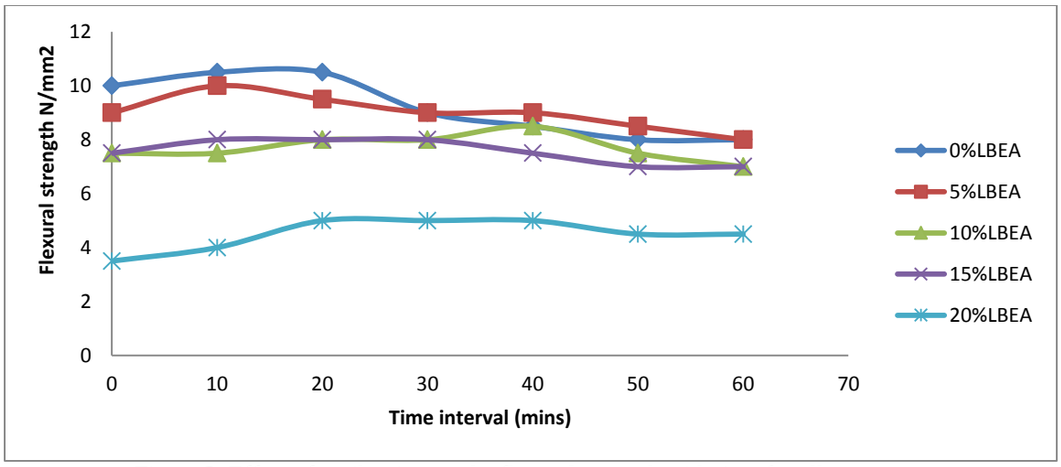

Figure 3: Effect of revibration on the flexural strength with time for all percentages

Flexural Strength of Revibrated and Non- revibrated Concrete Beams with SDA at 28 Days: The flexural strength test result of the fifty beam specimens is shown in table 6 (non-revibrated), table 5 (revibrated), table 7 (revibrated and non revibrated), figure 3 (revibrated). It can be seen from table 5 that the flexural strength increases at the initial stage of revibration at 10^{th} min and 20^{th} min interval giving rise to a value of 10.5N/mm^2 to 10.5N/mm^2, but later there is a gradual decrease in strength from 30^{th} min respectively for the 0%. The trend is the 5%.

The early increase in flexural strength may be attributed to the calcium hydroxide in the OPC and revibration which enhanced densification and volumetric compaction of the concrete beam, but later revibration will debone the chemical compound of C_3S which leads to a decrease in strength from 30^{th} minute to 60^{th} minute. It can also be seen from table 7 that the average flexural strength value obtained after revibration at 10 minute lag time interval to duration of 1 hour seem to have an improved strength compare to the value obtained for the non-revibrated concrete beam containing corresponding 0%, 5%, 10%, 15% and 20% LBPEA after a curing period of 28 days, thus indicating that revibration has improved the strength of concrete (Krishna *et al*., 2008).

CONCLUSION AND RECOMMENDATION

Conclusion

Effect of revibration on the flexural strength of concrete, using locust bean pod epicarp ash as partial replacement for cement is presented. From the study, the following conclusion can be drawn:

Chemical analysis LBEA indicated that the major constituents of LBEA includes; calcium oxide (CaO), Silicon dioxide (SiO_2), iron oxide (Fe_2O_3) and Aluminium Oxide (Al_2O_3) and other minor oxides in proportions Magnesium Oxide (MgO), Sodium Oxide (Na_2O) and Potassium Oxide (P_2O_5) placing LBPEA in the Class F as specified by ASTM C 618- 78 (2005) for pozzolana;

The indication of flexural strength of revibrated LBEA concrete beams for 0% and 5% replacements gaining increase from 0^{th} to 20^{th} minutes of revibration and then decreases thereafter on further revibrations, show that LBEA can be used up to 5% to replace cement.

The mean flexural strengths of revibrated and non-revibrated beams when compared, show that the flexural strengths for revibrated beams are higher than that of non-revibrated. Thus revibration affected the flexural strength of LBEA concrete considerably positively.

Recommendations

Based on the experimental works the following recommendations were made:

The process of re-vibration should be encouraged in concrete work in other to ensure improvement in quality.

LBPEA if properly burnt can be used up to 5% to replace cement in concrete work.

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EFFECT OF SUPERPLASTICIZER ON SETTING TIME AND STRENGTH OF MORTAR MADE USING RICE HUSK ASH (RHA) AND CALCIUM CARBIDE WASTE (CCW) AS BINDER

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Consequent to the challenge of global warming partly associated to high CO_2 emission and energy consumption from cement production processes, research focus has shifted to sourcing alternatives to Portland cement in concrete and mortar production. Incinerated ashes from agro-wastes such as Rice Husk Ash (RHA) at controlled temperature has been found to be pozzolanic with major components been amorphous silica which combines with lime in the presence of water to give cementitious properties. RHA – CCW binder has however been reported to be of high water demand, slow setting rate and strength development. This study incorporates a superplasticizer (Master Glenium ACE 456) – a water reducing agent and set accelerator as an attempt at overcoming the limitations of this new binder. Pastes of 1:3 binder: sand (b:s) and 0.5 water cement (w/c) ratio in accordance to BS EN 197: 2000 made from the different proportion combinations of RHA – CCW were examined for influence of superplasticizer on setting times, degree of hydration and strength development. The study showed that the superplasticizer enhanced early setting and strength development of the mortar. Mortar samples from 60/40 RHA – CCW binder showed superior performance over the other percentage blends with respect to 28 days compressive strength.

Keyword: Calcium Carbide Waste; Mortar; Rice Husk Ash; Setting Time; Strength Development; Superplasticizer

INTRODUCTION

Portland cement (PC) – the major known binder in concrete and mortar production is adjudged non-environmental friendly due to its carbon dioxide (CO_2) and energy consumption with resultant global warming effect from its production processes. The PC production processes contributes about 5% to global anthropogenic CO_2 emission making the cement industry an important sector of CO_2 emission mitigation strategies (Rubenstein, 2012).

Most research efforts have been on the partial replacement of PC while little has been reported on total cement replacement in concrete/ mortar. Incinerated ashes from agro-wastes such as rice husk ash (RHA) at controlled temperature have been found to be pozzolanic with major components been amorphous silica which combines with lime in the presence of water to give cementitious properties (Habeeb & Mahmud, 2010). RHA, known to be of high silica content (Parande, *et al*, 2011) was combined at varied proportions in this study with oven-dried calcium carbide waste (CCW) – CaC_2 , which is known to be mainly calcium oxide (CaO). Yunusa (2015) reported CCW to react with water yielding calcium hydroxide as a by-product as shown in equation 1 below.

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2 \quad (1)$$

The concept of pozzolanic reaction is based on the fact that PC react using tricalcium silicate (C_3S) with water to give calcium-silicate-hydrate (C-S-H) and calcium hydroxide (CH) (Mehta & Monteiro, 2014)

$$C_3S + H \rightarrow C - S - H + CH \quad (2)$$

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Enejiyon, et al., (2018). **EFFECT OF SUPERPLASTICIZER ON SETTING TIME AND STRENGTH OF MORTAR MADE USING RICE HUSK ASH (RHA) AND CALCIUM CARBIDE WASTE (CCW) AS BINDER.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

While the Portland-Pozzolan cement reaction follows as

$$Pozzolan + CH + H \rightarrow C - S - H \quad (3)$$

Where C = CaO, S = SiO_2 and H = $(OH)^-$

The reaction in Equation 2 is known to be fast and lime producing while the reaction in Equation 3 is rather slow or latent depending on the properties of the pozzolanic material. The pozzolanic reaction in (Equation 3) is basically lime-consuming and does not necessarily require presence of cement but an active source of lime, hence the thought for alternative source of lime to enhance pozzolanic reaction with an agricultural waste ash as SiO_2 source is the focus of the present study.

RHA and CCW have been used in most research as partial replacement of cement in the production of mortar and concrete (Abalaka, 2012; Rao *et al.,* 2014; Gupta & Wayal, 2015 and Yunusa, 2015).

Nigeria's drive for Agriculture with rice production at the centre stage and Niger State being a major rice producing State in Nigeria is a motivation for this study. This study is an attempt to explore the possible utilization of RHA and CCW as an alternative binder in construction, which will not only provide low cost cement and concrete but also help to decrease environmental hazard posed by CO_2 gas emission during cement production. The use of these materials in mortar as a binder may help to achieve energy conservation with economic, ecological and technical benefits. A recent report on RHA – CCW binder (Olawuyi, *et al*., 2017) reports high water demand, slow setting and strength development. This paper reports attempt at enhancing better performance of this new binder by adding a superplasticizer in the mixture.

LITERATURE REVIEW

Pozzolan is defined as a siliceous or siliceous and aluminous material which itself has little or no cementitious value but will in finely divided form and in the presence of moisture, chemically reacts with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties (ASTM C125; Neville, 2012). RHA is classified as Pozzolan due to its high silica content (say about 90%) (Kartini, 2011; Thirougnaname & Sundararajan, 2013)., Roa *et al.,* (2104) reported that RHA which took about 48 hours to burn under uncontrolled combustion process with temperature ranges between 600 – 850^{o}C, grinded with ball mill has about 85%-90% amorphous silica. Rice husk is an agricultural residue obtained from the outer covering of rice grains during milling process. It constitutes 20% of the 500 million tons of paddy produced in the world. When the husk was converted to ash by uncontrolled burning above 500^{0}C, the ignition would not be completed and leads to considerable amount of un-burnt carbon being found in the resulting ash (Givi. *et al.*, 2010).

RHA is reported by Ramezanianpour *et al.,* (2009) to be a carbon neutral green product and known to be a good super-Pozzolan. It produce a high amount of silicon dioxide (SiO_2), with silica content of above 89%, in very small particle size of less than 35 microns and can be used in High Performance Concrete. Oyekan & Kamiyo (2011) reported that an increase in RHA content up to 30% in sandcrete block resulted to decrease in compressive strength and density of the blocks. Sandcrete blocks permeability increases with RHA content and ambient temperature with decrease in thermal conductivity.

RHA replacement up to 25% in concretes resulted to improved compressive strength, flexural strength and increase in bond strength with reduction in density compared with conventional concrete (Nair *et al*., 2013).

Thirougnaname & Sundararajan (2013) examined 1:4 cement mortar with RHA added as an admixture from 7.50% to 17.50% at 2.5% variation steps and reported that the compressive strength of mortar cube samples increased up to 10% RHA content.

In the work of Srinivas & Kishore (2015), RHA replacement of PC gave early strength value slightly less than the conventional concrete. There is an increase of around 23.1% and 33.9% in compressive strength for 20% RHA blended cement concrete at 28 and 56 days age of normal water curing.

Geetha & Kumar (2015) as reported by Kumar **(**2010) in their research got the compressive strength values of RHA concrete to be in the range of 70-80% of conventional concrete for a replacement of cement up to 20%. Early-age strength of RHA concrete was reported to be lower with strength increases recorded with age.

CCW is a CaO source and a by-product from acetylene gas production process. It is generated when calcium carbide reacts with water to produce highly flammable acetylene gas. It is majorly sourced from auto factory (Panel-beaters and Welders) as the a result of calcium carbide use by them (EMI,

2017). 10% replacement of PC with CCW was reported by Yunusa (2015) to give a satisfactory result with increase in water absorption as the RHA content in the mix increases.

MATERIALS AND METHODS

The material constituents, their mix, presence of admixtures and manufacturing process are important factors that determine the properties of the mortar cubes. The materials used and method of manufacture employed in this investigation are thus presented.

Materials

The materials for this study are Portland cement (PC), rice husk ash (RHA), calcium carbide waste (CCW), sand, superplasticizer and water.

PC

The Dangote (3X) brand of Portland cement (CEM 42.5N) from a dealer at Gidan Kwano, Minna, Niger State was be used in this study. Various physical tests were conducted on the materials for their characterization and assessment of conformity with BS standard (BS EN 197-1:2011) for Portland cement. Result of the chemical and physical properties of the RHA, CCW and the PC are given in Table 1.

RHA

The Rice Husk was collected from a milling site at Garatu Village, Minna, Niger- State. The husk was burnt to ash using the locally fabricated incinerator available at Building Department Laboratory of Federal University of Technology, Minna by open air method for about 48hours. It was allowed to cool before harvesting and milled with ball milling machine at Federal Polytechnic, Bida so as to achieve the required fineness. The fineness test was conducted to ascertain the fineness as required and stored in an air tight polythene bag. Samples of the resulting ash and powders were then packaged and sent to Ewekoro Works Department of Lafarge Cement for chemical analysis.

CCW

CCW was collected from the Mechanic Village at Keteren – Gwari as the by-product of oxy-acetylene gas welding. It was first Sun-dried and later Oven-dried at 105^{o}C in the Building Department Laboratory. The dried CCW was ground with ball mill at Federal Polytechnic, Bida. Fineness test by wet sieving method was conducted and the final powdered material kept in air tight polythene bag.

Fine Aggregate

Natural sand available in Minna served as the fine aggregate used in this study. Materials retained within 1.18 and 75μm (simulated reference sand) was adopted for this experiments. The sand has a specific gravity of 2.51 and an average moisture content of 1.20%. The coefficient of uniformity of the sand is 2.95.

Water

Portable water from the tap behind the Convocational Square of the Federal University of Technology, Minna used for the experiments was noted to be colourless, odourless and tasteless and free from organic matter of any kind.

Superplasticizer

High range water-reducing admixture MasterGleniun ACE 456 produced by BASF served as the Superplasticizer used in this study, as an attempt to combat the high water demand of RHA: CCW as observed in earlier study (Olawuyi, *et al*., 2017).

Methods

This study centres on the characterisation (physcio-chemical properties) of the materials and the fresh hardened properties (setting times, degree of hydration and compressive strength) of the RHA-CCW pastes and binders.

50 mm mortar cubes were cast, compacted with table vibrating machine and cured by immersion in water for varied ages (3, 7, 14, 12 and 28 days) before testing. The standard mix proportion of 1:3 cement-sand ratio and 0.5 water-cement (w/c) ratio in conformity with BS EN 196-1:2016 using CEM 1 42.5N serve as control, while the alternative binders was made of varied combination proportions (70:30; 60:40; 50:50; 40:60 and 30:70) of RHA-CCW.

Physical Properties of the materials

Particle size distribution

Particle size distribution of the available natural sand was conducted using the dry-sieve approach in accordance to BS EN 933-1:1995 for proper classification of the available natural sand. The reference sand required for mortar production in strength determination test specified in the standard (BS EN 196-1:2016) was then extracted using an arrangement of sieve sizes 1.18 mm and 75 µm. The particles passing the 1.18 mm sieve but retained on the 75 µm sieve was used for the mortar mixture for the strength test. The 1.18 mm sieve was adopted as the upper limit value for the simulated reference sand instead of the 1.6 mm sieve specified by BS EN 196-1:2016 because of non-availability of the 1.6 mm sieve in the laboratory. Figure 2 of Section 4.1 present the particle size distribution of both the natural sand and the simulated reference sand.

Specific gravity and Fineness of the Binders

The specific gravity test was conducted on the constituent materials in accordance to BS EN 1097: 2013 while fineness test was also conducted on the CEM I 42.5N and the varied combination of RHA/CCW by wet sieving method in conformity to BS EN 196-6:2016 using a 53 µm sieve available in the Laboratory.

Setting Time of the Binders

The consistency test was carried out on the paste of the cementitious materials to determine the amount of water demanded for a standard consistency (Neville, 2012). Vicat apparatus Model No EL 38 - 2010 by ELE was used for measurement of the consistency. The setting time (initial and final setting times) was carried out in conformity with the procedures as outlined in the standard (BS EN 196-3:2011). The setting time both initial and final setting times and the Le Chatelier soundness tests for the binders (CEM I 42.5N and the various proportion combinations of RHA/CCW) were determined using neat pastes of standard consistency in accordance to BS EN 196-3:2011. The soundness test was also carried out on the respective binders using a Le Chatelier apparatus Model No EL 38 – 3400 by ELE.

Chemical Properties

The chemical property of the binders used was carried out with X-Ray Fluorescence (XRF) analysis for determination of the oxide composition (CEM I 42.5, RHA, and CCW) at Ewekoro Works Department of Lafarge Cement using XRF Analyser connected to a computer system for data acquisition.

Strength Properties of the harden mortar

Determination of strength with 50 mm mortar cubes which involves weighing of various constituents materials for the production of mortar ensuring a thorough mix of the materials. The alternative binders (RHA and CCW) were measured and mixed together; the measured reference sand was poured and mixed in a mixing pan thoroughly. The weighed water and superplasticizer, mixed together was then added to the already mixed materials and thoroughly mixed until homogeneous mortar paste is arrived at. The mixed paste was then cast into the oiled 50 mm cubes moulds. The control mortar samples on the other hand, has the CEM I 42.5N mixed as described above with the simulated reference sand and requisite quantity of mixing water and superplasticizer before casting into the cube moulds. Based on observation from the setting times tests as reported in Section 4.2, the samples were left covered with jute bags and cured by water sprinkling until 48 hours before demoulding and cured by immersion in water until testing age. The mortar cubes were cast and crushed at the different curing ages (3, 7, 14, and 28 days) in the Digital Universal Testing Machine (DUTM – 20) to assess the strength development.

RESULTS AND DISCUSSION

Sieve Analysis (SA)

The analysis represented in Figure 1 shows the result of both natural sand and the simulated reference sand used for the experiment. It showed the simulated reference sand to have a C_u and C_c values of 2.16 and 0.96 respectively and a Fineness Modulus (FM) of 2.67 revealing it to be medium sand classification of Shetty (2004).

Table 1 shows the summary of the particle size distribution of the CEN reference sand for determination of cement strength as compare to the simulated reference sand. It was noted that four out of six size requirement was in compliance with CEN reference sand as required in BS EN 196-1:2016.

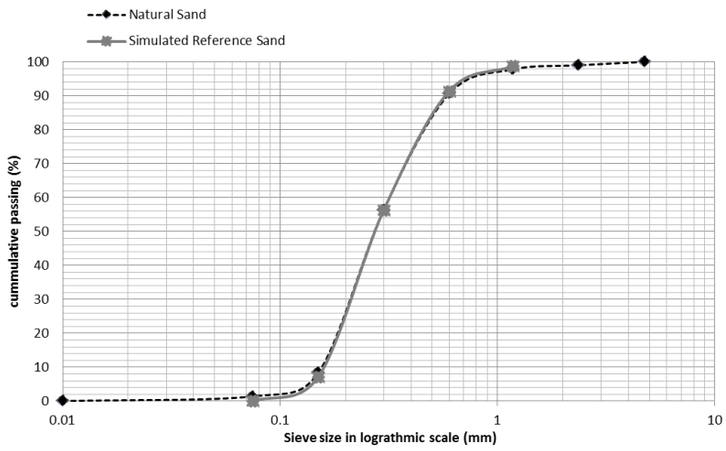

Figure 10: Sieve Analysis of Fine Aggregate

Despite the challenge observed with non-compliance of the size requirements on the simulated reference sand not correlating with the CEN reference sand as expected. The reference sand was adopted for the experiment since the study is mainly to compare the strength development of the alternative binder developed and the CEM I, but not product validation and certification of the cement. The strength of the mortar samples from CEM I used in this study serve purely as a reference to which the strength of the alternative agro-industrial waste binder was compared.

Table 2 present the specific gravity for the constituent materials. The result shows that the values are well fitted as earlier reports in literature (Neville, 2012)

Table 3: Particle Size Distribution of Fine Aggregate

Sieve opening (mm)	CEN Reference Sand (%)	Simulated Reference Sand (%)	Remark
2.00	0	0	√
1.60	7 ± 5	0	
1.00	33 ± 5	28	√
0.50	67 ± 5	16	
0.16	87 ± 5	92	√
0.08	99 ± 1	99	√

Table 4: Specific Gravity of Constituent Materials (kg/m^3)

Materials	Average Gs
Cement	3.13
RHA	2.30
CCW	2.36
Sand	2.51

XRF result (Table 3) from Lafarge Cement in Ewekoro shows the oxide composition of the various binders used in this study.

Table 5: Result of XRF Analysis for Oxide Composition of Cementitious Materials

Samples	LOI	SiO_2	AlO_3	FeO_3	CaO	MgO	SO_3	NaO	K_2O	TiO_2	P_2O_5	Mn_2O_3	Cr_2O_3	AR	SR	SiO_2 + $Al2O_3$ + Fe_2O_3
RHA	0.0	93.6	1.1	0.9	1.3	1.2	0.1	1.7	0.2	0.1	0.0	0.0	0.0	1.2	49.3	95.5
CCW	26.4	3.6	1.6	1.3	65.8	0.2	0.0	0.1	1.0	0.1	0.0	0.0	0.0	1.2	1.2	6.5
CEM I	0.0	21.5	5.2	1.2	64.0	2.9	4.5	0.6	0.0	0.1	0.2	0.0	0.0	4.5	3.4	27.8

It shows that RHA has silica content of about 94% - a good indication that the RHA is a good Pozzolan as well as a Class N Pozzolan with a total sum of the three major oxide composition (SiO_2+Al_2O_3+Fe_2O_3) of 96% far above the minimum70% as required by the standard (ASTM C618-2017). The RHA sample also meets the requirement of SO_3 below 4% and loss on ignition (LOI) of less than 10%. The CCW gave 66% CaO content, similar in value to that of the CEM I (64%). The SiO_2 and Al_2O_3 content was observed to be of lower value to that of CEM I while the LOI value is higher than the expected limit but preheating in oven at temperature 105^{0}C for 24 hour resulted in a

LOI of 2.9 as shown in Table 4 below the specified 10% maximum due the heat treatment adopted for also for effective performance.

Table 4: Result of LOI on binder materials

Binder	Cement	RHA	CCW
Wt. of Crucible (g)	52.0	48.0	60.0
Wt. of Crucible + Binder (g)	73.0	60.0	74.0
Wt. of Crucible +Ignited Binder (g)	73.0	60.0	73.6
L.O.I	0.2	0.0	2.9

Setting Times and Soundness of Binders

The consistency as well as soundness test results for the varied RHA: CCW binder combination and CEM I as control is presented in Table 5. The result revealed the water demand of RHA: CCW binder to be twice that of the CEM I pastes while Olawuyi *et al*, (2017) reported triple value of CEM I water demand. The adoption of Superplasticizer dosage administered improved setting time with a maximum twice value and one sixth of initial and final setting respectively of CEM I (Figure 2) as compare to Olawuyi, *et al.*, (2017), with one and half and triple value of CEM I initial and final setting time respectively. RHA: CCW binders reflect a trend of similar penetration values to the control. It is further noted that the higher the RHA content, the higher the quantity of superplasticizer demanded for the consistency paste. The water demand was then accounted for in the mortar production process for strength test of the binders.

Table 5: Fresh Properties of Binders

RHA/CCW (%)	Final Setting Time (min)	Initial Setting Time (min)	Depth of Penetration
CEM 1	340	138	6
70/30	369	195	5
60/40	350	152	6
50/50	412	160	6
40/60	515	257	5
30/70	570	301	6

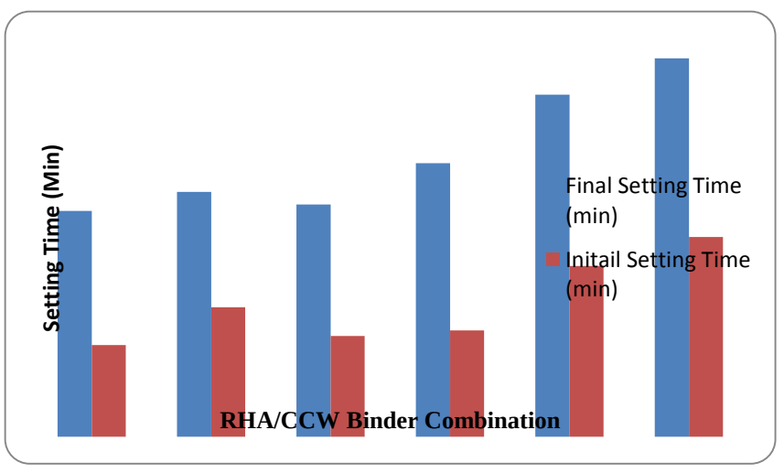

Figure 11: Setting times of the RHA/CCW Binder

Figure 3 presenting the soundness test for RHA: CCW and CEM I in accordance to BS EN 197-1:2011 revealed that all the binder combinations conform to the 10 mm maximum expansion specified by the standard.

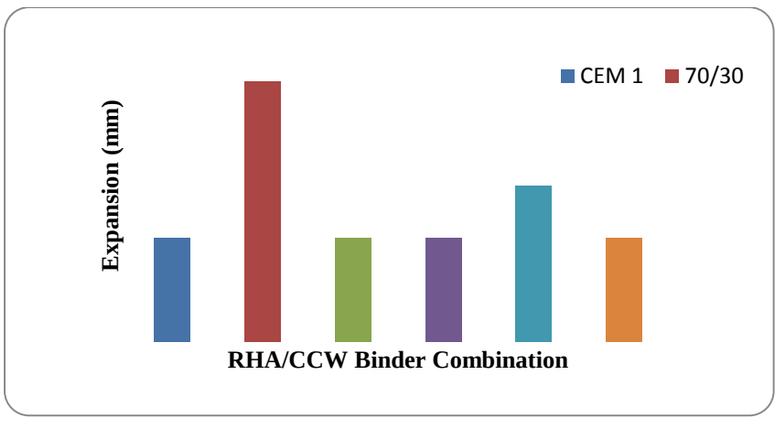

Figure 3: Soundness of the Binders

This affirms literature postulation that Pozzolan are of latent setting in nature. Addition of superplasticizer however helps in accelerating the setting times which is was confirmed by the enhancement of the strength development trends.

Strength of RHA: CCW Binders and CEM I

The plot of the compressive strength of the binders is presented in Figures 4. It follows similar trend of results with 60:40 RHA: CCW having at 28day compressive strength values of 8.78N/mm^2 [MPa] -31% of CEM I based mortar (control) strength while Olawuyi *et al*,(2017) had 5.3 N/mm^2 [MPa] – 25% of CEM I strength which indicates an improvement on strength development resulting from pre-heat treatment on the alternative binders and the adoption of the water reducing admixture (superplasticizer).There was a better strength development of the RHA: CCW observed in this study, the binding property of the materials was noted to be more effective when the samples were demoulded after 48hours. The mortar were in perfect condition when immerse in water and all through the curing period.

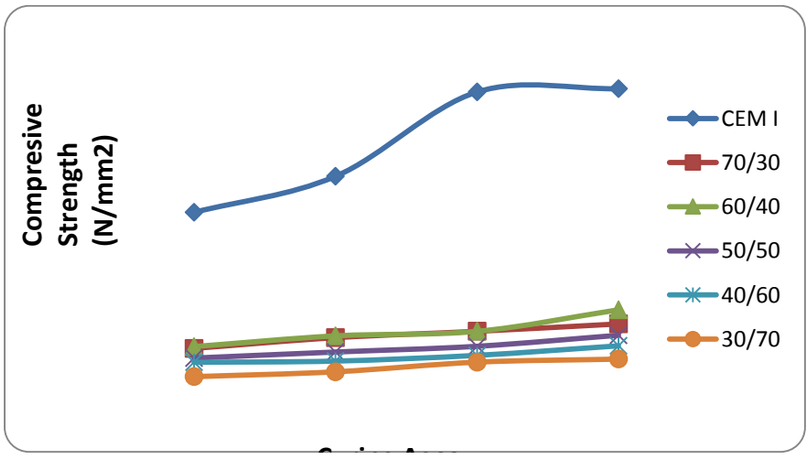

Figure 4: Compressive Strength of RHA/CCW Binder

CONCLUSION AND RECOMMENDATIONS

Conclusively, the results from the study indicates that the application of superplastizer help in reduction of water demand for the standard consistency paste which in turn improve the setting time and hence the strength development of the RHA: CCW mortar cubes as compared to the mortar cubes made without superplastizer. RHA: CCW binder at the varied combinations exhibit goo binding properties while the individual materials (RHA and CCW) met the codes requirements as a Pozzolan on basis of its physcio-chemical properties. The chemical analysis shows RHA as a Class N Pozzolan of high SiO_2 content (94%) while CCW is a good CaO source of similar percentage concentration as the CEM I used for the study. The following are thereby recommended based on the findings of this study.

i. RHA/CCW (60/40) in 1:3 binder/sand mortar at 0.5 W/B with water-reducing admixture can be adopted for use in masonry works

ii. Further studies on the RHA: CCW should focus on influence temperature above the ambient temperature on the setting time and the strength development trend.

iii. Studies the micro structure and products of hydration of the mortar specimen should be carried out to ascertain the performance of the new alternative binder.

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AFFORDABLE HOUSING IN NIGERIA USING ALTERNATIVE BUILDING TECHNOLOGIES AND MATERALS: A NBRRI PERSPECTIVE

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The issue of housing in Nigeria is one that has lingered over the years, and have become a serious concern for both government and the citizens. While the nation's housing deficit was estimated at 17 million in 2012, Nigeria's National Bureau of Statistics showed that population increased by 23,595,533 since then. It is projected that 700,000 houses must be built annually in order to bridge the housing deficit gap. Currently, only 100,000 houses are being achieved thereby posing enormous task to all stakeholders. Previous governments have tried to tackle housing issue but have recorded marginal success due to a combination of factors that have continued to be serious hindrances to achieving satisfactory accomplishment in housing and real estate sector. Access to funding, legal processes involved in property and land procurement, and access to affordable and high quality building materials constitute the main constraints to improving the existing housing stock in Nigeria. Conventional building materials and technologies are currently expensive and they require hundreds of billions of Naira to acquire. It is on this premise that this paper examined affordable strategies and solutions for improving the building stock in Nigeria by deployment of alternative building materials for mass housing projects using NBRRI technologies and innovations. Although, with varying standards, NBRRI technologies – through peculiar methods, materials and manpower have shown that with awareness for the pressing need for appropriate use of alternative building materials, they can bridge the nation's housing gap as a sustainable vehicle for affordable housing.

Keywords: Affordable housing, building materials, housing deficit, housing stock, NBRRI technologies and sustainable housing

1. INTRODUCTION

Over the years, housing in Nigeria has become an issue of concern to both the government and citizens. In 2012 alone, the housing deficit in Nigeria was estimated at about 17 million while from then to date, the population have increased from 168,240,403 to 191,835,936 which is 23,595,533 additional people (Worldometer, 2017). This increase implies that the housing deficiency is expected to have climb, and is likely to worsen in the nearest future if urgent steps are not taken by the government in conjunction with all the stakeholders in the built environment to improve on the current housing supply. Nonetheless, it would be unfair to down-play the efforts of previous dispensations in the provision of quality housing in Nigeria. Almost every dispensation since the colonial era have formulated policies to contain the housing situations; while some yielded success, some failed to make any significant impact on the housing and real estate sector. Investigations identified a combination of causes that must be systematically addressed in order to realign aspirations as a nation on the path to providing and delivering affordable housing for its people (Chellman, Ellen, Mccabe Stiefel, Ellen, &, 2011; Haggerty & Turner, 2010; José, Neto, & Heller, 2016).

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Agbola (1998) described housing as both a product and as a process which can be said to comprise the combination of environment, human and material resources for its production. The significance of housing may also be noted with regards to the social, psychological, economic, cultural and political influence it has on man (Okeyinka, 2014). Consequently, the approach to providing housing in Nigeria must shift paradigm from a conventional process based approach to more compartmentalised and adaptable strategies. These strategies must seek to embrace housing as a closely intertwined network of process delivery and product (building) production. Processes may include the pre and post product development and production activities like NEEDS analysis, financing & funding, mortgaging, partnerships, off-taking, sales, rentals, leases etc. Product phase captures the construction of the houses (that is, product) from start to finish taking into consideration the building materials, technologies and methodologies as well as personnel involved throughout the construction process.

In order for Nigeria to keep up with the demand for housing in addition to the existing 17 million deficit, an estimated additional 700,000 houses must be built annually to keep up with the growing population and urban immigration as against the less than 100,000 houses that are being built annually (World Bank, 2013). In 2015, a report by the National Bureau of Statistics (NBS) summarised the main constraints to provision of adequate housing into three; first was the access to finance to enable foreclosure of mortgage facilities, the second was the legal processes surrounding property and land procurement and finally, access to affordable high quality materials as building in Nigeria is relatively expensive which in turn reflects on the high cost paid by the customers or end users in the rentals and real estate (Mohit et al. 2010; Duque et al. 2015; Olorunfemi, 1980).

Therefore, in the provision of adequate affordable housing for any nation, it is important to point out that whichever strategies adopted may have little success unless there is a healthy housing stock on ground. (The preceding sentence is ambiguous) To achieve this in Nigeria, hundreds of billions of Naira will be required to build millions of housing units; this is a herculean task for any nation especially with the present poor economic situation. It is against this background that the nation must make conscious and timely efforts to adopt strategies that will significantly reduce the cost of building houses like the case of NBRRI. This paper is therefore predicated on the provision of affordable housing by using alternative building materials and technologies to reduce the cost of building houses in Nigeria.

ALTERNATIVE BUILDING TECHNOLOGIES AND MATERIALS

Alternative Building Materials in Nigeria

Building houses is a highly capital intensive endeavour and a bulk of this capital is gulped up in procuring building materials which constitute 60% of the cost of construction (Omange, 2013). Besides the cost implications of undertaking high volumes of construction projects, there is also consideration of sustainability. Thus experts in the built environment call for the reversion to alternative building materials and technologies that would be substitutes or complimentary to conventional building materials (Al-kodmany, 2011; Dobson, Nyamweru, & Dodman, 2015)**.**

Conventional building materials are those founded in the formal production methods like concrete, steel, glass, timber, etc (Adogbo & Kolo, 2009). They are popular and widely used in modern day construction. However, they are very expensive and mostly imported, hence not entirely sustainable. Conventional building materials, especially concrete take a lot of time to be produced, cured and assembled which may pose a challenge in delivering as many houses as may be required not to mention the underlying cost due to delays.

Much energy is also required in the production and transportation of cements through factories, warehouses and sites, which inevitably lead to high Carbon dioxide (CO_2) emissions. Formidable formworks are required in producing several building components using concrete elements like columns, beams, and slabs, etc, which has wide reaching socioeconomic impacts on the timber stock. Conventional materials are relatively heavy especially when steel reinforcements or other steel structural members are incorporated into concrete. Highly skilled personnel may be required for complex works, they may be imported which usually increases overall construction costs and opens channels for capital flight, that ultimately depletes the nation's weak economy (Brennan & Israel, 2008; Sanusi, 2010; Manwa & Manwa, 2014).

Alternative building materials on the other hand are predominantly traditional building materials such as thatch, mud or clay, laterite, gravel, straw, Azara and Raffia Palm that have been in local production from historic times and have undergone primary modification using rudimentary technologies to improve their inherent properties without completely altering the original natural molecular structure. Alternative building materials do include stabilized earth bricks or blocks; made from clay, mud or laterite, laminated bamboo, granite, marble, stones, etc. These alternative building materials can be adopted for quick erection construction that have potentials to save time and cost, be less complicated and eco-friendly. These properties are achieved due to less energy dissipation as raw materials only undergo primary processing like sieving, mixing, pressing, impregnating, treating, soaking, drying, cutting, shaping, coating, polishing, clamping, stabilization, etc, depending on the type of raw materials and the application required in the building (Bartlett, 1997; Jelili, Adedibu, & Ayinla, 2006; Boonyabancha & Kerr, 2015; Mahadevia, Bhatia, & Bhatt, 2016).

Alternative building materials are characteristically indigenous and locally sourced which gives them an advantage of being abundant and readily available (Baker et al., 2013; Mazibuko, 2013; Meskell, 2013) for the production of different components of the building like roofs, walls, doors, floors, etc. Kogbe (1989) and Okereke (2003) identified various locally sourced raw materials in Nigeria, their applications in building construction, and locations where they predominantly and traditionally occurred naturally as presented on Table 1.

Table 1: Geographical Distribution of Some Alternative Building Raw Materials in Nigeria

Alternative Materials	Applications	States/Regions Found
Granite	Good flooring material	Plateau, Ondo, Ado Ekiti, Bauchi, Abia, Ebonyi
Limestone	Essential ingredient in the production of Ordinary Portland Cement, additive in paints, aggregates in concrete and as foundation stones	Anambra, Cross River, Benue, Imo, Edo, Delta
Marble	Good flooring material	Kwara, Edo, Delta, Plateau, Kaduna
Laterite	Foundations, floors, production of walling blocks	All the States of the country
Clay	Pottery, Ceramics, brick making, roofing tiles	Cross River, Ondo, Oyo, Sokoto, Gombe, Kano, Niger, Imo, Anambra
Bamboo	Furniture making, floors, laminated panels, frames, scaffolds etc	Eastern Nigeria, Niger Delta
Timber	Roofing members, floors, frames, formwork etc	Eastern and Western Nigeria

After::Kogbe (1989) & Okereke (2003)

If properly harnessed, all the raw materials (Table 1) can be deployed for the construction of one or more components of a building. Laterite is abundant across all states of the nation and has been widely used (Bradley & Sparling, 2017; Dobson et al., 2015) as sustainable walling material in the production of Cement Stabilized Earth Bricks (CSEBs) while bamboo is fast growing and is abundantly available in the eastern parts of the country. When such indigenous technologies and materials that present low import input are appropriately researched and developed, managed and operated; then the problems of prohibitive costs, irregular and erratic material supply can be overcome over time (UNCHS, 1985; UNCHS & Common Wealth Science Council [CSC], 1990; Bala & Zubairu, 1993; Sanusi, 1993).

Alternative Materials and Technologies for Affordable Housing in Nigeria

In Nigeria, neither the government nor the private sector provides sufficient housing units for the people. It is therefore imperative that all the stakeholders in the built environment; be it government affiliated or private sector should synergize and assume mutual responsibilities in the provision of affordable housing. Affordable housing in itself can be described as housing units that are affordable to a specific portion (in most cases majority population) of the society that receive incomes that are lesser than the median household income (The Economic Times, 2017). Different definitions may suffice for different countries, but are all predominantly the same reasoning in that affordable housing is expected to target the needs of the lower or medium income earners which are mostly the significant lot in developing countries. This implies that the housing units that fall under this umbrella should be financially accessible without compromising quality of materials used, and the decency of the abode. To achieve this, housing constraints such as mortgage

facilities, land acquisition and titling should be subtly down played without complete negligence to quality and sustainability. This is because they constantly led to round tripping of policies on housing delivery that has systematically seen the real estate sector record marginalised successes in previous dispensations. Ample emphasis also needs to be laid on strategies to significantly cut down on construction costs with a view to improving the existing housing stock in Nigeria (Tibaijuka, 2009).

It is however worthy of note that the prices of affordable housing units are basically informed by the cost of construction materials which constitutes approximately 60% of the total selling price of affordable housing projects against premium residential project where pricing is largely guided by the cost of land. As a result, the need to minimise construction costs cannot be over emphasized as it is a vital aspect in ensuring the viability of affordable housing. Conventional building materials such as cement, steel, paints etc. have experienced price escalation of 20-50% in the recent past owing to the fluctuations and uncertainties in foreign exchange indices. It is in this light that indigenous alternative building materials and methods must become inevitable options as all their inherent advantages of ready availability, sustainability, originality and character, thermal stability, community inclusiveness in procurement and usage, proximity etc, are brought to the fore.

These raw materials can be utilised in order to unlock remarkable feats in infrastructural development especially in ailing sectors like the real estate to provide affordable housing. Although most of these raw materials are being used for construction purposes, there is still so much that is untapped or under-utilised.

INSTITUTIONAL FRAMEWORK

Housing and the General Framework of NBRRI

The indigenous building materials sector started gradually to establish relevance since the colonial era, when it became apt to regularise targeted research into building materials that prompted the need to create organized entities. The West African Building Research Institute (WABRI) became the resultant pioneer institution that directed collaborative research in all the British West African colonies of Gambia, Ghana, Nigeria and Sierra Leone. Following the independence in 1960, the WABRI arrangement lasted only two more years leaving Nigeria without any organised institutional framework on building materials research for over a decade. This lasted until the establishment of National Construction, Building and Road Research Institute (NCBRRI) in the Federal Ministry of Works and Housing in 1975. Following this, another agency, the National Science and Technology Agency (NSTDA) was established in June 1976 to assume the responsibility of coordinating all Federal Government research institutes. The Nigerian Building and Road Research Institute (NBRRI) was established in 1978 to take over the affairs of NCBRRI and was assigned to spearhead integrated applied researches on construction materials, processes/techniques and structural designs to increase utilisation efficiency and effectiveness and also on the development of design criteria specifications and codes of practices, respectively (Okereke, 2003).

NBRRI Approach to Affordable Housing

Construction Methods

There are several techniques or methods that NBBRI has adopted and have tried to modify over the years to ensure affordability in housing.

Design

NBBRI, in line with its mandate has targeted a reduction in cost of construction right from the design stage. The Institute, in this sense view sustainable designs as those that allows for integration of the Nigerian climatic conditions to ensure thermal comfort and humidity, space and spatial optimization, demand and type of housing, design concepts with respect to lighting, ventilation, painting, and materials selection to ensure affordable housing. An example is the core housing design where the house is developed in phases and can expand from a one bedroom to a four bedroom over a period of time (Golesh, Danjuma , & Abdullahi, 2014). The size of the house grows with increased earning capacity of the family as well as growth in the size of the core family unit.

Process

NBBRI has over the years adopted and also modified construction processes such that it speeds up building assembly to eventually facilitate affordability in construction. The Institute has dedicated years of extensive research and development on mortarless construction technology through the promotion of Cement Stabilised Earth Blocks (CSEBs) for buildings. The blocks are made with grooves incorporated on two faces that are dry stacked to align and interlocked. This mortarless concept permits quick construction hence leading to cost savings through:

i. Combined effects of less skilled labour and increased output;
ii. Reduced use of costly cement
iii. Interlocked blocks can easily be dismantled and reused.
iv. Wall surfaces have an extremely appealing face-brick finish and provide a pre-pointed straight masonry that uses minimal or no mortar and makes application of paints optional.

Equipment

Technologies available at NBRRI in pursuit of affordable housing are reflective of the achievements recorded in its hardware technology. This refers to tangible outcomes of innovations ranging from simple construction hand tools, vibrating tables for roofing tiles to more sophisticated brick making machines.

Construction Materials

Building materials constitute the single largest input in construction, thereby imposing a great influence on the total cost of any construction product. It is one of the principal components that dictate the performance of construction and its output in the Nigerian built environment (Abiola, 2000 and Adogbo & Kolo, 2009). A building comprises of a sub-structure (foundation) and a super-structure (Walls, frames and roof), and as such NBBRI has tried to develop alternative building materials from the abundant available local raw materials across the country to substitute the conventional ones with notable success. These materials are:

Laterites

Laterites which are iron oxide rich soil layer derived as a result of the weathering of a wide variety of rocks by oxidizing and leaching actions. It is clayey in nature, generally soft when freshly quarried but hardens when exposed forming in the tropical and subtropical regions and abundant in Nigeria. It is indeed a sustainable raw material for the construction of foundations, floors, and production of walling materials and popular with the production of NBRRI interlocking blocks for walling by stabilizing with 4-5% cement The resulting CSEBs have been successfully deployed in mass housing projects, small cottage buildings, and multipurpose and industrial facilities, spread across the country.

Bamboo

Bamboo is another raw material that that can be harnessed to provide affordable alternatives to conventional or imported building materials and components. Bamboo is a fast growing and easily replenished plant that can survive in about any soil or climate; structurally, it has high compressive strength and hardness which makes it suitable for certain engineering purposes (Ogunwusi, 2014). In recent times, technological advancement has seen bamboo evolve into a super material and it now commands a global recognition as a sustainable substitute for timber in the wood industry (Wooldridge, 2012). Currently, bamboo is being processed into several building materials and components like panels for walls and ceilings, Medium Density Fibreboard (MDF), Flat Matboards, Corrugated Matboards (roofing), Bamboo Veneer, Laminated Lumber, Flooring Parquet, and Building Poles, etc. NBRRI is currently exploiting the potentials of bamboo as an alternative building material and has successfully produced laminated bamboo panels from bamboo culms.

Other Materials and Components

There are other building materials and components that have been developed by NBRRI to facilitate affordable housing. Composite roofing tiles have been developed from incorporating coir fibres (from coconut husk) into cement and sand to produce Fibre Concrete Roofing Tile (Mador Tiles) vibrated on a vibrating table designed by the Institute. A pozzolana factory has also been established and recently commissioned to produce

pozzolanic cement that will be partial replacements to the conventional Ordinary Portland Cement in production of concrete. Pozzolanic materials include volcanic ash, fly ash and burnt clays, etc. It has the potentials to significantly reduce the cost of cement in a construction project hence reducing the overall cost of the project.

Capacity Building for the Construction Industry

NBRRI in line with its mandate and a determination to reduce dependence on foreign labour increased the local stock of skilled labour, and curb excessive capital flight that annually runs into billions of Naira, and also engages in capacity building in the built environment. The Institute in 2012 identified that a dearth of skilled manpower at the artisan level was largely responsible for the high rate of building collapses in the country. The skill shortage cuts across the entire construction industry which leads to the engagement of foreign labour from neighbouring West African countries, particularly from Benin Republic, Togo, Chad, Niger and Cameroun. Therefore, NBRRI took strategic steps to train artisans and technicians in the various trades in the construction industry. Also, curricula have been developed in ten building construction trades; namely; concreting, masonry, iron bending, painting & decoration, plumbing, tiling, carpentry & joinery, electrical installations, drafting & detailing, including safety in construction. This was to facilitate artisans' training needs and the increasing demand for this skilled workforce, through skill acquisition centres set up to build capacity from the grass root in both conventional and alternative construction techniques. These initiatives will bolster the indigenous stock of skilled and unskilled competent manpower which will reduce the overall cost of building construction.

CONCLUSION

Provision of affordable housing is a task of mutual responsibilities involving all the stakeholders including government at all levels and the private sector operators. It requires the adoption of materials and technologies that will evolve to affordable housing from cost reduction in building construction by taking advantage of the inherent potentials of alternative building materials and technologies in Nigeria. The NBRRI technological innovations illustrates, that alternative building material like the CSEB technology can prove invaluable in the effective provision of affordable housing in both small and large mass housing projects. A prudent application of these innovations and promotion of schemes strengthened with aggressive capacity building schemes in the country can actually lead to revolution and massive reduction in the housing deficit.

It is therefore recommended as follows:

i. Alternative building materials must be seen as a potential strategy for improving the housing stock in Nigeria. The bulk of these materials and accompanying concepts need to be protected and adopted, taking advantage of the benefits of quick construction time, environmental friendliness and positive social impacts on the environment.
ii. As much as possible, materials that prove to be green, like being energy efficient, renewable and sustainable should be preferable in housing projects. This can reduce the use of conventional materials like cement that requires a lot of energy for manufacture, transportation and usage besides given out harmful substances and bye-products during thse processes.
iii. Locally sourced materials must be encouraged and applied in innovative ways in the wide range of the construction industry. This will reduce construction costs as using foreign and imported materials raise construction costs especially now that exchange rates are always rising.
iv. In order to sustain and further increase the growth and applications of this drive, the government as a matter of policy should encourage the application of indigenous alternative building materials by emphasising certain percentages of building materials and components to promote local content.
v. Government and Non-Governmental Organizations (NGOs) must continue to create awareness on the inherent benefits of using alternative building materials to increase its current level of patronage.
vi. Any local alternative building material must also be seen in its contributions to global sustainability, as a force in curtailing carbon emissions by being climate friendly.

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PERFORMANCE EVALUATION OF EGG-SHELLS AND COW BONE ASHES AS POZZOLANA IN CONCRETE PRODUCTION

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Concrete is a widely engineering composite material made with cement, aggregates and admixture in some cases used in construction project. Due to day by day innovation and development in construction industry, the global consumption of natural aggregate and cement as binding constituent is very high. Extensive use of concrete leads to depletions of natural resources and high cost of construction material such as ordinary Portland cement for construction. therefore, this paper study the possibility of utilizing cow bone and egg shell ashes blended with cement in production of concrete having sufficient qualities for construction. Partial replacement of cement by ashes from cow- bones, and egg- shell will not only provide affordable concrete, but also provide better way of managing the waste from the present nuisance it constitute to the environment. Furthermore usage of these materials for construction will provide job opportunities which are a global problem. The chemical composition of cow bone and egg shell ashes and compressive strength of the concrete produced were determined through laboratory experimentation. In this experimental study, cement is partially replaced at 0%CBA/ESA, 15%CBA/5%ESA, 20%CBA/0%ESA, 10%CBA/10%ESA , 15%ESA/5%CBA and 20%ESA/0%CBA respectively for concrete production, using a mix ratio of 1:2:4 and a water cement ratio of 0.5 was adopted. The maximum compressive strength of the concrete produced for each batch was 31.26N/mm^2,28.37N/mm^2, 32.84N/mm^2, 24.22N/mm^2, 27.77N/mm^2.and 22.87N/mm^2 respectively at 28 days curing periods. From the result of 28 days curing, it can be concluded that although ESA and CBA are week pozzolanic materials, thus but can still replace cement up to 20% replacement of CBA only and 15% of CBA with 5% of ESA.

Keyword: Aggregate ,Cow Bone Ash, Compressive strength, Egg Shell Ash, Pozzolana

INTRODUCTION

As a result of the depletion of natural resources which is a common phenomenon in a developing countries coupled with the environmental effects associated with cement production, there is need to develop alternative binder to make concrete production profitable. In view of this, researchers have been searching for suitable materials which could be used as either an additives or as pozzolana to conventional ingredients of concrete so that the existing natural resources be saved to the possible extent, and could be made available for future generation. In line with this , different agricultural waste materials such as rice husk, cassava peal, coconut, groundnut, corn cob and egg shells have been tried seperately as a viable substitute material to conventional material in concrete production proved and suitable usable and effective (Sekar, 2011). The cement reacts chemically with water and other ingredients to form a hard matrix which binds all the materials together into a durable stone-like material that has many uses. Often, additives (such as pozzolanas) are included in the mixture to improve the engineering properties of wet or the finished material ASTM C618, (2008). The use of alternative binders that are less pollutant and/or the use of residues could impact the construction industry towards the production of concrete with less environmental impact. In order to achieve this, concrete must have adequate characteristics, implying that certain mechanical characteristics and water behavior must be achieved.

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Adamu, et al (2018). **PERFORMANCE EVALUATION OF EGG-SHELLS AND COW BONE ASHES AS POZZOLANA IN CONCRETE PRODUCTION.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

According to Abid, (2009) eggs shell is the outer covering of a hard-shelled egg. It is a natural porous bio ceramic which has largely been studied since 1964. Egg shells are bye product generated from food restaurant, bakeries and chick hatcheries, egg shells used in producing concrete made the constructional materials more economical and hence reducing the environmental pollution (Mazizah, 2016). Egg shells can be recycled and have the possibility of use in concrete production. Egg shells waste fall within the category of food waste, which is a material from the domestic preparation of food and drinks, if subjected to adequate scrutiny, they could be suitable alternative materials for construction (Raji, 2015). Cow-Bone causes a severe disposal problem and continues to gather at increasing rate, which if not properly managed, the bone will create increasing environmental problems (Mahmud, 2016). According to Akinyemi (2016), at 10%, bone ash can partially replace cement in concrete at 28 days comprehensive strength value. Ahmad (2016), carried out an experimental investigation to study the effect of cattle bone ash on the properties of concrete. The result shows that the CBA contained high percentage of lime (CaO) of 60.7% against 61% of ordinary Portland cement, it was also observed that all concrete produced attained a strength ranging between 14-30Mpa at 28 days. Combination of CBA and ESA has never been study. The previous studies where on separate use of the materials.

Therefore, this research will be directed at utilization of egg shells Ash (ESA) blended with cow bone ash (CBA) blended with cement in Concrete production.

Materials and Methods

The composition of materials used for this research includes fine aggregate (Sharp sand) coarse aggregate (crush granite stones not exceeding 19.50mm) according to BS 882:1992, and water. Ordinary Portland cement (in accordance with codes of practice (BS) 12 (1996) for the production of concrete in the addition to egg shell ash (ESA), and Cow bone ash (CBA) used here as supplementary cementitious materials.

Fine aggregate

The fine aggregate used was cleaned sharp sand bought from truck dealer in Bida with a specific gravity of 2.60. The sieve analysis of the sand was done in accordance with BS812 Part1:1975.

Coarse aggregate

The coarse aggregate used was crushed granite of nominal size 20mm with a specific gravity of 2.70 and average impact value of 20.87 percent. The sieve analysis of the coarse aggregate was done in accordance with BS 812Part1:1975.

Water

Portable water from the Department of Civil Engineering Federal polytechnic Bida was used for mixing and curing of concrete samples.

Egg shell is a by- product of waste egg shells collected from local meal provider "Mai shai" and bread bakery around Bida metropolis Niger State. The ash was obtained through closed incineration at the temperature of 650^{o}C at National cereal Research Institute (NCRI) Baddegi Bida Niger State, and the ash was sieved through 75μm sieve. Cow bone ash is a by- product of wastes bones collected from abattoirs in Bida Niger state. The waste bones were sun-dry after carefully separation from flesh, tissues, and fats. The sizes were gradually reduced by mortar and the ash was obtained through closed incineration at the temperature of 650^{o}C at National cereal Research Institute (NCRI) Baddegi Bida Niger State, the ash was sieved through 75μm sieve.

Chemical composition analysis of the Cow Bone Ash (CBA), and egg shell ash (ESA) was conducted by the use of X – Ray Refraction analytical method using X – Ray spectrometer at Chemistry National Laboratories Centre, Ahmadu Bello University Zaria Kaduna State.

The mix was designed using the absolute volume method, a mix ratio of 1:2:4 at water /cement ratio of 0.5 was also adopted in this work. Cement was partially replaced by 0%CBA/ESA, 15%CBA/5%ESA, 20%CBA/0%ESA, 10%CBA/10%ESA , 15%ESA/5%CBA and 20%ESA/0%CBA respectively for concrete production.

The mixing was done mechanically and slump test was carried out to assess the workability of the fresh concrete. 18 concrete cubes of size 150mmx 150mm x150mm were cast for three batches respectively. The specimen were demoulded after 24hours, and cured

in a curing tank containing clean water, since curing improves the physical and chemical properties of concrete resulting to increase of concrete strength. The compressive strength was determined by crushing concrete cubes at different curing periods of 7, 14, 21, and 28days. The results presented were at the average of the three tests trials as shown in table 3.

DISCUSSION OF RESULTS

Chemical Analysis of Egg Shell and Cow Bone Ashes

The results of the oxides composition of egg shell, cow bone ash, and cement is shown in Table 1. The chemical composition of both CBA and ESA were almost the same to that of Portland cement. For instance, CaO which is the major constituent of Portland cement is also a major constituent in CBA, and ESA. Some of the compounds in Portland cement are Al_2O_3, SiO_2, MgO, Fe_2O_3, K_2O, P_2O_5, SrO, SO_3, and Cl are also present in egg shell ash as detailed in Appendix A. The presence of siliceous and aluminous material in egg-shell ash indicates that when it is in finely divided form, it can react with calcium hydroxide (CH) to form calcium silicates hydrate (CSH), (a strength forming product in cement) ASTM C618 (2008). The summation of the composition of silicon oxide (SiO_2) plus aluminium oxide (Al_2O_3) and iron oxide (Fe_2O_3) was less than 70%. It was also observed that the values of SO_3 of 0.056% for CBA,and0.18% for ESA were lower than the 4% specified by ASTM C618-12 indicates the possibility of improved durability and prevention of soundness when use in concrete. Therefore SO3 of 0.056%, and0.18 is much lower than 4% maximum specified by ASTM C 618-12. This indicates that both CBA and ESA may improve durability and prevent unsoundness when used in mortar concrete (Neville, 2011).

Table 1: oxides composition of CBA, ESA, and Dangote 3x Cement

OXIDES	ESA	CBA	CEMENT
NA_2O	0	0.488	0
MgO	0.688	0.765	1.023
Al_2O_3	0.313	0.339	3.262
SiO_2	1.766	1.548	14.381
P_2O_5	0.328	36.438	0.169
SO_3	0.18	0.056	3.097
Cl	0.13	0.159	0.123
K_2O	0.09	0.096	0.235
CaO	96.123	59.912	74.229
TiO_2	0	0.049	0.2
Cr_2O_3	0	0	0.02
Mn_2O_3	0	0	0.093
Fe_2O_3	0.061	0.06	3.011
ZnO	0	0.007	0.005
SrO	0.322	0.083	0.91

Workability of fresh concrete

The workability of fresh concrete made with egg shell and cow bone ash partially replacing cement in a predetermine percentage is shown in table 2. Table 2 shows that the workability decreases with percentage replacement, and lower at 20% replacement of ESA only. This shows that ESA absorbed moisture more than CBA. It is applicable in precast and pre-stressed work, concrete of very dry consistency is used ACI 318(2015) . The result of the compressive strength is shown in Table 3 and figure 1.

Table 2: Workability Test for concrete of Various Batches

Batch No.	% Replacements	Slump (mm)	Slump type
1	Control	30	low
2	15% CBA, 5% ESA replacement	20	low
3	20% CBA, 0% ESA replacement	20	low
4	10% CBA, 10% ESA replacement	10	very low
5	5% CBA, 15ESA replacement	20	low
6	0% CBA, 20% ESA replacement	10	very low

Table 3: Compressive strength results (N/mm^2) for 7days and 28 days curing period

Curing period	Percentage replacement					
	0%	15%CBA/ 5%ESA	20%CBA/ 0%ESA	10%CBA/ 10%ESA	5%CBA/ 15%ESA	0%CBA/ 20ESA
7days	27.93	26.31	26.55	27.56	23.47	16
14days	28.83	24.02	27.61	27.97	27.85	22.73
21days	28	24.42	28.43	25.67	28.74	20.92
28days	31.26	28.37	32.84	24.22	27.77	22.87

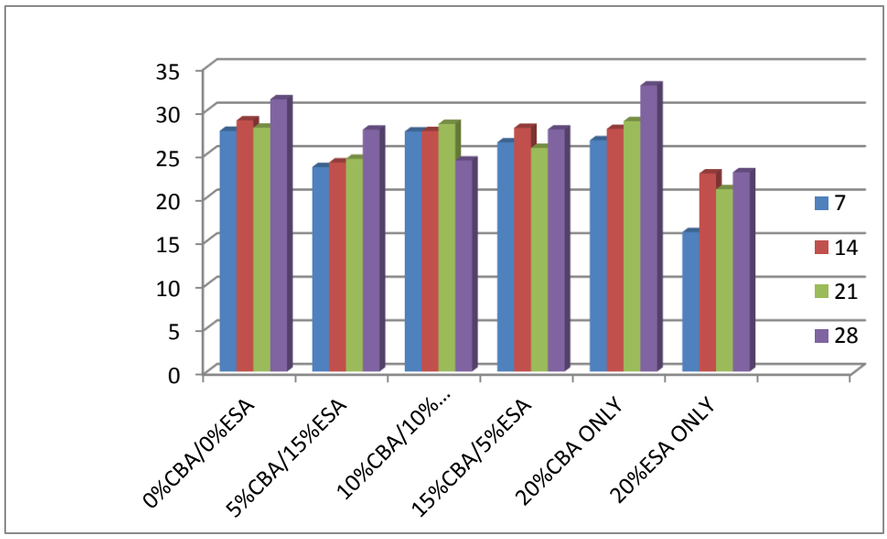

Fig 1: Compressive strength and percentage replacement at various batches.

The results of compressive strength on the four curing ages of 7, 14, 21, and28, days are as presented in the relationship between compressive strength to days of curing and content of combined percentage of CBA, and ESA were in figure 1 above. The compressive strength increases as the percentage replacement of CBA in the batches increases, while that of ESA also increases as the replacement increases up to 15%. The highest strength of 32.81N/mm^{2,} and 27.79N/mm^2,27.77N/mm^2 obtained for 20%CBA only, 15CBA and 5%ESA, 5%CBA and 15%ESA, 5%CBA respectively at 28days curing period. This shows that CBA has more significant influence on the compressive strength of concrete.

The Britsh Standard BS 8110 specified a minimum compressive strength of 26N/mm^2 for concrete at 28 days curing period; therefore, it is adequate for general construction work.

CONCLUSION AND RECOMMENDATION

Conclusion

From the results of the test and analysis carried out on CBA, and ESA Concrete to realize the aim and objectives set out for this study; the followings conclusion were drawn:

The CBA, and ESA both has low reactivity, with a combined SiO2, Al2O3, and Fe2O3 contents of (1.947%), and (2.14%) respectively, which indicate that do not satisfied yhe minimum value of 70% recommended in ASTM 618 for a good pozzolana.

The consistency, initial and final setting time of cement increased with the combined effect of CBA and ESA Contents. This indicates that combined CBA and ESA extended setting time of cement paste and would be useful as retarder AC1 318, (2005), also according to Alp et al, (2009) the setting time tends to increase with the natural pozzolan replacement level of up to 25%w/w. it was also observed ESA absorbed more water as compared to control concrete.

The compressive strength of concrete increased with increase in CBA content, and decreased with increased in ESA contents as shown in table 2. However, the 28 days compressive strength of concrete mixes with CBA replacement up to 20% produce concrete of higher the characteristic strength; when compared to the normal concrete produced from a mixture of cement, sand, and normal coarse aggregate. Therefore, any replacement more than 20% will give strength less than the 26N/mm^2 recommended by BS 8110 part 1, (1990).

Also inclusion of CBA, and ESA as admixture in concrete has improved the compressive strength of concrete .Concrete with combined mixes of CBA, and ESA for 15%CBA/5%ESA, 20%CBA/0%ESA,15%ESA/5%CBA and 20%ESA/0%CBA as partial replacement of cement showed the highest compressive strength of 28.37N/mm2, 32.84N/mm2, 27.77N/mm2, and 22.87N/mm2 respectively, as compared to 24.60N/mm^2 at 10% optimum from the study of cow bone powder as pozzolana in concrete production carried out by Tsado, (2017).

The workability decreases as the percentage replacement of ESA increases.

Recommendations

On the basis of the investigation carried out on ESA, and CBA as a pozzolana for partial replacement of cement in concrete production, the following recommendations were drawn:

Replacement of CBA content up to 20% is recommended for structural concrete. Since the compressive strength of 32.81N/mm^{2,} 27.79N/mm^2 was achieved for 20%CBA only, and 15CBA and 5%ESA respectively at 28days curing period.

For structural concrete works, CBA content up to 20% is recommended for partial replacement of cement to act as a retarder suitable for hot weather concreting, mass concrete and long haulage of ready mixed concrete, but a small amount of plasticizer may be added to improved workability of concrete.

There is need for further research on investigating the pozzolanicity, and performance of CBA and ESA combined in concrete production.

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EFFECT OF REVIBRATION ON THE FLEXURAL STRENGTH OF CONCRETE, USING MAHOGANY SAWDUST ASH AS PARTIAL REPLACEMENT FOR CEMENT

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Effect of revibration on the flexural strength of reinforced concrete beams using Mahogany sawdust ash (MSDA) as partial replacement for Ordinary Portland Cement (OPC), is presented. Chemical analysis of the MSDA indicates major chemical oxides found in cement: SiO_2 (39.87%), Al_2O_3 (18.05%), Fe_2O_3 (6.92%). The beam specimens were of sizes 150mm x 150mm x 600mm reinforced with 12mm diameter steel bars (Y12) and 8mm diameter steel bars (Y8) as links which were cast for each 0%, 5%, 10%, 15% and 20% replacements of cement for SDA. The beams were revibrated after initial vibration for 20seconds at an interval of 10 minutes successions up to 1 hour. Fifty beams were cast in total and cured for 28 days: thirty-five revibrated and fifteen non-revibrated. Flexural strength test carried out on each beam shows that the peak flexural strength occurred at 0% followed by 5% replacement at 20 minutes revibration time lag interval. The Revibrated beams show a peak flexural strength of 10.50N/mm^2 and 10.00N/mm^2 at 20th minute revibration for 0% and 5% replacements; while for the non-revibrated beams 8N/mm^2 and 7N/mm^2 were attained for 0% and 5% replacements respectively. The flexural strength test result shows that revibration has improved the flexural strength of the concrete beams produced and MSDA (as pozzolana) can comfortably replace cement up to 5% to replace cement.

Keywords: Flexural strength, reinforced concrete beam, revibration, MSDA

INTRODUCTION

The rising cost of conventional building materials specifically cement and the present day's devaluation of Naira in Nigeria has partly made the construction of building difficult for low – income earners of Nigerian population to own a personal house. This also has contributed to the difficulty in the construction of civil engineering infrastructure that is needed for national development (Onwuka, *et. al.*, 2013).

Continuous generation of wastes arising from industrial by-products and agricultural residue, create acute environmental problems both in terms of their treatment and disposal. The construction industry has been identified as the one that absorbs the majority of such materials as filler in concrete (Antiohos *et al*., 2005). If these fillers have pozzolanic properties, they impart technical advantages to the resulting concrete and also enable larger quantities of cement replacement to be achieved (Hossain, 2003). Much less attention is placed on revibration and its importance in concrete production, the process whereby a vibrator is reapplied to concrete at some interval of time after the initial vibration has been carried out (Auta, 2011). A pozzolana is a material which, when combined with calcium hydroxide, exhibits cementitious properties. Pozzolanas are commonly used as an admixture to Portland cement concrete mixtures to increase the long-term strength and other material properties of Portland cement concrete and in some cases reduce the material cost of concrete. Pozzolanas are primarily vitreous siliceous materials which react with calcium hydroxide to form calcium silicates; other cementitious materials may also be formed depending on the constituents of the pozzolana.

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Sawdust ash (SDA) is a waste material from the timber industry. It is produced from log of timber sawn into planks at sawmills located in virtually all major towns in the country. This process is a daily activity causing heaps of sawdust to be generated after each day. The need to convert this waste product into a useful by-product is the focus of this study (Oset and Jackson, 2012). Some industrial wastes have been studied for use as supplementary cementing materials such as: fly ash (Mathong, 2012); Silica fume (Raheem *et al,* 2012); pulverized fuel ash (Revindarajah and Caroll, 2001), Volcanic ash (Hossain, 2005); rice husk ash (RHA) and corn cob ash (CCA) (Raheem and Adesanya, 2011).

Auta and Micheal, (2015) stated in their findings that flexural strength of RHA concrete increases at the early stage of re-vibration, the flexural strength of RHA concrete decreases from 30 minutes to 60 minutes of revibration almost for all percentage replacement level of RHA.

The flexural strength of structural elements may explained as its resistance to bending and it is determined either by the ultimate strength of the concrete yield stress f_{ck} or the steel reinforcement *fy*. This resistance may then be divided by a proper factor of safety to determine what bending resistance to be relied upon under working condition.

Published findings by researchers show that focus is made on SDA (Auta, *et al*., 2016) which has combinations of different wood specie. But different wood species have different characteristic strength (Agwuwa, 2016). Thus, in this paper Mahogany was identified with considerable high characteristic strength and hence chosen to produce Mahogany sawdust ash (MSDA) for this research.

MATERIALS AND EQUIPMENT

Materials

The materials used in this study include:

Fine Aggregate

The fine aggregate (sand) used was clean sharp river sand that is free of clay, loam, dirt, and any Organic or chemical matter. It sand is passed through 5mm British Standard Test Sieves. It conforms to BS EN 12620 (2008).

Coarse Aggregate

The gravel that was used was also clean from particles and the gravel particle size falls between 10mm to 14mm B.S sieve. Quarry gravel was bought from Kpankugu in Minna, Niger state, Nigeria. It conforms to BS EN 12620 (2008).

Mahogany Sawdust Ash (MSDA)

The sawdust ash was obtained from Mahogany wood specie sourced from Dei-Dei timber shed along Kubwa- Abuja express way, transported to Minna, sun dried and later burnt at a controlled temperature of 800^0 C to obtain the MSDA.

Water

The water used to mix the concrete in this study was free from organic materials and suspended debris. It was obtained from the borehole beside the Civil Engineering Laboratory of the Federal University of Technology, Minna. It also conformed to BS EN 1008 (2002) requirements.

Steel Reinforcement

For each specimen, two numbers of steel bars of size 12 mm (Y12) were used as the tension bars and also two numbers of 12 mm steel bars as compression bars and 8 mm links was used.

Equipment

The equipment used for this study includes: A weighing machine, British standard sieve, head pan, hand trowel, tamping rod, buckets, Poker vibrator and 150mm x 150mm x 600mm beam mould and Universal Testing Machine for the flexural strength test of cured beam specimens.

EXPERIMENTAL PROCEDURE

Procedure

The experimental procedures adopted in this study include the following:

Chemical analysis of MSDA: The chemical analysis of Mahogany saw dust ash was conducted at the chemical laboratory where the Oxides composition was carried out using the X-Ray fluorescent (XRF) tests. This technique was used to discover in-depth information about the chemical composition of MSDA.

Aggregate Characterization: The aggregates used for this study were tested for their physical properties such as: specific gravity, particle size distribution (sieve analysis) and bulk density.

Preparation of Beam Specimens: Fifty (50) rectangular beams specimens of sizes 150mm x 150mm x 600mm were produced for this study. The batching and casting of the beams were carried out using absolute volume method in accordance with BS 1881: part 2 (1970), with a concrete mix ratio of 1:2:4, water/cement ratio of 0.5. The main reinforcement used was 12mm (Y12) diameter tensile steel and the size of the links provided was 10mm (Y10) bar at regular spacing of 125mm c/c. The beam specimens were produced for two procedures: revibrated and non-revibrated. For the revibrated beams, 35 beams were produced for percentage replacements (0%, 5%, 10%, 15% and 20 %) of OPC for MSDA. For each of these percentage replacements, seven (7) numbers of beams were cast. The revibration process was carried out 20sec at 10 minute successions through 1 hour. For non-revibrated beams, three (3) beams specimens were produced each percentage replacements to make a sub-total of fifteen (15) non-revibrated beams. Poker vibrator was used to compact the concrete mix in the mould for both initial vibration and revibration processes. The beams were de-moulded after 24 hours and cured for twenty eight (28) days. After which the beams were tested for flexure using universal testing machine (UTM).

RESULTS AND DISCUSSIONS

The Laboratory test results includes: Chemical analysis of MSDA, aggregate characterization, test on both fresh and hardened concrete. The results are presented in Tables 1, 2, 3, 4, 5, 6 and Figures 1, 2, 3.

Chemical analysis of MSDA: The chemical composition of MSDA used in this study is presented in Table 1. The chemical composition include: Silicon dioxide (SiO_2 = 39.873%), Iron oxide (Fe_2O_3 = 6.924%) and Aluminium oxide (Al_2O_3 = 18.053%) which constitutes a total sum of 64.84% which is slightly below 70%, but greater than 50% for a pozzolanic material.

Fly ash with potential use for concrete is classified into class C and F (ASTMC 618-9, 1991). The classification is based on the sum of. Based on the classification, if the sum of the three oxides (SiO_2, Fe_2O_3 and Al_2O_3) above is ≥70%, the ash is classified as class F, while if the sum ≥50%, it is classified as class C. In this study, the MSDA is a pozzolanic material it falls under class C (ASTMC 618-9, 1991).

Table 1: Chemical composition of MSDA

Element	Concentration
Na_2O	1.012
MgO	6.905
Al_2O_3	12.046
SiO_2	49.054
P_2O_5	2.017
SO_3	3.212
Cl	2.412
K_2O	1.224
CaO	11.125
TiO_2	1.562
Cr_2O_3	0.000
Mn_2O_3	0.198
Fe_2O_3	8.935
ZnO	0.209
SrO	0.125

Aggregate Characterization: The aggregates and MSDA were tests such as: specific gravity, particle size distribution and bulk density tests.

Particle size analysis for fine, coarse aggregates and MSDA: The results of particle size distribution of MSDA, coarse and fine aggregates used in this study are presented in Table 2, Figures 1 and 2 respectively.

Coarse aggregate particle size analysis:

From Figure 1, the grain size corresponding to 60% (D_{60}), 10% (D_{10}) and 30% (D_{30}) are 10.5mm, 10.1mm and 10.3mm respectively. Therefore, the uniformity coefficient, Cu is calculated as equal to 1.04, while Coefficient of curvature, Cc is calculated as equal to 1.003

Hence, the aggregate is well graded since the results agrees with the unified soil classification system (USCS) well graded sand with less than 5% fine has $1 \leq Cc << 3$ as stated by Arora (2010).

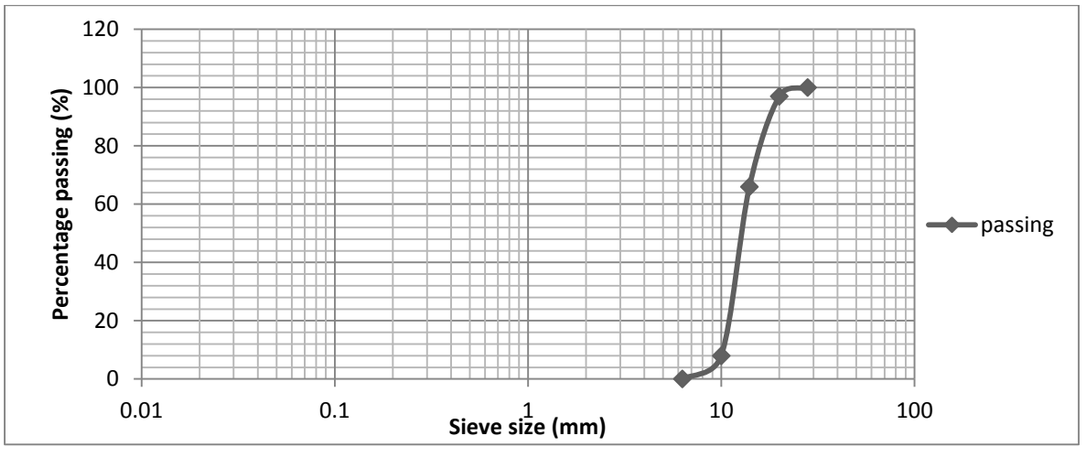

Figure 1: Particle size distribution of coarse aggregate

Fine aggregate particle size analysis: From Figure 2 below, the grain size corresponding to 60% (D_{60}), 10% (D_{10}) and 30% (D_{30}) are 0.95mm, 0.35mm and 0.59mm respectively. Therefore, the uniformity coefficient, Cu is calculated as equal to 2.70, while Coefficient of curvature, Cc is calculated as equal to 1.05.

Hence, this shows that the aggregate is within SW-SM, well graded sand which agrees with the unified soil classification system (USCS) conforming to 5% fine has $Cu \leq 6$ and $1 \leq Cu \leq 3$ as stated by Arora (2010).

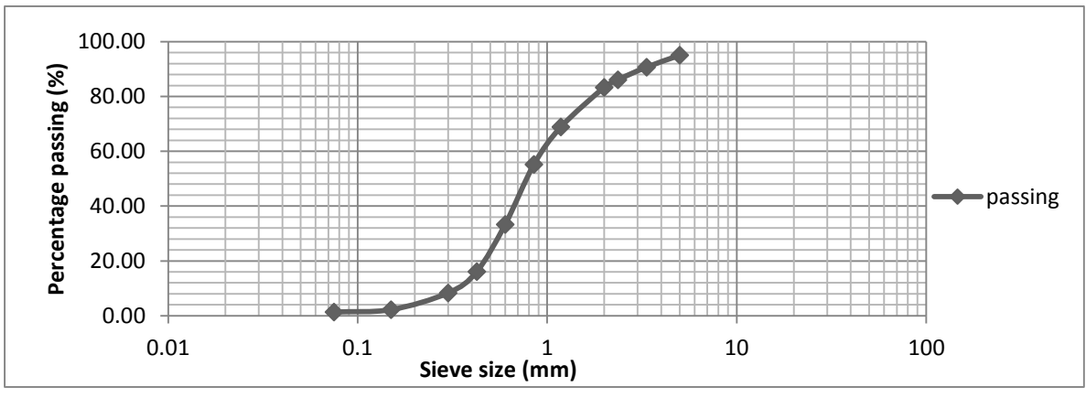

Figure 2: Particle size distribution of fine aggregate

Mahogany sawdust ash particle size analysis result

From Table 2, the MSDA fineness modulus (FM) is obtained as equal to 1.51. The fineness modulus of 1.51 is less than the fineness modulus of 2.1-2.3 for fine aggregate suggested by American Society for Testing and Materials (ASTM) C 33, hence, MSDA is finer than fine aggregate.

Table 2: MSDA particle size analysis

Sieve size (mm)	Sample weight retained (g)	Percentage retained (%)	Cumulative percentage retained (%)	Cumulative percentage passing (%)
0.850	0.00	0.00	0.00	0.00
0.600	0.00	0.00	0.00	0.00
0.425	0.00	0.00	0.00	0.00
0.300	22.20	11.10	11.10	88.90
0.150	95.68	47.84	58.94	41.06
0.075	44.39	22.19	81.13	18.87
Pan	36.55	18.27	-	-
Total			151.17	

Specific gravity test of aggregates and MSDA: The specific gravity of MSDA, fine and coarse aggregates are 2.62, 2.65 and 2.63 respectively. Each of the test results were performed thrice with the same sample and the mean specific gravity of each of the sample taken. However, the specific gravity of MSDA is less than the specific gravity of cement of 3.15.

Bulk density test of aggregates and SDA

The value for compacted and un-compacted bulk densities of MSDA are 478.91Kg/m^3 and 455.88Kg/m^3. The compacted and un-compacted bulk densities of coarse aggregate are 1668.82Kg/m^3 and 1589.99Kg/m^3 and that of fine aggregate are 1534Kg/m^3 and 1352Kg/m^3

Slump and compacting factor test of fresh MSDA-cement concrete

Slump test: The slump test result for the fresh concrete beams is presented in Table 3 below. The difference in height between the standard cone height and the height of concrete after slump gives the slump value. Table 3 also shows the variation of slump values when cement is partially replaced with MSDA in concrete. The slump value decreases with increasing percentage replacement of OPC with MSDA; this due to the high demand for water as the ash content increases leading to low workability.

Compacting factor test: Compacting factor test results are presented in Table 4. The table shows that the compacting factor values reduce as the MSDA content increases. The compacting factor values reduced from 0.92 to 0.84 as the percentage of MSDA replacement increases from 0% to 20% for the revibrated beams. The high demand for water as the MSDA content increases was due to increase of silica in the mixture. This is different in the case of pozzolana cement concrete as the silica-lime reaction requires more water in addition to water required during hydration of cement (Auta *et al*. 2016).

Table 3: Slump test result of fresh concrete beams (W/C = 0.5)

Serial No.	Percentage Replacement for MSDA (%)	Slump (mm)
1	0	25
2	5	19
3	10	16.5
4	15	14
5	20	No slump

Table 4: Compacting factor for the fresh concrete beams

S/NO	SDA percentage replacement (%)	Compacting factor value
1	0	0.92
2	5	0.88
3	10	0.87
4	15	0.86
5	20	0.85

Effect of revibration on flexural strength of both revibrated and non-revibrated concrete beams treated with MSDA at 28 days curing: Table 5 and 6 shows the results of the flexural strength test of each beam specimen for revibrated beams over time interval and for non-revibrated concrete beams respectively. The mean flexural strength of the control specimen is 9.29N/mm^2 higher than 5% replacement of MSDA with OPC of 8.93N/mm^2 after 28 days curing age. The overall mean flexural strength of the specimen

reduces from 8.93N/mm^2 to 4.79N/mm^2 for 5% to 20% replacement of MSDA with OPC. The peak flexural strength for revibrated and non-revibrated beams was 10N/mm^2 at 20th minutes revibration (Table 5) time and 7.0N/mm^2 (Table 6) for 5% replacement respectively. Table 5 shows that the flexural strength increased significantly from 0th to 20th minutes of revibration time and decreases from 30th to 60th minutes within the same percentage replacements, indicating that revibration has increased the flexural strength of the concrete.

Table 5: Flexural strength of concrete beams at 28 days curing

S. No	Percentage replacement for MSDA (%)	Flexural strength at each revibrated time lag, N/mm^2							Mean Flexural strength (N/mm^2)
		0th mins	10th mins.	20th mins.	30th mins.	40th mins.	50th mins.	60th mins.	
1	0	9.5	10.0	10.5	9.5	9.0	8.5	8.0	9.29
2	5	9.0	9.5	10.0	9.5	9.0	8.0	7.5	8.93
3	10	7.5	7.5	8.0	8.5	8.0	7.5	7.0	7.71
4	15	6.5	7.0	7.5	7.0	6.5	6.0	6.0	6.64
5	20	4.0	4.5	5.0	5.5	5.5	4.5	4.5	4.79

Table 6: Flexural strength of non-revibrated beams at 28 days of curing

S/No.	Percentage replacement for MSDA (%)	Weight of specimen (Kg)	Density of specimen (Kg/m^3)	Flexural strength of specimen		Mean flexural strength (N/mm^2)
				bar	(N/mm^2)	
1	0	34.92	2586.67	80	8.0	8.0
		34.24	2536.30	85	8.5	
		35.05	2596.30	75	7.5	
2	5	33.02	2445.93	70	7.0	7.0
		33.05	2448.15	75	7.5	
		33.10	2451.85	65	6.5	
3	10	34.90	2585.19	65	6.5	6.2
		34.85	2581.48	60	6.0	
		34.54	3558.52	60	6.0	
4	15	36.31	2689.63	45	5.5	5.3
		34.65	2566.67	50	5.0	
		33.86	2508.15	55	5.5	
5	20	33.21	2460.00	45	4.5	4.7
		33.87	2508.89	50	5.0	
		32.63	2417.04	45	4.5	

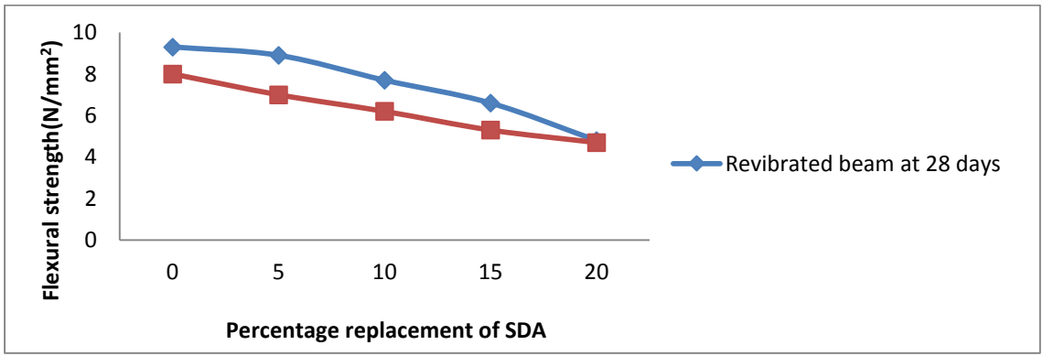

Figure 3: Flexural strength of revibrated and non-revibrated beams at 28 days curing

In figure 3, the flexural strengths of revibrated and non-revibrated beams are compared. It clearly indicated that values for revibrated beams are higher than that of non-revibrated. This thus has demonstrated the positive effect of revibration on the flexural strength of reinforced MSDA – cement concrete beams. However, the general flexural strength decreases with increase of MSDA.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Effect of revibration on the flexural strength of reinforced concrete beams using Mahogany sawdust ash (MSDA) as partial replacement for Ordinary Portland Cement (OPC) is presented. From the study the following conclusions can be drawn:

1. The major constituents of SDA from the chemical analysis includes: Al_2O_3, SiO_2 and Fe_2O_3, whose percentage summation of 64.84% is nearly 70% as stipulated by ASTM C 618 (1991), indicates that MSDA obtained belongs to class F pozzolana.
2. The mean flexural strengths of revibrated and non-revibrated beams compared clearly indicated that values for revibrated beams are higher than that of non-revibrated depicting a positive effect of revibration on the flexural strength;
3. The maximum flexural strength were attained at 20^{th} minutes revibration for both 0% and 5% replacements. All others were low both at revibration time intervals and percentage replacements;
4. The compacting factor and flexural strength values reduces as the percentage replacement of SDA increases.

Recommendations

The following recommendations can be made from this research work as carried out:

The Sawdust should be properly assembled and differentiated from other sawdust obtained from other wood species, sun dried, burnt and the chemical analysis of the sawdust should be determined before it's used in concrete production.

Revibration process can be employed always in concrete production for high quality improved concrete and when treated with MSDA, should not exceed 5% replacement of cement and revibration beyond 20^{th} minutes is not recommended.

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EFFECT OF CALCIUM CARBIDE WASTE AND GROUNDNUT SHELL ASH BLENDED WITH CEMENT IN CONCRETE PRODUCTION

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This research work presents the detailed experimental investigation into the strength of modified concrete produced from mixes containing cement blended with calcium carbide waste (CCW) and groundnut shell ash (GSA). Oxide compositions of CCW and GSA were determined to ascertain their oxide composition. The compressive strength of concrete containing CCW and GSA was studied at 5% CCW for all mix and varied 5%, 10%, 15%, 20% and 25% for GSA by weight of the cement, but all other concrete ingredient are kept constant. A total of one hundred and eighty (180) cubes of 1:2:4 mix and water cement ratio of 0.50 concrete specimens containing CCW, GSA and OPC of 150mm dimensions were prepared, cured and tested for compressive strength at 7, 14, 21, 28, 56, and 90 days respectively. The result of the study show that CCW was more of CaO concentration of up to 90.300% and a combined SiO_2, Al_2O_3 and Fe_2O_3 concentration of 8.92%. Also, GSA has low CaO concentration of 12.260% and a combined SiO_2, Al_2O_3 and Fe_2O_3 concentration of 55.359%. That shows CCW can react with GSA through pozzolanic reactions, yielding a product that may be similar to those obtain from cement hydration process. The compressive strength of the control mix and those of other percentage compositions increases with curing age. Concrete specimens with 5% CCW and 10% GSA replacement showed high strength in comparison to the control. However, the maximum replacement does not exceed 5% CCW and 25% GSA. This work provides the means for CCW and GS disposal by converting these wastes into treasure, reduced the pressure on the used OPC thereby reducing the cost of concrete produced and sanitizing the environments.

Keywords: Calcium carbide waste, Groundnut shell ash, cement, compressive strength

INTRODUCTION

The possibility of blending wastes from industrial and agricultural processes in the construction industry as either binder or filler, posed the need to provide sustainable materials for construction. This can either be achieved by searching for new materials that are environmentally stable and friendly or contributing towards the limitation of carbon dioxide emission into the atmosphere (Hardjito *et al*., 2012). Research trends in improvement of construction material have been on providing alternative material necessitated by the high cost of conventional materials, difficulties in accessing resources for construction and building development. The alternative materials to conventional material include the use of pozzolanas as partial replacement to cement or as mineral admixtures and the use of some binders from agricultural wastes and industrial processes, to reduce the cost of construction materials, several research works have been aimed at towards the application of the cheap and readily available local materials as substitute for binder or aggregate in construction (Wazumtu *et al*., 2015)**.**

The substitution of cement partially with pozzolanic materials is well recorded and recommended in many countries today. Pozzolanas are siliceous material, which on their own possesses little or no hydraulic properties, but when mixed with lime in the presence of water will set and harden like Portland cement (Alp 2008).

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Pozzolanas are grouped into natural and artificial sources; pumicite are naturally occurring pozzolanas, and good blast furnace slag, fly ash are artificial pozzolanas. When Portland cement is mixed with pozzolanic materials it is called the pozzolanic cements, such pozzolanic cement possess the advantages like, appreciable resistance to attacks from chemicals, lower heat of hydration, economy, improve workability, decrease bleeding and high impermeability (Manasseh, 2010).

In the third world nations, the most versatile and readily available material that can be employed to replace cement partially with no any economic disadvantage are agro wastes such as, Acha husk ash (AHA), Bone powder ash (BPA), Groundnut husk ash (GHA), Rice husk ash (RHA) and Wood Ash (WA). The Advantages of utilizing agro waste in replacing cement partially are low cost rate per ton production when compared to cement, low cost rate of waste management, pollution control and an added advantage to the famer when those waste are sold, and therefore encourage production, conservation of limestone deposits and decreases the emission of CO_2 (Aribisala, 1989).

In Nigeria, the acetylene gas is used for welding in local panel beating workshops across the country. The by-product of calcium carbide waste (CCW) is often discarded as waste and dumped in landfills and this possess effects to our environment. Calcium carbide waste (CCW) composed of calcium hydroxide and is mainly alkaline, with pH greater than 12, Sun *et al*., (2015).

Over the years, groundnut shell ash and calcium carbide waste were used separately to replace cement partially in concrete productions. Alabadan, *et al*., (2005), investigated the effect of partial replacement of ordinary Portland cement (Opc) with Bambara groundnut shell ash (Bgsa) in concrete. The ash contained 10.91% CaO, 2.16% Fe_2O_3, 4.72% MgO, 33.36% SiO_2, 1.75% Al_2O_3, 16.18% K_2O, 9.30% Na_2O, 6.40% SO_3, 6.02% CO_3 and 9.20% HCO_3. 10%, 20%, 30%, 40% 50% and 0% ash was used in the mix to replace cement. The strength of cement/ash concrete increased with curing period but decreased with increasing ash percentage. The highest strength was 31.24N/mm^2 and 20.68N/mm^2 at 28 days for 0% and 10% ash respectively. Substitution of cement with ash in concrete formation was relatively possible not exceeding 10%. Though the strength of OPC/BGSA concrete was lower than that of 100% cement; it can be used for light load bearing elements.

Sanusi, (2015) studied the effect of calcium carbide waste on the compressive strength and workability of concrete used as partial replacement of cement. Concrete cubes of grade G20 were casted, 18 cubes were tested at 14 days of curing and the remaining 18 cubes were tested at 28days. 0%, 10%, 20%, 30%, 40% and 50% calcium carbide waste was replaced with cement. The results of workability test show that the value are within the assume slump of 10-30mm in mix design and the compressive strength of the specimen at 14 and 28days at 10% replacement of cement with calcium carbide waste were 21.00N/mm^2 and 28.00N/mm^2. Replacement of cement with calcium carbide waste of up to 10% gives a satisfactory result.

Samidurai *et al*., (2017), reported the partial replacement of cement with groundnut shell ash (GSA) and sea shell powder (SSP) in concrete productions and concluded that when sea shell powder is added to the Groundnut shell and partially replacing cement, increases the compressive strength. It is due to the sea shell contains more amount of calcium content. The compressive strength generally increases with curing period and decreases with increased amount of Groundnut shell Ash. Only 10% GSA substitution is adequate to enjoy maximum benefit of strength gain. The compressive strength also increases with the combination of sea shell powder up to 15% to 20% weight of cement.

However, the combination of these wastes [groundnut shell ash (GSA) and calcium carbide waste (CCW)] has not been tested elsewhere in concrete production. As a result, this research is set to investigate the use of binary system [calcium carbide waste (CCW) and groundnut shell ash (GSA)] blended with cement in concrete production. This may be a cheaper alternative to conventional binder, which may lead to reduction in the cost of construction. This may also be a means of addressing the environmental pollution caused by the accumulation of both agro and industrial waste.

MATERIALS

The material ingredients for this concrete production are Cement (ordinary Portland cement), water, fine aggregates (sharp river sand), coarse aggregates (crush granite stones not exceeding 19.50mm), calcium carbide waste and groundnut shell ash.

The materials used are as indicated in Table 1.

Table 1 Material and Sources

S/№	Material	Source
1	Cement	Fresh dangote brand of ordinary portland cement in 50Kg bags sourced in Bida.
2	Calcium Carbide Waste	From pane beaters shop at Ilorin garage, Bida local government, Niger State.
3	Groundnut Shell Ash	From Dzanchita, along Bida Kutigi road, Niger State.
4	Fine Aggregates	Sharp river sand sourced within Bida.
5	Coarse Aggregates	Crushed granite stones of 19.5mm sourced within Bida.
6	Water	Portable borehole water sourced in Bida.

RESULTS AND DISCUSIONS

Chemical Analysis of GSA and CCW

Table 2 shows the oxide compositions of Groundnut shell ash and Calcium Carbide waste. The combined concentration of SiO_2, Al_2O_3 and Fe_2O3 for the GSA used was 55.359% and fall within the class C of ASTM C 618–05. However, the groundnut shell ash used is pozzolanic and has cementing properties (ASTM C 618-05). The used CCW has low reactivity with 8.92% combined concentrations of SiO_2, Al_2O_3 and Fe_2O_3. However, since the main component of CCW is $Ca(OH)_2$, it can react with certain pozzolans (GSA) with high silicon dioxide (SiO_2) or aluminum oxide (Al_2O_3) content through pozzolanic reaction resulting in a final product that are similar to those obtained from the cement hydration process (Wang *et al*., 2013) and (Xing *et al*., 2015)

Table 2 Result of X-ray Analysis of GSA and CCW

Oxides	**GSA** (%)	**CCW** (%)
Na_2O	0.000	0.000
MgO	9.043	0.000
Al_2O_3	9.412	2.660
SiO_2	42.767	5.956
P_2O_5	4.944	0.089
SO_3	2.730	0.424
Cl	0.270	0.073
K_2O	12.391	0.087
CaO	12.260	90.300
TiO_2	2.425	0.059
Cr_2O_3	0.004	0.004
Mn_2O_3	0.436	0.000
Fe_2O_3	3.177	0.304
ZnO	0.055	0.000
SrO	0.086	0.045

Specific Gravity

Tables 3 show the specific gravity of GSA, CCW, fine and coarse aggregates. The average specific gravity of the groundnut shell ash, calcium carbide, sand and coarse aggregates used were 2.45, 2.22, 2.58, and 2.74 respectively, as show in the table 3. Mahmud, Belel and Nwakaire (2012) reported that the specific gravity value ranges from between 1.9 to 2.4 for pulverized ash and 2.6 to 2.7 for natural aggregates. The values obtained were within the specified range. In this case however, the low specific gravities of calcium carbide waste and groundnut shell ash has affected the density of the concrete cubes produced, since the specific gravity of any material depends on it density.

Table 3 Result of the specific gravity of sand, granite, CCW and GSA

Material	Specific Gravity
Sand	2.58
Granite Stones	2.74
Calcium Carbide	2.22
Groundnut Shell Ash	2.45

Workability

The workability was measured by two test slump and compacting factor. Increase in the water-cement ratio result in increase in the workability. The slump decreases when cement is blended with CCW and GSA. The values for compacting factor fall within the low plastic range, and the slump fall within the very low range. However, the water-cement ratio of 0.5 for CCW and GSA concrete indicate slight low workability, this may be due to the much water that is absorbed by CCW and GSA leaving little mixing water to lubricate other concrete ingredients. The workability of concrete for all replacements are as indicated in Table 4

Table 4 Result of Compacting Factor Test and the slump for Various Batches

Batch №	% Replacements	Compacting Factor	Slump(mm)
1	Control	0.8953	5
2	5% CCW, 5% GSA replacement	0.8895	0
3	5% CCW, 10% GSA replacement	0.8798	0
4	5% CCW, 15% GSA replacement	0.8817	0
5	5% CCW, 20% GSA replacement	0.8683	0
6	5% CCW, 25% GSA replacement	0.8797	0

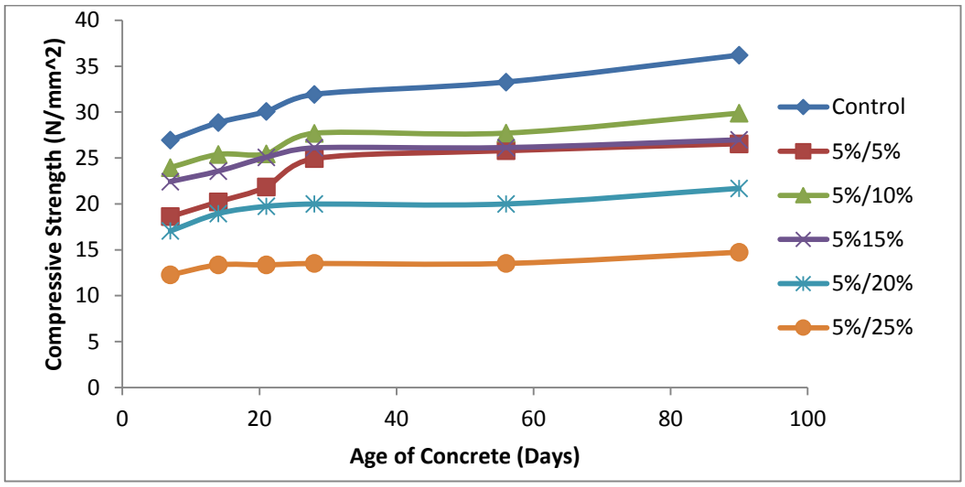
Compressive Strength

The compressive strength of the control mix and those of other percentage compositions increases with curing age. Concrete specimens with 5% CCW and 10% GSA replacement showed high strength in comparison to the control at 90 days. The strength development of 5% CCW and 10% GSA replacement is due to the pozzolanic reactions between CCW and GSA, which in turn react with the cement and improved the hydraulic properties of Portland cement used in the concrete productions as reported by (Wang *et al*., 2013) and (Xing *et al*., 2015). However, the maximum replacement does not exceed 5% CCW and 25% GSA, which has the minimum compressive strength of 14.738N/mm^2 at 90 days less than the minimum compressive strength specified in the BS 8110 to be 26 N/mm^2. This may be due to the high percentage of groundnut shell ash by weight as manifested in the result obtained for the batch (25%GSA and 5%CCW). The results of the effect of calcium carbide waste and groundnut shell ash on the compressive strength of concrete at various ages of 7, 14, 21, 28, 56 and 90 days, is detailed in table 5.

Table 5 Result of Compressive Strength test of the Concrete Cubes

Replacement (%)	Age of Curing (Days)	Average Compressive Strength (N/mm^2)
0%CCW and GSA	7	26.960
	14	28.854
	21	30.062
	28	31.931
	56	33.281
	90	36.205
5%CCW, 5% GSA	7	18.613
	14	20.225
	21	21.842
	28	24.930
	56	25.795
	90	26.459
5%CCW, 10% GSA	7	23.964
	14	25.387
	21	25.449
	28	27.695
	56	27.910
	90	29.884
5%CCW, 15% GSA	7	22.436
	14	23.570
	21	25.082
	28	26.106
	56	26.136

	90	26.986
5%CCW, 20% GSA	7	17.049
	14	18.943
	21	19.730
	28	19.989
	56	19.994
	90	21.692
5%CCW, 25% GSA	7	12.267
	14	13.355
	21	13.506
	28	13.508
	56	13.512
	90	14.738



CONCLUSION

The physical properties of sand, granite, as well as oxides compositions of groundnut shell ash were determined and found suitable for concrete productions. The groundnut shell ash (GSA) used is classified as pozzolanic material and has cementing properties, it falls within the class C of ASTM C 618-05, and the calcium carbide waste (CCW) used is classified as non pozzolanic material. At 90 days, the compressive strength of concrete cubes with 5% calcium carbide waste and 10% groundnut shells ash replacement has the highest strength (29.883N/mm^2) compared to other percentage replacement and the control mix. The use of calcium carbide waste and groundnut shell ash blended with cement in concrete production is ideal especially, in solving the environmental problems resulting from dumping these wastes. These wastes can also be employed in producing light weight concrete where necessary. This research can also guarantee employment, which has been the national problem and a global phenomenon.

RECOMMENDATIONS

This research work recommends the following:

(1) Groundnut shell ash and calcium carbide waste can be blended with cement at 5%CCW and 10%GSA optimum for use in concrete productions.
(2) Groundnut shell ash and calcium carbide waste may be used to produce light weight concrete.
(3) It is also recommended that further study on this work should include the effect of water/cement ratio on the compressive strength of CCW and GSA concrete, determined at 7, 21. 28, 56, and 90 days of curing.

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SUGARCANE STRAW WASTE ASH AS A POTENTIAL BINDER IN CONCRETE PRODUCTION

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The utilization of industrial and agricultural waste produced during the manufacturing processes has been the emphasis of waste reduction research for economic, environmental and technical reasons. Sugar cane straw waste ash (SSWA) is a fibrous waste product of the sugar industry, along with ethanol vapor. This waste product is already causing serious environmental pollution, which calls for urgent ways of handling the waste. The SSWA is reach in SiO_2+Al_2O_3+Fe_2O_3 (83.13). It has limited life span and after use its either stock piled or sent to landfills. This study focuses on experimental investigation on the use of SSWA as cement substitute in concrete production. Total number of 120 cubes of size 150x150x150 mm, 72 numbers of cylindrical size of 150mm diameter and 300mm height specimen were casted from a mix ratio of 1:2:4 by weight and water cement ratio of 0.6 were used. In this experimental research work concrete cubes were casted and tested to examine various properties of concrete. The SSWA was analyzed physically and chemically and partially replaced in the ratio of 0%, 5%, 10% 15% 20% and 25% by the weight of cement. The slump test was conducted on the fresh concrete and found out that the workability increase with increase in additional level of SSWA which shows that the water absorption capacity of SSWA is low. The compressive strength and flexural strength were carried out on the hardened concrete at various ages of 7, 14, 21 and 28 days respectively. The compressive strength and flexural strength of concrete decrease with increase in SSWA content, however, from the results we can conclude that optimum amount of sugarcane straw waste ash that can be replaced with cement is 10% by weight without any admixture.

Keywords: PPC, SSWA partial replacement, Workability, Compressive strength, and Flexural strength.

INTRODUCTION

Concrete is a composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate, usually a combination of fine aggregate and coarse aggregate. Concrete is made from some basic component such as aggregates (fine and coarse), cement, water and some time with addition of additive (Gambhir, 2004). The cement reacts chemically with the water and other ingredients to form a hard matrix which binds all the materials together into a durable stone-like material that has many uses. Often, additives (such as pozzolana) are included in the mixture to improve the physical properties of wet mix or the finished material (Kosmatka and Panarese, 2002).

The over dependent on the utilization of industrially manufactured binding materials (cement) have kept the cost of construction financially high. Thus has up till now prevented third world countries like Nigeria in providing good housing for its citizen particularly rural dwellers that are mostly agriculturally dependent (Agbede and Joel; 2011). The use of waste materials in mortars and concrete can be an important step towards sustainability as the construction industry is significant and worldwide use cement as their main binder, (Krammart, 2004). The use of alternative binders that are less pollutant and/or the use of residues could impact the construction industry towards the production of concrete with less environmental impact. In order to achieve this, concrete must have adequate characteristics, implying that certain mechanical characteristics and water behavior must be achieved.

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Sugarcane straw waste (SSW) is the by-product of milling the sugarcane, which can also be produced by chewing the sugarcane by individuals. Since bagasse is a by-product of the sugar industry, the quantity of production in each year is in line with the quantity of sugar cane produced. About 33% of the (SSW) produced, supplies the fuel for the generation of steam (Bilba et al 2003). According to Jayminkumar and Raijiwala (2015), the SSW has been considered being a waste which causes the problems of disposal at the power plant; and also the landfills of SSW ash are still the problem of power plants because the waste of ash is currently not useful for any works

With present alternative sources of fuel, sugar factories have an excess of bagasse, which together with locally generated bagasse, pose serious environmental production problem, which when inhaled in excess, causes respiratory disease known as bagassiosis (Laurianne 2004). In Nigeria, the estimated land under sugar cane cultivation is 23kha – 30kha, while large scale cultivation is done at Bacita and Numan in Niger State of Nigeria, with an estimated annual output of 96, (Misari et al. 1998). According to Ahmad and shaikh (1992), the physical and chemical properties of sugarcane straw ash are found to be satisfactory and conform to the requirements for class N pozzolana (ASTM C618-78). Although reports by Ola (1983) through Osinubi (2006) has shown that the use of phosphate waste and pulverized coal bottom ash and sugarcane straw ash as pozzolana does not received considerable attention.

Materials Preparation

The material used for this study are fine aggregate (correspond to zone 2 based on sieve analysis carried out in accordance to BS 882 code of practice), coarse aggregate, ordinary Portland cement, sugarcane straw waste ash, and water – cement ratio of 0.60 which was obtained from mix design. The method adopted in the preparation of sugarcane straw waste ash is as follow; The sugarcane straw waste samples used were obtained from Wuya in Gbako local government area of Niger State and then dried to remove the moisture content, after which the dried sample is then burnt using close burning at National Cereal Research Institute (NCRI) Baddegi, Niger State and sieved using BS sieve (75 microns), the portion passing through the sieve would have the degree of fineness of 0.63mm and below for cement, while the residue was thrown away and the sieved SSWA was then stored in a cement bag ready for use. Casting and testing of concrete cubes; a total of 120 cubes of 150 x 150 x 150 mm dimensions were cast based on 28 days target compressive strength of 25N/mm^2. The cubes were caste using 0%, 5%, 10%, 15%, 20% and 25% of SSWA as a partial replacement for cement and slump test was carried out during casting to check the workability of each concrete mix.

METHODOLOGY

This study involved the collection and preparation of sugarcane straw waste ash, and the mix design in accordance with BS 5328: Part2; 1991 was adopted, then followed by casting, curing and testing of concrete cubes. The total numbers of 120 cubes of 150x150x150 mm and 72 numbers of cylindrical size of 150mm diameter and 300mm height specimen were cast in which 20 cubes and 12 cylinders were cast for each percentage replacement of cement with sugarcane straw waste ash and 5 cubes from each mix (i.e. 30 cubes) and 18 cylinder from each mix (i.e. 18 cylinders) were tested at 7, 14, 21 and 28 days of curing and at least three cubes test result out of five (5) of each percentage mix of SSWA was taken and recorded. The cubes and cylinder were casted using 0%, 5%, 10%, 15%, 20% and 25% of sugarcane straw waste ash as partial replacement of cement and slump test was carried out during casting to check the workability of each concrete mix. Casting of the cubes and cylinders were carried out immediately after the workability test, to determine the compressive strength; the cubes were left for 24 hours before de-moulding. At the end of each curing period (7, 14, 21 and 28 days), five cube and three cylindrical specimens from each mix were tested for compressive strength and flexural strength at room temperature but only three out of five cube were considered and the average value was recorded.

RESULTS AND DISCUSSION

The Summary of chemical composition of cement and sugarcane straw waste ash are shown in Table 1. The Chemical analysis indicates that the SSWA has cementitious compounds

like calcium oxide, alumina and iron oxide. Calcium Oxide (CaO) content in SSWA is about 65.05% which indicate hydrated lime when slaked with water, with a value of loss on ignition (LOI) of about 27.92%.

Table 1: Chemical Composition of Cement and Sugarcane Straw Waste Ash

Chemical compound	Type I cement Reddy et al. (2013)	Sugarcane Straw Waste Ash
SiO_2	22.00	68.42
Al_2O_3	5.00	5.812
Fe_2O_3	3.50	2.56
CaO	65.00	4.58
SO_3	1.00	4.33
MgO	0.2	0.57
K_2O	1.00	1.28
Na_2O	0.77	0.92
LOI	0.20	5.60
Blaine fineness m^2/kg	350.00	410.00
Relative density	3.15	2.12

Setting Time Test Result

The water requirement of SSWA blended cement paste at various percentages of mix increased. It was noted that the setting time increases with an increase of partial replacement of SSWA with cement. As the SSWA content is increased from 0% to 25%, the initial setting time was found to increase from 105 minutes to 142 minutes and the final setting time increased from 195 minutes to 351 minutes. This is logical as the increase of SSWA content reduces the cement content in the mix and also decreases the surface area of the cement and in the other hand retard (delay) the setting time of the SSWA concrete. As a result hydration process slows down causing setting time to increase. The delay in hydration means low rate of heat development. The final setting time of all additional level was within the specification of the code (BS 812 part 3, 1975), which stipulate a final setting time of not more than 600 minutes.

Table 2: Physical characteristics of OPC and SSWA-Cements

Additional level (%)	0	5	10	15	20	25
Initial setting time (min)	105	112	115	123	129	142
Final setting time (min)	195	235	248	277	303	351
Specific gravity	3.16	3.09	3.02	2.97	2.86	2.80
Fineness (m^2/kg)	310	309	306	313	317	221
Soundness, expansion (mm)	0.73	0.98	1.30	1.10	1.36	1.35

Workability of fresh concrete

Workability of the fresh concrete mix is shown in Table 3 below. A high quality concrete is one which has acceptable workability in the fresh condition and develops sufficient strength. Essentially, the higher the height of the slump, the better the workability, which shows that the concrete flows freely and free from segregation; A slump value of 77 mm was determined for control. The workability of fresh SSWA concrete increased with increase in the percentage of SSWA by weight and acceptable workability, this is due to the increasing in the surface area of sugarcane ash.

Table 3: Slump Test

Water cement ratio	0.60					
Additional level (%)	0	5	10	15	20	25
Slump (mm)	77	85	97	122	148	173
Description of workability	High	High	High	High	High	High

Compressive Strength and Flexural Strength of Concrete

a. Compressive Strength of concrete

The compressive strength of hardened concrete specimens was done on compression testing machine in accordance with BS1881-119 (1983) using (150mm x 150mm) cubes loaded

uniaxial in the universal compressive machine. Compressive strength of sugar cane ash contain concrete cubes was determined after 7, 14, 21 and 28 days moist curing. The average compressive strength values of the concrete specimens at each percentage of addition and age is presented in Table 4. The compressive strength of SSWA concrete increased with age, the compressive strength at 28 days ranged from 29.50 to 25.20N/mm^2, which depends on the percentage addition of SSWA. This result indicated that the SSWA mixture could be used as a cementitious material in concrete.

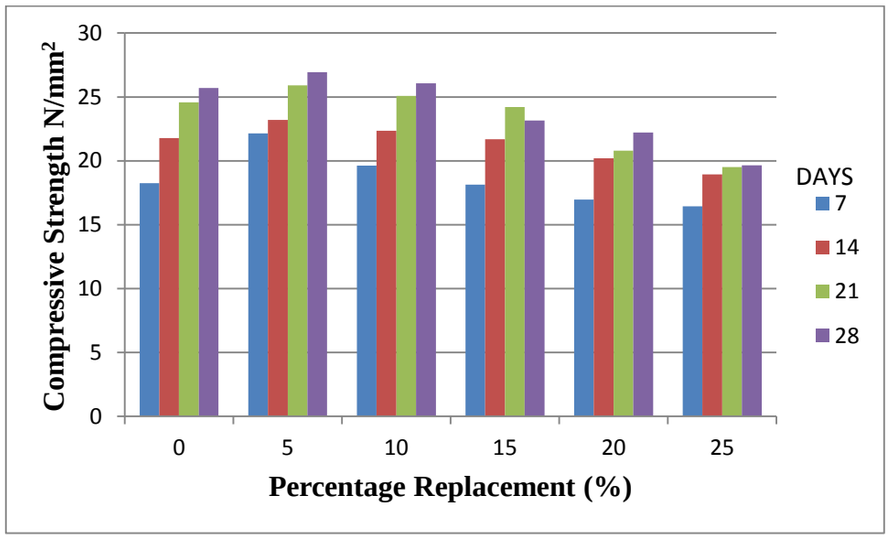

Figure 1: Comparison of compressive strength result at 7th, 14th, 21th and 28th days

b. Flexural strength of Concrete

Flexural strength test was carried out in accordance with BS: 516 (1959). Beams were tested for flexure in Universal testing machine. The axis of the specimen is aligned with the axis of the loading device. The beam was loaded till it fails and the maximum load applied to the beam during test is noted. The flexural strength increase with curing age but decreased with increase in SSWA content. Though, the flexural strength of SSWA content at 5% is comparable to that of control sample. The decrease in the flexural strength with increase in SSWA content is attributed to dilution effect of Portland cement and weaker formation of C-S-H gel as a pozzolanic reaction of SSWA (Oyekan and Kamiyo, 2011).

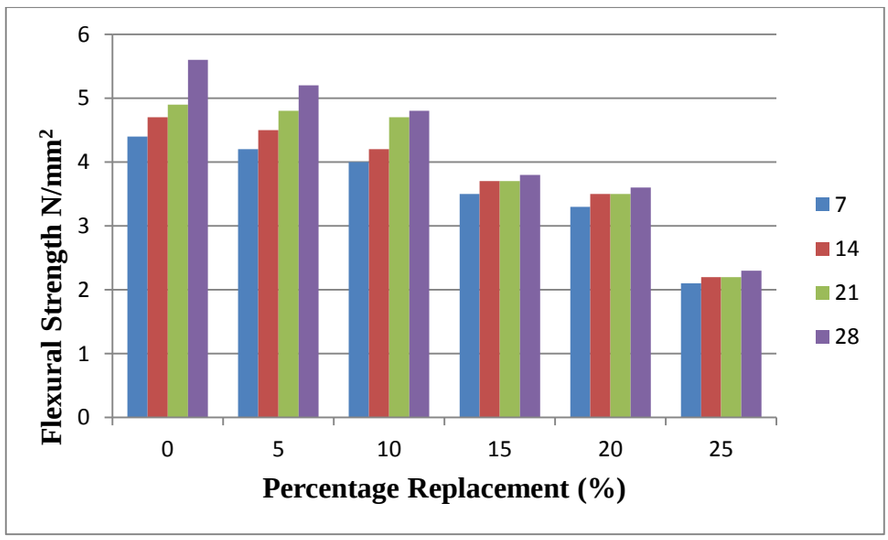

Figure 2: Comparison of flexural strength result at 7th, 14th, 21th and 28th days

The result showed that the inclusion of SSWA in the blended concrete mixed enhanced the flexural strength. The improvement in flexural strength of blended SSWA mix may be attributed to increased pozzolanic reaction and the packing ability of the fine particles of SSWA.

CONCLUSION AND RECOMMENDATION

This investigation on the potential of sugarcane straw waste ash on the properties of concrete has demonstrates how the use of suitable technology can transform abundantly available, cost-effective, non-conventional and locally available materials which could be potential environmental hazards into a natural resource and hence, it can be suitable for construction, especially those that can partially replace cement, which may also help to prevent environmental pollution. The results obtained from the experimental works showed that sugarcane straw waste ash can replace cement in concrete production. Pulverized SSWA is a suitable pozzolanic material for use in concrete. From the experimental results and it can be concluded that replacement of sugarcane straw waste ash with cement can be up to 10% by the weight of cement without significant loss in strength of concrete.

The following conclusions are drawn:

✓ Compressive strengths increases with age but reduces with increase in SSWA content in the mix especially when more than 10% SSWA is used.

✓ Concrete with SSWA constitute of 5, 10, 15, 20 and 25% is still stable and could be acceptable in most concrete work.

✓ SSWA replacement of 5, 10, 15, 20 and 25% in concrete with OPC showed no significant loss in strength compared to the control sample.

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COMPRESSIVE STRENGTH OF REVIBRATED CONCRETE USING SAWDUST ASH FROM SELECTED WOOD SPECIES AS PARTIAL REPLACEMENTS FOR CEMENT

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This study aims at determining the compressive strength of revibrated concrete using sawdust ashes (ASDA, MSDA) from selected wood specie as partial replacements for cement. Apa and mahogany wood specie were used to carry out this study. Chemical analysis of the ASDA and MSDA contain the major chemical oxides found in cement which includes SiO_2, Al_2O_3 and Fe_2O_3. Six (6) concrete cubes of 0% replacement by weight were produced with ordinary Portland cement (OPC), while another Six (6) concrete cubes were cast each using 5%, 10%, 15%, 20%, 25% and 30% replacement of OPC with SDA from the specified wood specie giving rise to a total of seventy-eight (78) cubes produced without revibration. These cubes were cured and subjected to a compressive strength test at 7 and 28 days. The optimum ASDA replacement for cement was attained at 5%, while that of concrete cube containing MSDA was attained at 10%. Another set of concrete cubes numbering eighty-four (84) was produce, fifty-six (56) of which were cast using the optimum percentage from ASDA and MSDA, while the remaining twenty-eight (28) were cast using OPC only. All the eighty-four cubes were revibrated for 20 seconds at 10 minutes intervals through 1 hour after initial vibration. The cubes were cured for 7 days, 28 days and subjected to compressive strength test. The result reveals that the compressive strength of the revibrated concrete cubes increases up to a certain time lag and thereafter decreases to the lap hour. The result also reveals that the maximum strength obtained after revibration, seems to have an improved strength compare to the mean value obtained from non- revibrated concrete cubes.

Keywords: Compressive strength, Concrete, Revibration, ASDA, MSDA.

INTRODUCTION

Vibration and revibration plays a major role in placing and distribution of high quality concrete. Vibration or compaction is the principle method of consolidation of concrete. Previous studies established that the improvement of concrete quality is due to both compaction and consistency made by vibration. Revibration is the process in which a vibrator is reapplied to fresh concrete at some time after initial vibration (Auta, Amanda and Sadiku, 2015). Since early days many Civil engineers are of the opinion that partially set concrete should not be disturbed, strong belief has it that any disturbance to concrete, like revibration in the initial setting stage makes the concrete deteriorate and lose its strength (Krishna, Rathish and Bala, 2008). However, it is suggested that revibration eliminates defects (honey comb and voids) thereby increasing the compressive strength of the concrete (Krishna *et al.*, 2008). The overall relevance of concrete in virtually all civil engineering practice and building construction works cannot be overemphasized (Adewuyi and Adegoke, 2008). Concrete consist of water, cement, fine aggregate, coarse aggregate and admixture if need be, which are mixed in a particular proportion to get a particular strength. However, the construction industry relies heavily on conventional materials such as cement, granite and sand for the production of concrete. The high and increasing cost of these materials has greatly hindered the development of shelter and other infrastructural facilities in developing countries (Olutoge, 2010).

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As the infrastructure of the entire world is kept developing, the construction industry is in need of large amount of raw materials (Olugbenga and Sunmbo, 2014). Thus, there is the need to search for local materials as alternatives for construction and building works. Cement as one of the basic ingredient of concrete is one of the main construction materials used widely. The increasing demand for cement is expected to be met by partial cement replacement. The search of non-conventional local construction materials which may serve as alternative for cement or binder replacement in concrete production led to the discovery and possibility of using agricultural waste and industrial by product as cementitious materials (Obilade, 2014). Saw dust also known as wood dust can be define as a loose particles or wood chippings obtained as by-product resulting from the mechanical milling or processing of timber into various shapes and sizes.

The resulting ash know as sawdust ash is a form of pozzolan (Obilade, 2014). According to American Society for Testing Materials (ASTM, C-618-1978), pozzolana is a siliceous or a siliceous aluminous material which contains little or no cementitious value, but in finely divided form and in the presence of moisture or water, chemically reacts with calcium of moisture at ordinary temperature to form compound possessing cementitious properties. Saw dust is in abundance in Nigeria and other parts of the world. However, its continuous accumulation in recent times can lead to health hazard and environmental problem. It is logical that one way of disposing of it can be its beneficial incorporation into structural concrete system. Cheah and Ramli (2011) investigated the implementation of wood waste ash as a partial cement replacement material in the production of structural grade concrete and mortar. Elinwa, Ejeh and Mamuda (2008) assessed the fresh concrete properties of self-compacting concrete containing Saw Dust Ash. Elinwa and Mahmood (2002) considered ash from timber waste as cement replacement material. The need to convert this waste product into a construction product is the focus of this study. This research work examined the use of saw dust ash from selected wood species as partial replacement for Cement in concrete production. It also involved the determination of compressive strength of revibrated concrete using optimum percentage level of replacement.

MATERIALS AND EQUIPMENT

Materials

The materials used in this study are as follows:

Sawdust Ash (SDA): The sawdust from Apa (ASDA) and Mahogany wood species (MSDA) which was used for this research work were sourced from Dei-Dei timber shade in Abuja along Kubwa- Abuja expressway in F.C.T. The saw dusts were brought to Minna and taken to where they were burnt into ash to produce the sawdust ashes (ASDA, MSDA) at 800^{o} C.

Coarse Aggregate: The gravel (coarse aggregate) which was used for this research work was sourced from Kpankugu in Minna, Niger state. Gravel material with particle size between 10mm to 14mm was used as coarse aggregate for this research work. The coarse aggregate was free from impurities such as dust, clay particles.

Fine Aggregate: The sand (fine aggregate) was sourced from Kpankugu in Minna, Niger state, Nigeria. It was free from impurities, organic matter and later sun dried. It conformed to the requirements of BS EN 12620 (2008).

Water: The water which was used for mixing the materials was obtained from borehole which conformed to BS EN 1008 (2002) requirements. Therefore, the water is fit for drinking, free from suspended particles, organic materials and soap which might affect hydration of cement.

Cement: The cement which was used as a binder throughout this project is Dangote cement which is a type 1 ordinary Portland cement (i.e. a general purpose Portland cement suitable for most uses) conforming to BS EN 197-1 (2000) specifications.

Equipment

The equipment used to carry out this research work includes; electric weighing balance, table vibrator, British standard sieves, stop watch, hand trowel, tamping rod, head pan, Seidner compression machine, bucket and 150mm × 150mm × 150mm metal mould

EXPERIMENTAL METHOD

Procedure

The following procedure was adopted in this research work:

Chemical Analysis of ASDA and MSDA: Samples of ASDA and MSDA were taken to a chemical laboratory to determine the oxides composition using the X-Ray fluorescent (XRF) test.

Aggregate Characterization: Physical properties tests of aggregate such as specific gravity, particle size distribution (sieve analysis) and bulk density tests were carried out on the constituent materials used which include fine aggregate, coarse aggregate and ASDA and MSDA.

Production of Concrete cubes

The concrete mix design was carried out using the absolute volume method for the constituent materials of concrete mix ratio of 1:2:4 with a constant water / cement ratio of 0.5 for the production of concrete cubes. Mixing of the concrete was done manually based on the volume to be use, slump and compacting factor test were carried out on the fresh concrete and the result presented in Table 1. A total of one hundred and sixty (162) concrete cubes specimen of metal mould size 150mm × 150mm × 150mm was produced for this study. The concrete cubes were produced for two procedures, revibrated and non-revibrated. For the non-revibrated, a set of seventy-eight (78) cubes were produced in total, six (6) concrete cubes (control cubes) were produced with pure cement and another six (6) cubes were produced each using 5%, 10%, 15%, 20%, 25% and 30% ASDA and MSDA replacements for cement. However, another set of concrete cubes numbering eighty-four (84) was produce, fifty-six (56) of which were cast using the optimum percentage replacements of ASDA and MSDA for cement. The remaining twenty-eight (28) using OPC were cast and revibrated. The revibration process was carried out for 20 seconds at 10 minute intervals through duration of 1 hour after initial vibration. Vibrating table was used to compact the concrete mix in the metal mould. The concrete cubes were de-moulded after 24 hours and were cured by method of ponding (immersion of the cubes into water) for a period of 7 and 28 days only. Compressive strength on the concrete cubes was carried out after a 7^{th} and 28^{th} days of curing in accordance with the specification in BS1881: Part 116: (1983) using Seidner compression machine.

RESULT AND DISSCUSSION

The results of the Laboratory tests which include: Chemical composition of ASDA and MSDA, physical properties test of aggregate and test on concrete (fresh and hardened properties) are presented in Tables 1, 2, 3, 4 and figures 1, 2, 3, 4.

Chemical composition of ASDA and MSDA

The chemical composition of the SDA for the specified wood specie used in this study are presented in table 1. It can be seen that the oxide concentration of the ash using an X-Ray fluorescent (XRF) test showed that its major oxide concentration is CaO, SiO_2, Al_2O_3, Fe_2O_3, MgO and SO_3. Element such as Na_2O, ZnO, Cl, Mn_2O_3, SrO, Cr_2O_3, P_2O_5, TiO_2 and K_2O were detected in trace amount. The analyte concentration of Apa wood specie ash on table 1 shows that oxides concentration of silicon oxides (SiO_2 = 37.628%), aluminium oxides (Al_2O_3 = 16.529%) and iron oxides (Fe_2O_3 = 7.132%) constitute a total sum of 61.289% of pozzolanic materials which is slightly below 70% but greater than 50%, thus indicating that the Apa wood specie ash falls under class C as specified by ASTM C 618 (1978) for pozzolana based on its lime content while the analyte concentration of Mahogany wood specie ash on table 4.2 also shows that oxides concentration of silicon oxides (SiO_2 = 39.873%), aluminium oxides (Al_2O_3 = 18.053%) and iron oxides (Fe_2O_3 = 6.924%) constitute a total sum of 64.814% of pozzolanic materials which is slightly below 70% but

greater than 50%, thus indicating that the Mahogany wood specie ash falls under class C as specified by ASTM C 618 (1978) for pozzolana based on its lime content.

Table 1: Analyte concentration of SDA from the specified wood species

Element	ASDA	MSDA
	Concentration (Wt %)	Concentration (Wt %)
Na_2O	0.668	0.567
MgO	5.954	5.043
Al_2O_3	16.529	18.053
SiO_2	37.628	39.873
P_2O_5	0.271	0.324
SO_3	1.152	1.160
Cl	0.521	0.530
K_2O	0.412	0.434
CaO	29.167	26.568
TiO_2	0.402	0.449
Cr_2O_3	0.011	0.007
Mn_2O_3	0.042	0.021
Fe_2O_3	7.132	6.924
ZnO	0.109	0.010
SrO	0.046	0.037

Particle size analysis of fine, coarse aggregate and SDAs: The results of particle size analysis of ASDA and MSDA, fine and coarse aggregates used in this study are presented table 2, table 3, Figure 1, figure 2 respectively. The fineness modulus of MSDA as calculated from table 2 is 1.51 while that of ASDA as calculated from table 3 is 1.57, thus implying that the result attained for both wood specie is less than FM of 2.3-3.1 for fine aggregate recommended by American Society for Testing and materials (ASTM) C 33, therefore, ASDA and MSDA are finer than fine aggregate. From figure 1, the uniformity coefficient C_U is calculated as equal to 6.0, while the coefficient of curvature C_C is calculated as 1.63. This signifies that Sand is within specifications of a well-graded sand, which complies with the unified soil classification system (USCS) conforming where $C_U \geq 6$ and $1 \leq C_C \leq 3$ (Arora, 2010). From figure 2, the uniformity coefficient C_U is calculated as equal to 1.5, while the coefficient of curvature C_C is calculated as 1.12. Hence the aggregate is well graded gravel because the result complies with the Unified Soil Classification System (USCS) of well graded sand with less than 5% fine has $1 \leq Cc \leq 3$ as stated by Arora (2010).

Table 2: MSDA particle size analysis

Sieve size (mm)	Sample weight retained (g)	Percentage retained (%)	Cumulative percentage retained (%)	Cumulative percentage passing (%)
0.850	0.00	0.00	0.00	0.00
0.600	0.00	0.00	0.00	0.00
0.425	0.00	0.00	0.00	0.00
0.300	22.20	11.10	11.10	88.90
0.150	95.68	47.84	58.94	41.06
0.075	44.39	22.19	81.13	18.87
Pan	36.55	18.27	-	-
Total			151.17	

Table 3: ASDA particle size analysis

Sieve size (mm)	Sample weight retained (g)	Percentage retained (%)	Cumulative percentage retained (%)	Cumulative percentage passing (%)
0.850	0.00	0.00	0.00	0.00
0.600	0.00	0.00	0.00	0.00
0.425	0.00	0.00	0.00	0.00
0.300	24.30	12.15	12.15	87.85
0.150	97.24	48.62	60.77	39.23
0.075	47.58	23.79	84.56	15.44
Pan	28.84	14.42	-	-
Total			157.48	

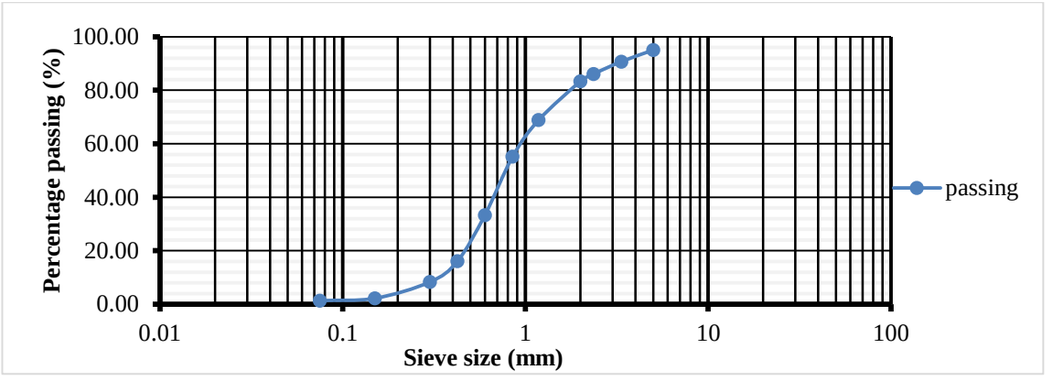

Figure 1: Particle size distribution of fine aggregate

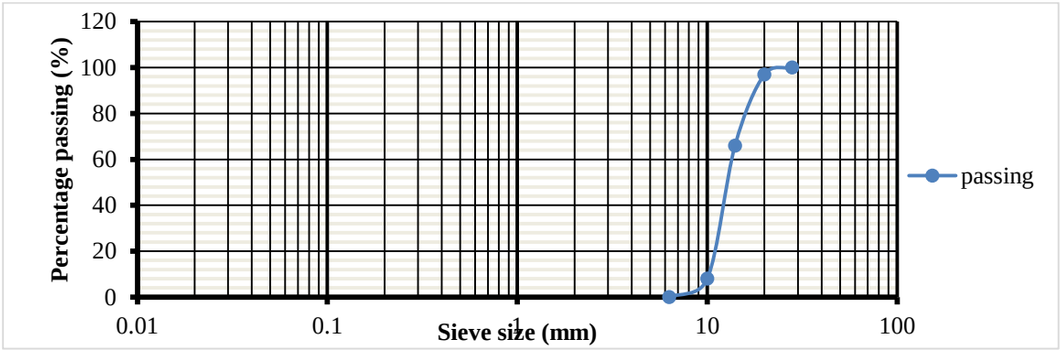

Figure 2: particle size distribution of coarse aggregate

Bulk density: The compacted and un-compacted bulk density of the fine aggregate (sand) are 1669kg/m^3 and 1590kg/m^3 while that of coarse aggregate (gravel) are 1534kg/m^3 and 1352kg/m^3. This correspond to the range of 1200-1800kg/m^3 specified by BS 812, part 2: 1975 for aggregates. The value for compacted and un-compacted bulk density of SDA from Apa wood specie are 812kg/m^3 and 650kg/m^3 while that of mahogany wood specie are 470kg/m^3 and 449kg/m^3. The results of bulk density depend on how the samples of materials are closely packed. SDA are loose materials that are light in weight which are not closely packed thereby leading to low coherent bulk density.

Specific gravity: The specific gravity was found to be 2.62 for fine aggregate and 2.65 for coarse aggregate, these values obtained is within limit of 2.5 to 3.0 for natural aggregate as specified by BS812: part 107, 1995. The specific gravity value of ASDA and MSDA were found to be 2.53 and 2.63, being average of three trials.

Fresh Concrete Properties Test

The slump and compacting factor test were conducted according to specification on the prepared fresh concrete

Slump: The results of slump test for the concrete cubes containing ASDA and MSDA shown in table 4. It was observed from the slump test result that the slump value reduces as the SDAs content increases upon inclusion in the mix from 0% to 30%, the difference in slump value when cement is partially replaced with SDAs shows the demand of water, hence giving rise to lower workability.

Compacting factor: The results of compacting factor test from table 5 shows that the compacting factor values reduce as the SDAs content increases. The compacting factor values reduced from 0.92 to 0.84 as the percentage SDAs replacement increased from 0% to 30% for the concrete cubes containing the ash from the different wood species. Thus, indicating that the concrete becomes less workable as the SDAs percentage increases signifying that more water is required to make the mixes more workable. According to Auta *et al.* (2016), the high demand for water as the SDAs content increases is due to increased amount of silica in the mixture.

Table 4: Slump test result of fresh concrete

Percentage replacement (%)	ASDA slump (mm)	MSDA slump (mm)
0	25	25
5	18	19
10	16	16.5
15	13	14
20	10	11
25	No slump	No slump
30	No slump	No slump

Table 5: Compacting factor test result of fresh concrete

Percentage replacement (%)	Compacting factor value for ASDA	Compacting factor value for MSDA
0	0.92	0.92
5	0.88	0.88
10	0.87	0.87
15	0.87	0.86
20	0.86	0.86
25	0.85	0.85
30	0.84	0.84

Hardened Concrete Properties Test

The compressive strength was test was carried out based on the specification in BS1881: Part 116: 1983 on the hardened concrete.

Compressive strength: The compressive strength of concrete containing sawdust ash (SDA) from the selected wood species and the effect of re-vibration using the optimum strength from the selected wood species were investigated after a curing period of 7 and 28 days respectively. The summary of the results is tabulated and presented graphically.

Effect of SDA from selected wood specie on the compressive strength of non-revibrated concrete

The result of the effect of ASDA and MSDA on the compressive strength of non-revibrated concrete is shown in table 6 and figure 3, it can be observed that the compressive strength value reduces as the percentage SDA from the specified wood specie partially replaced with cement increases 0, 5, 10, 15, 20, 25, and 30%. However, the compressive strength increases as the number of days of curing increases from 7 to 28 days for each percentage SDA from the specified wood specie partially replaced with cement. It was also observed from table 4.10 that the concrete cubes containing MSDA tends to show a higher gain in strength than the corresponding concrete mix containing ASDA, thus indicating that SDA from different wood specie tends to affect the compressive strength of concrete. The result also reveals fort concrete cube containing ASDA, the optimum percentage replacement was attained at 5% while that of concrete cube containing MSDA, the optimum percentage replacement was attained at 10% based on the strength obtained.

Table 6: Compressive strength test result obtained for non-revibrated hardened concrete

Percentage replacement (%)	Compressive strength of ASDA (N/mm^2)		Compressive strength of MSDA (N/mm^2)	
	7 days	28 days	7 days	28 days
0	17.74	22.90	17.74	22.90
5	15.06	18.81	16.59	21.24
10	13.77	16.35	15.93	20.03
15	12.05	14.60	13.86	17.68
20	10.16	12.11	10.93	13.86
25	8.88	11.19	9.74	11.85
30	7.46	9.80	8.03	10.01

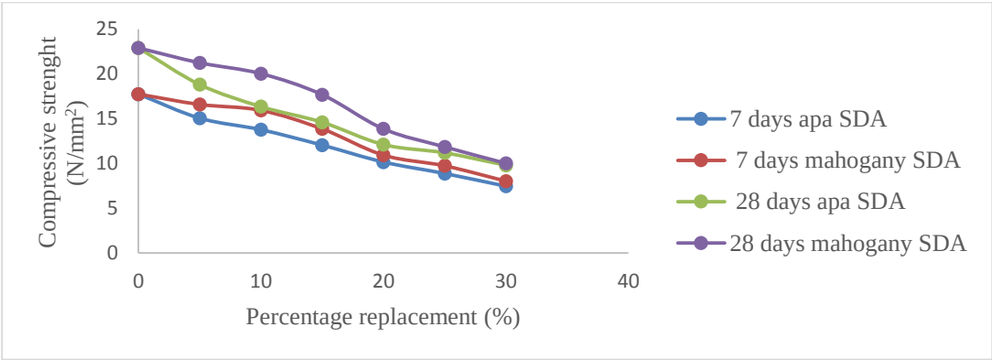

Figure 3: Effect of ASDA and MSDA on the compressive strength of concrete at different curing ages.

Effect of revibration on the compressive strength of ASDA and MSDA concrete

The major focus of this study is on the effect of revibration on the compressive strength of ASDA and MSDA using the optimum percentage replacements obtained for the non-revibrated concrete cubes. This is clearly shown by the result presented in table 7, figure 4 and figure 5 respectively.

From table 7, it visible that the compressive strength increases at the initial stage of revibration time lag interval from 0^{th} to 40^{th} minutes giving rise to strength value of 19.07N/mm^2 to 22.71N/mm^2 at 7days and 25.69N/mm^2 to 31.46N/mm^2 for 28 days of curing but later gradually decreases in strength from 50 minute (21.10N/mm^2, 26.79N/mm^2 at 7 and 28 days) to 60 minutes (20.46N/mm^2, 26.09N/mm^2 at 7 and 28 days) for the 0% replacement level. It can also be seen from table 7 where cement was partially replaced with ASDA using the 5% optimum replacement level obtained for the non-revibrated concrete cube that there is also a significant increase in compressive strength from 0^{th} to 40^{th} minutes giving rise to strength value of 18.75N/mm^2 to 22.35N/mm^2 at 7days and 22.35N/mm^2 to 26.39N/mm2 for 28 days and later decrease in strength from 50^{th} minute (19.46N/mm^2, 23.88N/mm^2 at 7 and 28 days) to 60^{th} minute (18.25N/mm^2, 22.24N/mm^2 at 7 and 28 days). From table 7, the result concrete cube containing 10% optimum replacement level obtain using MSDA partially replaced for cement shows an increase in compressive strength from revibration time lag interval of 0^{th} to 30^{th} minutes with strength value of 18.93N/mm^2 to 21.28N/mm^2 at 7days and 23.46N/mm^2 to 28.21N/mm^2 for 28 days of curing and a gradual drop in strength from 40 minute (19.15N/mm^2, 23.81N/mm^2 at 7 and 28 days) to 60 minute (18.88N/mm^2, 23.10N/mm^2 at 7 and 28 days). Generally, as stated by Auta *et al*. (2016) the early increase in compressive strength may be attributed to the calcium hydroxide in the OPC and revibration which enhanced densification and volumetric compaction of the concrete, but later re-vibration will de-bond the chemical compound of C_3S which lead to decrease in strength as can be seen from the result obtained. The maximum compressive strength for the 0% was attained at 40 minute revibration time lag with strength value of 22.71N/mm^2 and 31.36 N/mm^2 at 7 and 28 days respectively, that of 5% ASDA was also attained at 40^{th} minute revibration time lag with strength value of 22.35N/mm^2 and 26.39N/mm^2 at 7 and 28 days while the maximum strength value of 21.28N/mm^2 and 28.21N/mm^2 was attained at 30^{th} minute revibration time lag for the 10% MSDA. This maximum strength value obtain after revibration seems to have an improved strength compare to the average value obtained for corresponding percentage replacement for the non- revibrated concrete cubes. Furthermore, the result shows that revibration improves the compressive strength of OPC and OPC – SDA concrete cubes which agrees with findings of Krishna *et al.*, (2008) which states that revibration increases the compressive strength of concrete if carried out within the initial setting time of the concrete.

Table 7: Compressive strength test result obtained for revibrated hardened concrete

Time interval (Mins)	Compressive strength of Control (0%) replacement level (N/mm^2)		Compressive strength of ASDA 5% optimum replacement level (N/mm^2)		Compressive strength of MSDA 10% optimum replacement level (N/mm^2)	
	7 days	28 days	7 days	28 days	7 days	28 days
0	19.07	25.69	18.75	22.35	18.93	23.46
10	20.27	27.46	19.73	23.24	20.17	25.70
20	21.51	28.51	20.79	24.35	20.66	26.50
30	22.08	30.13	21.64	25.33	21.28	28.21
40	22.71	31.46	22.35	26.39	19.86	25.15
50	21.10	26.79	19.46	23.88	19.15	23.81
60	20.46	26.09	18.95	23.24	18.88	23.10
Mean strength	21.03	28.02	20.24	24.11	19.85	25.13

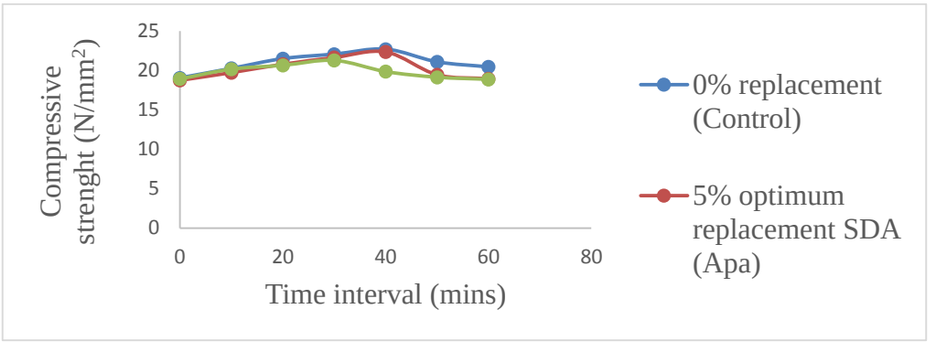

Figure 4: Effect of revibration on the compressive strength with re-vibration time lag for the specified percentages at 7 days of curing

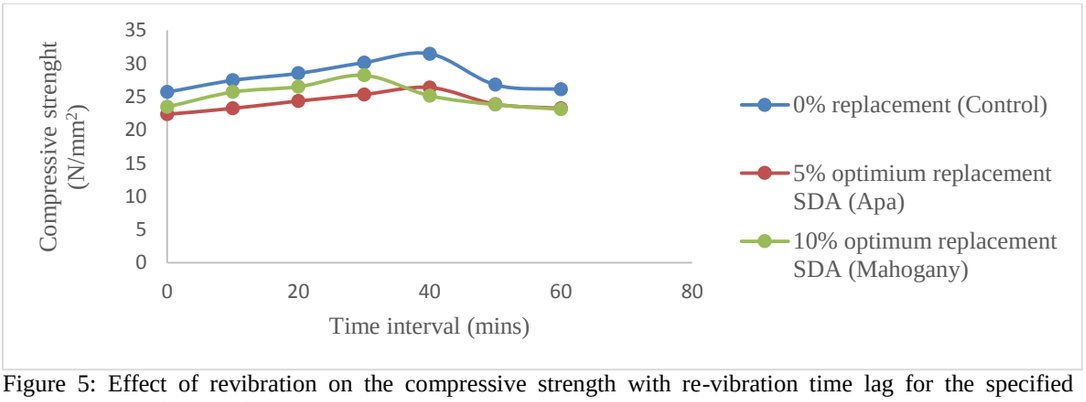

Figure 5: Effect of revibration on the compressive strength with re-vibration time lag for the specified percentages at 28 days of curing

CONCLUSION AND RECOMMENDATION

Conclusion

Based on the result of study obtained, the following conclusions were drawn:

The chemical composition of ASDA and MSDA show that they are of class C Pozzolana, where the sum of SiO_2 + AL_2O_3 + Fe_2O_3 fall under in-between 50% -70% specified by ASTM C 618 – 78 (2005) for pozzolana.

Workability of the concrete decreases with increase in percentage replacements of ASDA and MSDA.

The compressive strength generally increases with curing period and decreases with increased amount of ASDA and MSDA as partial replacements for cement.

It was also observed from the compressive strength result that optimum replacement level attained for concrete cubes containing MSDA is 10% while that of ASDA is 5%.

It was observed that the compressive strength of the revibrated concrete cubes increases up to a certain time lag and thereafter, decreases to the lap hour.

It was observed that maximum strength value obtained after revibration using 0%, 5% ASDA and 10% MSDA seem to have an improved strength compare to the average value obtained for corresponding percentage replacement for the non- revibrated concrete cubes.

Recommendations

The following recommendations were drawn based on the experimental work:

The process of revibration should be encouraged in concrete production to enhance better quality and strength as well as elimination of defects

Quantity and quality of SDA may vary with many factors such as combustion temperature, species of wood and combustion technology used. Hence proper analysis of SDA should be determined before it application in concrete works.

A comprise between the strength of concrete, cost of saving of cement replacement with MSDA would allow a replacement of up to 10% for normal strength while that ASDA would allow a replacement of up to 5% in production of light weight concrete. The utilization of SDA in concrete production will lead to reduction in environmental pollution as well improper waste management.

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SUSTAINABLE CITY GROWTH

SPATIAL VARIATION OF FACTORS INFLUENCING NEIGHBOURHOOD CHANGE IN THE PERI-URBAN AREAS OF MINNA, NIGER STATE

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As residential location choices are dependent on a wide range of housing and location attributes, the search for residential location has been a recurring challenge to urban dwellers. This study examined the spatial variation of factors that influenced neighbourhood change in fourteen peri-urban neighbourhoods of Minna. The data for this study were collected from both primary and secondary sources. Primary data were generated from the peri-urban residents through questionnaire administration. The systematic random sampling technique was employed in the selection of 825 respondents. For the secondary data, the neighbourhood demarcation map was used to determine the variation of factors influencing residents' change of neighbourhoods in the peri-urban areas. The study revealed eight important factors that influenced residents' decision to change the place where they lived and these vary across the entire neighbourhoods. These factors are availability of community facilities (roads and electricity and water supply) (0.68); security of the neighbourhood (0.67); proximity to place of work (0.65); proximity to the city centre (0.63); shift in rental tenure to home ownership (0.62); low housing rent (0.62); reduction in the value and/or price of land (0.59); and availability of private and/or personal means of transportation (0.58). The study concluded that: proximity to places of work and availability of community facilities are two major factors influencing residents' mobility Minna peri-urban neighbourhoods. The study recommended rehabilitation of dilapidated infrastructure and provision of new one to ensure sustainable peri-urban development.

Keywords: Spatial variation, neighbourhood change, peri-urban, residential location

INTRODUCTION

Cities are products of many forces and are engines of economic development, centres of cultural innovation, social transformation and political change (Knox & McCarthy, 2005). A report on world of cities by UN-Habitat (2001) explained the collective implications of the growing population during the two hundred years of global economic expansions, in the 19th and 20th century. This implies that as the world moves into the realm of urban age, the dynamism and intense vitality of cities become prominent (UN-Habitat, 2013). Consequently, the dominant urban form and spatial planning challenge facing cities in the 21st century is found in peri-urban areas. Often times, this is consciously referred to as urban sprawl, which simply interpreted as an unplanned and uncontrolled development (Cillier, 2010). Much attention has been drawn to the concept of peri-urban interface and the factors influencing peri-urban development, as well as residential location decision in peri-urban areas across major cities in the world. The search for residential location has been a source of recurring problem to urban dwellers (Olatubara, 1995). With regard to a study of Idowu (2017) notable factors influencing the decision taken by urban dwellers to live in their neighbourhood were identified and these necessitated the adjustment or change of residential locations.

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Related studies show that households in urban areas compete for spaces by bidding for housing and land in any area that befits their social and economic status (Arthur, 2001; Kim *et.al.* 2003). Besides, other several researches have focused on residential location choice with emphasis on the effect of transport related attributes on residential location choice (Florez, 2002; Kim *et.al.* 2003); implication of social and economic class (Sanni and Akinyemi, 2009); and effect on rental value and price of land (Acheampong & Anokye, 2013; Popoola, 2015). Expectedly, these studies revealed different reasons why individualsn the peri-urban areas change their neighbourhood or choose to live in a particular location.

The trend of peri-urban transformation across Nigerian cities has gained the attention of several scholars, including Jinadu (2004); Sanni and Akinyemi (2009); Aguda & Adegboyega (2013); and Popoola (2015). The focus of their studies emphasized on the factors influencing resident's locational preference and the challenges of peri-urban areas across Nigeria cities. Hence, their contributions are worthy of commendation as it provides the base to study the variation of factors influencing neighbourhood change in the peri-urban areas of Minna, Niger State, Nigeria.

Minna, the administrative capital of Niger State is experiencing growth that is unplanned and uncontrolled. The most visible evidence of this development is that of large and rapid development of slums and squatter settlements. As noted, Sanusi (2006) admitted that Minna has grown beyond its traditional boundary, creating an informal growth in the areas that are ecologically and physically unstable. It is in the light of this foregoing that this study investigates the factors influencing neighbourhood change and presented the spatial variation of these factors across the peri-urban areas of Minna.

The Study Area

Minna lies between Latitudes 9° 33¹ and 9° 40¹ North of the Equator and Longitudes 6° 29¹ and 6° 35¹ East of the Greenwich Meridian (Figure 1). The town spanned along the main spine road that separates the city into West and East. This road is from Chanchaga in the South to Maikunkele in the North, covering a distance of about 20km. The West - East pattern, spanned from Gidan-Kwano along Bida axis in the West, to Maitumbi to Gwada axis, in the East, over a distance of 15km (Figure 2). The delineated areas that are referred to as the peri-urban neighbourhoods of Minna (Figure 3) comprises of Barkin-sale, Bosso Town, Bosso Estate, Chanchaga, Dutsen Kura Gwari, Fadikpe, Jikpan, Kpakungun, Maitumbi, Sauke-Kahuta, Shango, Tayi-Village, Tundun-Fulani and Nyikangbe/Gbaganu.

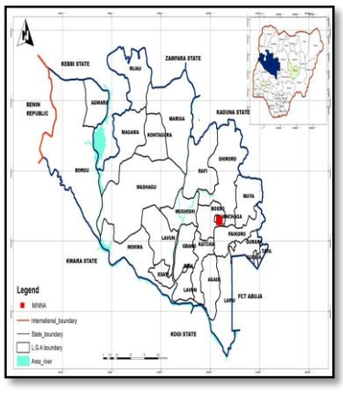

Figure 1: Map of Niger State insert is the Map of Nigeria

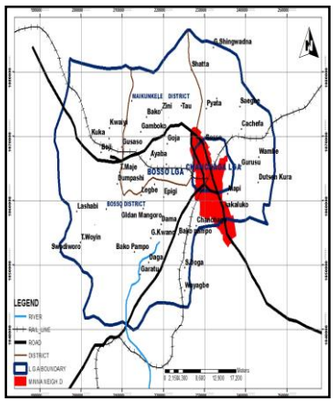

Figure 2: Minna in the context of Local Government Areas

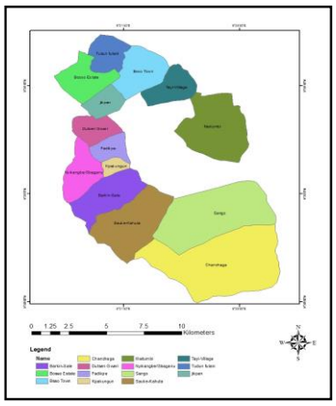

Figure 3: The Peri-urban Neighbourhoods of Minna

METHODOLOGY

The primary source of data was employed in this study with the aid of questionnaire administration. A systematic random sampling technique was employed in the selection of 825 respondents across the fourteen peri-urban neighbourhoods of Minna. The data from questionnaire administration were subjected to Likert Scale and rating method and the aggregate mean score of the factors influencing neighbourhood change was computed. The variations of the factors influencing neighbourhoods change in the peri-urban areas of Minna were determined by cross-tabulating the core factors of the aggregate factors influencing neighbourhood change against the variety of the core factors in each of the neighbourhoods and mapped using GIS technique.

DISCUSSION OF RESULTS

Factors influencing Neighbourhoods Change in the Peri-urban Areas

In this study, sixteen (16) variables were considered in examining the factors that influence change of neighbourhoods in the peri-urban areas of Minna. The aggregate mean score of the factors influencing residents' decision to change their neighbourhoods in the peri-urban area of Minna is presented in Table2. This represents the summary of the factors that influenced the respondents' decisions to change their neighbourhood.

Table 1: Sixteen Variables used in Determining Residents' Change of Neighbourhood

S/No	Factor	S/No	Factor
1	Ethnic /religion	9	Redevelopment of the former neighbourhood of residence
2	Reduction in the price of land	10	Informal economy
3	Low housing rent	11	Voluntary change in neighbourhood
4	Proximity to place of work	12	Proximity to city centre
5	Availability of community facilities	13	Interesting architecture and building design
6	Security of the Neighbourhood	14	Shift from rental tenure to homeownership
7	Avoidance of the influence of government policy	15	Change in profession or employment
8	Availability of personal/private means of transportation	16	Tenure composition

Source: Author's Survey, 2016.

The aggregate mean score was derived from the mean of scores of the entire neighbourhoods and the computed index value of it. The average aggregate mean score and relative index value of respondents in the peri-urban area of Minna are 2.86 and 0.57, respectively.

Eight variables as indicated in Table 2 were identified as the core factors influencing the respondents' decision to change their location. The core factors were determined based on if the mean score is greater than or equal to average mean score. These factors were ranked in their order of importance, with relative index value in parentheses. These factors are availability of community facilities (roads and electricity and water supply) (0.68); security of the neighbourhood (0.67); proximity to place of work (0.65); proximity to the city centre (0.63); shift in rental tenure to home ownership (0.62); low housing rent (0.62); reduction in the value and/or price of land (0.59); and availability of private and/or personal means of transportation (0.58). The auxiliary factor is determined when particular mean score is less than the average mean score, such include: voluntary change of neighbourhood (0.56); informal economy (0.54); avoidance of the influence of government policy (0.53); ethnicity/religion (0.53); composition of land tenure (0.49); redevelopment of former neighbourhood of residence (0.48); and the architectural/building design (0.47).

Table 2: Aggregate Mean Score of Factors Influencing Neighbourhoods Change in the Peri-Urban Areas

S/No	Influencing Factors	Tundun-fulani	Bosso Town	Bosso Estate	Chanchaga	Dutsen Kura	Barinkin-Sale	Maitumbi	Jikpan	Tayi-Village	Kpakungun	Fadikpe	Nyikangbe/ Gbaganu	Sango	Sauke-Kahuta	Aggregate Mean Score	Relative Index	Rank	*C/A
1	Ethnic /religion	2.32	2.61	2.43	3.97	3.19	2.52	2.67	2.57	2.39	1.85	2.07	2.47	2.53	1.69	2.52	0.50	13	A
2	Reduction in the price of land	2.83	2.58	3.45	3.50	3.51	3.15	2.83	2.76	3.06	2.58	2.50	3.17	2.51	3.20	2.97	0.59	7	C
3	Low housing rent	2.54	2.82	3.57	3.38	3.51	3.16	3.32	2.46	3.23	3.05	2.51	3.15	3.05	3.32	3.08	0.62	6	C
4	Proximity to their place of work	2.67	3.60	3.94	3.72	3.96	3.77	3.44	2.71	2.96	2.93	2.70	3.25	3.18	2.58	3.24	0.65	3	C
5	Availability of community facilities	2.58	3.50	4.11	4.68	4.08	2.83	3.02	3.52	4.26	2.93	2.68	3.30	3.53	2.60	3.40	0.68	1	C
6	Security of the Neighbourhood	3.43	3.10	3.63	4.53	4.06	2.91	3.41	2.93	3.70	2.97	2.65	3.17	3.34	2.80	3.33	0.67	2	C
7	Avoidance of the influence of government policy	2.45	2.36	3.02	4.05	3.46	2.47	2.77	2.64	2.31	2.39	2.07	2.55	2.65	2.24	2.67	0.53	11	A
8	Availability of personal/private means of transportation	2.53	2.93	3.52	4.02	3.43	2.83	3.07	3.10	2.73	2.58	2.29	2.74	2.71	2.39	2.92	0.58	8	C
9	Redevelopment of the former neighbourhood of residence	2.02	2.62	3.33	3.20	2.69	2.19	2.52	2.15	2.14	2.08	2.07	2.41	2.56	1.89	2.42	0.48	15	A
10	Informal economy	2.38	2.52	3.26	3.14	3.19	2.34	2.95	2.55	3.13	2.75	2.19	2.42	2.49	2.51	2.70	0.54	10	A
11	Voluntary change in neighbourhood	2.08	2.87	3.59	2.95	3.41	2.64	3.09	2.75	2.57	3.08	2.37	2.44	3.12	2.28	2.80	0.56	9	A
12	Proximity to city centre/ transportation network	2.19	3.39	3.82	3.84	3.88	3.47	2.90	2.98	2.82	3.33	2.63	2.92	3.59	2.58	3.17	0.63	4	C
13	Interesting architecture and building design	2.08	2.06	2.87	3.21	2.51	2.29	2.38	1.92	3.16	1.86	2.17	2.51	2.37	1.80	2.37	0.47	16	A
14	Shift from rental tenure to homeownership	2.74	2.98	3.24	3.78	3.24	2.98	3.10	2.80	3.37	3.60	2.64	3.32	2.43	2.93	3.08	0.62	5	C
15	Change in profession or employment	1.98	2.87	3.52	3.16	2.82	2.29	2.50	2.62	2.98	2.44	2.17	2.53	2.86	2.04	2.63	0.53	12	A
16	Tenure composition	2.53	2.13	2.67	3.00	2.80	2.27	2.49	2.88	2.08	2.20	2.41	2.53	2.37	1.91	2.45	0.49	14	A
	Average Neighbourhood Index Value															**2.86**	**0.57**		

Note: * The influencing factors are group either as Core (C) or Auxiliary (A) factors.

Source: Author, 2016.

Figure 4 shows the respondents' preferred neighbourhood in Minna. Based on the analysis, Chanchaga (0.73) appeared as the most preferred neighbourhood in the peri-urban area of Minna, while the least preferred neighbourhood is Sauke-Kahuta. Next to Chanchaga in rank are Bosso Estate (0.67) and Dutsen Kura Gwari (0.67).

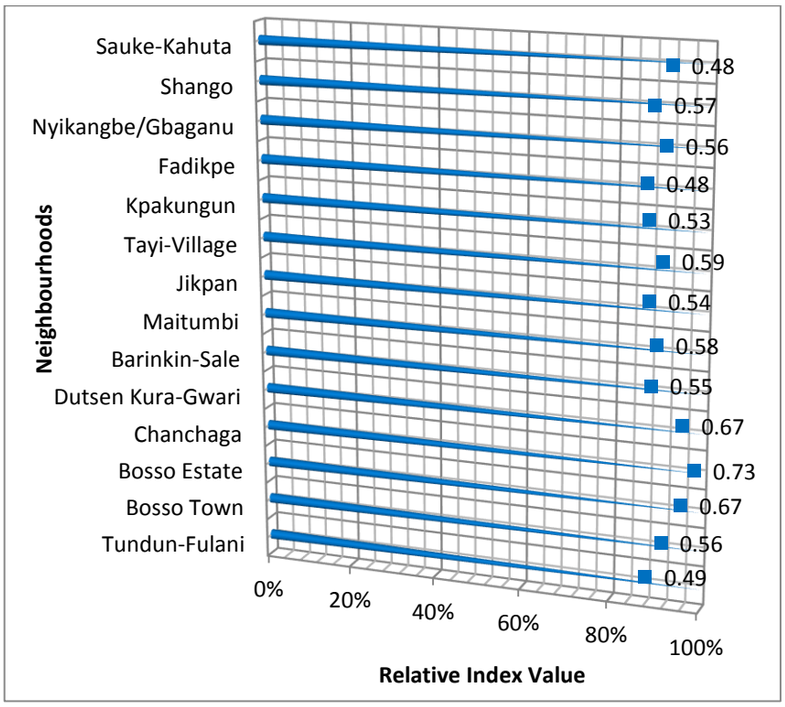

Figure 4: Residents Preferred Neighbourhoods in Minna Peri-urban Area
Source: Authors' 2016.

Spatial Variation of the Factors Influencing Neighbourhood Change across Minna Peri-urban Area

The illustrations of the variation of the factors that influenced residents' change across the peri-urban areas of Minna are thus presented in Table 3. The variation based on the eight factors is presented in Figures 5 – 12. Two out of the eight factors appeared in all the neighbourhoods (Figures 3 and 4). These factors are proximity to place of work and availability of community facilities. In other words, these two factors are the most important factors influencing the decisions taken by respondents to live in the peri-urban area. The variations of these eight factors across the peri-urban neighbourhoods with their relative index values in parenthesis are further discussed in detail.

Table 3: Pattern of Factors Influencing Neighbourhoods Change in Peri-urban Areas of Minna

S/No	Influencing Factors	Aggregate Factors	Chanchaga	Bosso Estate	Dutsen Kura Gwari	Tayi-Village	Maitumbi	Shango	Bosso Town	Nyikangbe/ Gbaganu	Barinkin-Sale	Jikpan	Kpakungun	Tundun-fulani	Fadikpe	Sauke-Kahuta
1	Ethnic /religion															
2	Reduction in the price of land															
3	Low housing rent															
4	Proximity to place of work															
5	Availability of community facilities															
6	Security of the Neighbourhood															
7	Avoidance of the influence of government policy															
8	Availability of personal/private means of transportation															
9	Redevelopment of the former neighbourhood of residence															
10	Informal economy															
11	Voluntary change in neighbourhood															
12	Proximity to city centre															
13	Interesting architecture and building design															
14	Shift from rental tenure to homeownership															
15	Change in profession or employment															
16	Tenure composition															

Source: Authors' Analysis 2016.

Proximity to Place of Work

Figure 5 shows that proximity to place of work influenced the decision taken to live where respondents reside in the peri-urban neighbourhood of Minna. For instance, Bosso Estate (0.79); Dutsen Kura Gwari (0.79); Barkin-Sale (0.75), Chanchaga (0.74); Bosso Town (0.72); Maitumbi (0.69); Nyikangbe/Gbaganu (0.65); Shango (0.64); Tayi village (0.59); Kpakungun (0.59); Jikpan (0.54); Fadikpe (0.54); Tudun-Fulani (0.53) and Sauke-Kahuta (0.52).

Availability of Community Facilities

The variation of availability of community facilities in the peri-urban area of Minna shown in Figure 6, influenced neighbourhood change in Chanchaga, Tayi village, Bosso Estate, Dutsen Kura Gwari, Shango, Bosso Town, Jikpan, Nyikangbe/Gbaganu, Maitumbi, Kpakungun, Barkin-Sale, Fadikpe, Tudun-Fulani, Sauke-Kahuta. The relative index for this factor in all the neighbourhoods ranges between 0.94 - 0.52.

Security of the Neighbourhood

The pattern of security of the neighbourhood varies in just ten neighbourhoods (Figure 7). The neighbourhoods that were mostly influenced by security are Chanchaga (0.91); Dutsen Kura-Gwari (0.81); Bosso Estate (0.73); Tudun-Fulani (0.69); Maitumbi (0.68); Shango (0.67); Kpakungun (0.59); Jikpan (0.59); Barkin-Sale (0.58) and Sauke-Kahuta (0.56).

Proximity to City Centre

The spatial pattern of proximity to the city centre is a major factor influencing the decision taken by respondents in eleven out of the fourteen neighbourhoods (Figure 8). These neighbourhoods are Dutsen Kura Gwari (0.78), Chanchaga (0.77); Bosso Estate (0.76); Barkin-Sale (0.69); Bosso Town (0.68); Kpakungun (0.67); Jikpan (0.60); Maitumbi (0.58); Nyikangbe/Gbaganu (0.58); Fadikpe (0.53) and Sauke-Kahuta (0.52).

Shift from Rental Tenure to Home ownership

The shift from rental tenure to home ownership is shown in Figure 9 mostly influenced the neighbourhoods of Chanchaga, Kpakungun, Tayi village, Nyikangbe/Gbaganu, Maitumbi, Bosso Town, Barkin-Sale, Sauke-Kahuta, Jikpan, Tudun-Fulani, and Fadikpe. The index value for this factor in these neighbourhoods ranged between 0.76 - 0.53.

Reduction in the Price of Land

Reduction in the cost of acquiring land (Figure 10) majorly influenced the decision of respondents to locate in their neighbourhood. The neighbourhoods that were affected by this factor are those of Dutsen Kura Gwari (0.70); Bosso Estate (0.69); Sauke-Kahuta (0.64); Nyikangbe/Gbaganu (0.63); Barkin-Sale (0.63); Tayi village (0.61); Turin-Fulani (0.57) and Jikpan (0.55).

Availability of Personal/Private Means of Transportation

The availability of personal/private means of transportation was also considered important by many people. The neighbourhoods of Chanchaga, Dutsen Kura Gwari, Maitumbi, Bosso Town, Barkin-Sale, Jikpan, Tudun-Fulani and Sauke-Kahuta rated the availability of personal means of mobility very important (Figure 11).

Low House Rent

These neighbourhoods of Bosso Estate (0.71); Dutsen Kura Gwari (0.70); Maitumbi (0.66); Sauke-Kahuta (0.66); Tayi Village (0.65); Nyikangbe/Gbaganu (0.63); Barkin-Sale (0.63); Kpakungun (0.61); Shango (0.61); Bosso Town (0.56); Tudun-Fulani (0.51) and Fadikpe (0.50) considered the low cost of renting an apartment as a major factor in their decision to reside where they live. This is perhaps not surprising because Kpakungun which is the least preferred neighbourhood in Minna falls within this category (Figure 12).

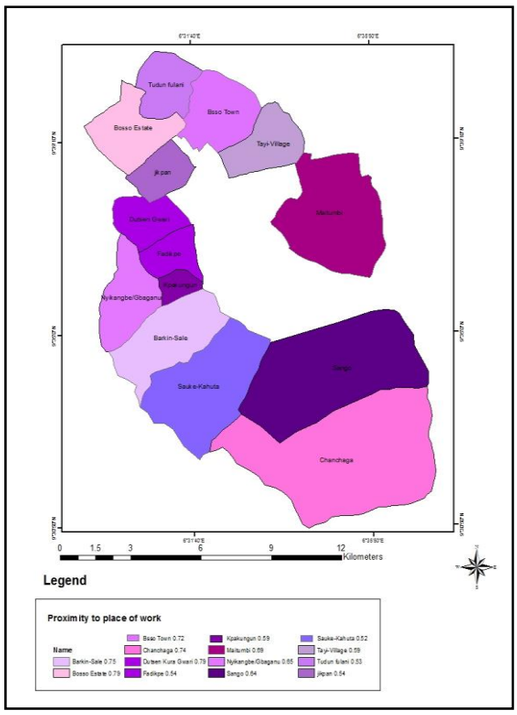

Figure 5: Pattern of Proximity to Place of Work

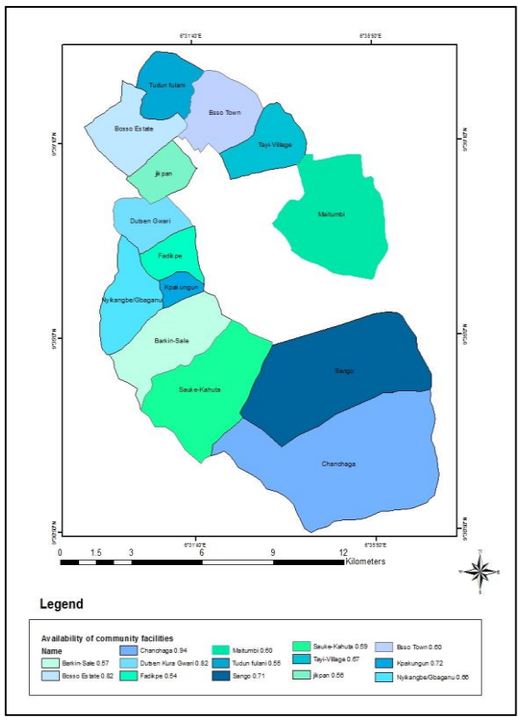

Figure 6: Pattern of Availability of Community Facilities

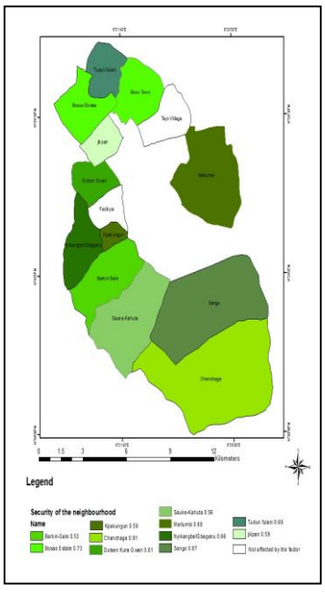

Figure 7: Pattern of Security of the Neighbourhoods

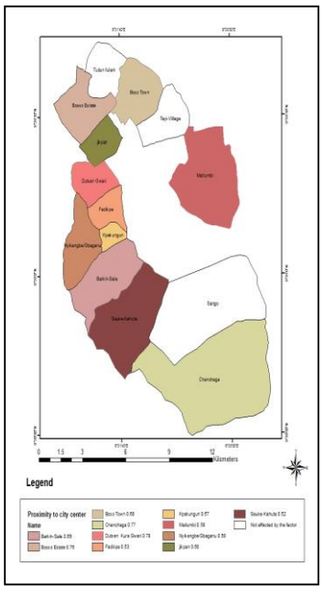

Figure 8: Pattern of Proximity to City Centre

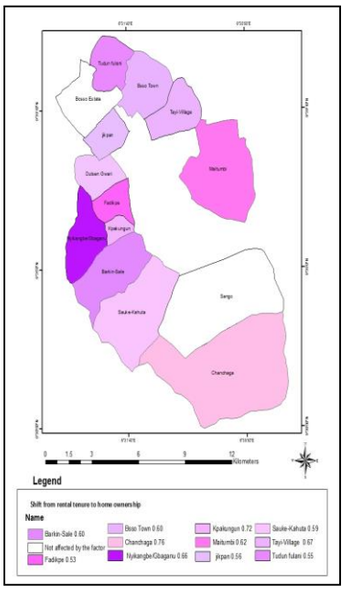

Figure 9: Pattern of Shift in Rental Tenure to Home-ownership Occupier

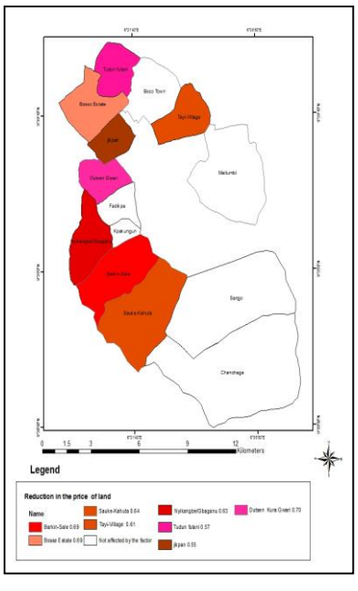

Figure 10: Pattern of Reduction in the Price of Land

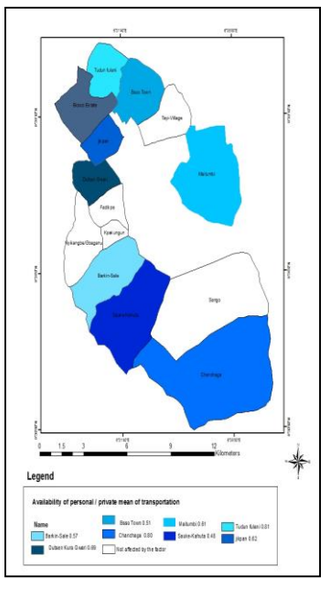

Figure 11: Pattern of Availability of Personal/ Private Means of Transportation

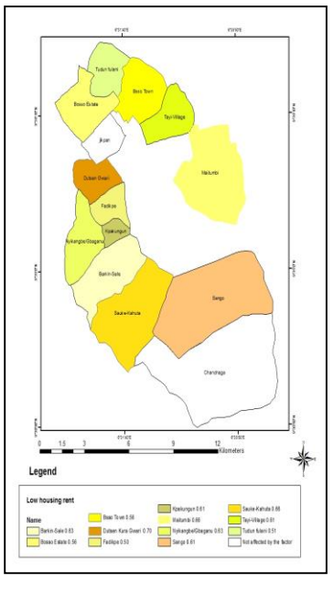

Figure 12: Pattern of Low House Rent

CONCLUSION AND RECOMMENDATIONS

The study documented notable factors influencing the decision of peri-urban residents to change their neighbourhoods in Minna and the variation of these factors across fourteen neighbourhoods. Eight (8) major factors identified are availability of community and infrastructural facilities; security of the neighbourhood; proximity to place of work; proximity to city centre; shift from rental tenure to home ownership; low rent; and reduction in the price of land. This study revealed that two of these factors (proximity to places of work and availability of community facilities) appeared in all the neighbourhoods, while the remaining factors vary within the neighbourhoods. Based on this fact, the Government should embark on rehabilitation of dilapidated infrastructure and provision of new basic infrastructure and also should develop a Strategic Development Plan to ensuring sustainable peri-urban development.

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ASSESSMENT OF THE APPLICATION OF CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED) IN RESIDENTIAL ESTATES IN MINNA

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Architecture right from the design of a simple building to the planning of an entire neighborhood can limit the opportunities for committing crime. Throughout the world, preventing crime has become a priority of citizens and government officials and thus all avenues including Crime Prevention through Environmental Design (CPTED) are being explored towards the reduction and fear of crime. Each community however, has its peculiar crime and thus requires an individualist approach towards the use of CPTED. More also is that limited study exists in the use of CPTED in the prevention of crime which has been on the rise in urban residential estates such as Minna, the capital of Niger state. This paper therefore assessed the extent of the application of CPTED in residential housing Estates in Minna, Niger State using the four features the Oscar Newman's 1973 principles of crime prevention. Data on the CPTED variables were collected via field observation conducted on housing estates in Minna. The descriptive statistics function of the SPSS was used to analyse the data collected, as well as showcase the pattern of CPTED in the housing estate. The findings of the research revealed some CPTED deficiencies such as lack of vehicular access control points (VACPs); hindered street surveillance due to high block-wall fencing practices and undulating vegetative cover; uncontrolled multiple entrance and exit points and improper environmental maintenance practices especially of the old buildings. This paper therefore recommends the adoption of some design features that can lead to a secured housing estate in Minna, and that this type of study should be carried out in other urban centers towards the reduction of crime.

Keywords *- CPTED, Crime, Environment, Minna, Residential building, Security.*

INTRODUCTION

Many urban centres have become vulnerable to criminal activities due to interplay of population explosion, rapid urbanization, globalization, environmental degradation. Quite often, social conflicts and anonymity, challenges the security of these areas, resulting in crime. (Banerji & Ekka, 2016). Hence over the years, urban centres have witnessed a high and increasing rate of crime and violence in both small and large settlements. Global statistics derived from surveys carried out by the United Nations indicate that crime increased steadily in the 1980-2000 period, rising from 2,300 to over 3000 crimes per 100,000 inhabitants (about 30% increase).

Reza et al. (2001) posited that the highest crime rates are found in developing countries, especially in Sub-Saharan Africa, Latin America and the Caribbean. These areas are acknowledged to have many crime risk factors such as high rate of urbanization, poverty, young and unemployed population, which promote the incidence of violent crime (Jinadu *et al.*, 2012). Thus, the WHO (2004) estimated that 90% of violence related deaths in year 2000 occurred in low and middle income with violent deaths rates of 32.1% per 100,000 people.It is against this backdrop that the protection of urban centres has for long times engage the attention of individuals, corporate bodies and government in most countries of the world, of which Nigeria is not an exception.

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Muhammad, et al., (2018). **ESTATE SURVEYORS' PERSPECTIVES ON RESIDENTIAL PROPERTY TENANCY DETERMINATION IN ILORIN METROPOLIS.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

As Architecture and technology evolved, building design addressed a host of other threats besides inclement weather and predators. Some of these arose from natural causes, while others were caused by human actions. The distinction between these threat types is important and worth repeating: Safety threats arise from natural or accidental conditions, whereas security threats result from actions planned and carried out people. Thus, all avenues including Crime Prevention through Environmental Design (CPTED) are being explored towards the reduction and fear of crime. This is because various studies have found that the built environment does influence criminal behaviour (Cozens, David, & Gwyn, 2001; Liebermann & Kruger, 2004; Merry, 1981). According to Nasar & Fisher (1993) the physical environment is more important than the social environment. This is because the physical environment covers design elements that can be revised through planning and design in order to reduce opportunities for the occurrence of crime.

The neighborhood as an entity of a wide range of inter-connected elements is subject to numerous potential threats to lives and properties. As highlighted by Gibson *et al.* (2002), they include; physical assaults, sexual harassments, burglary, vandalism, vehicle theft, house break-ins. Each community however, has its peculiar crime and thus requires an individualist approach towards the use of CPTED. Sadly, limited study exists in the use of CPTED in the prevention of crime which has been on the rise in urban residential estates such as Minna, the state capital of Niger state.

Crime Prevention through Environmental Design (CPTED)

Crime Prevention through Environmental Design (CPTED) is a most effective approach that reduces fear of crime, improves safety and enhances quality of life (Crowe, 2000). Lavy and Dixit (2010) stated that crime prevention through environmental design (CPTED) is an approach employed to provide protection to buildings and facilities and is centered on the concept of deterring crime and reducing fear of crime by thoughtful architecture and effective site design.

CPTED is of two (2) models namely; the Crowe/ Newman model and the Jeffery model. As of 2004, CPTED is popularly understood to refer strictly to the Newman/Crowe type models, with the Jeffery model treated more as multi-disciplinary approach to crime prevention which incorporates biology and psychology, a situation accepted even by Jeffery himself. (Robinson, 1996).

Principles of Newman/ Crowe models of Crime Prevention through Environmental Design (CPTED):

According to Oldroyd (2008), there are four basic principles:

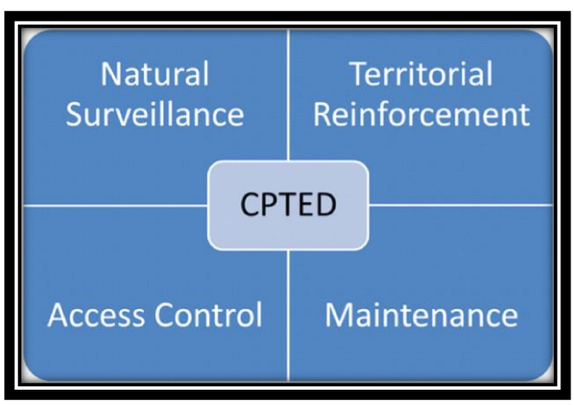

Figure 1.0: CPTED Principles Source: Google images (2017)

Territorial Reinforcement:
This involves the use of design to encourage proprietary behaviour among citizens, while at the same time creating an environment where the perceived probability of citizens' intervention is high. It is the strategy of using physical design to create a sphere of influence that can draw a clear delineation between private space and public spaces (Hanna *et al.*, 2015). The sense of ownership over this territory increases responsibility to overlook the space and keeps intruders away. Territoriality thus increases natural guardianship, natural congregation and natural defensibility (Taylor, et al., 1981). Property lines, landscape plantings, pavement designs, gateway treatments and fences are the devices that help draw boundaries.

Natural Access Control:

Natural access control limits the opportunity for crime by taking steps to clearly differentiate between public space and private space, by determining the location of entrances and exits, fencing, lighting and landscape to limit access or control flow, natural access control occurs.

Figure 2.0: Access controls Source: Google images (2017)

Natural Surveillance:

According to Hirsch, Finch, & Hankewycz (2004), this requires a design that provides a clear and unobtrusive view over critical areas through natural view, security devices and a capable guardian to monitor the operation of the security equipment. This is because of the fundamental premise that criminals do not wish to be observed. Therefore the placing of legitimate 'eyes on the street' increases the perceived risk to offenders, as well as increase the actual risk to offenders if those observing are willing to act when potentially threatening situations develop. So the primary aim of surveillance is not to keep intruders out but rather, to keep intruders under observation. Surveillance can be achieved by many techniques. The flow of activities can be channeled to put more people (observers) near a potential crime area. Windows, lighting and the removal of obstructions can be placed to improve sight lines from within buildings.

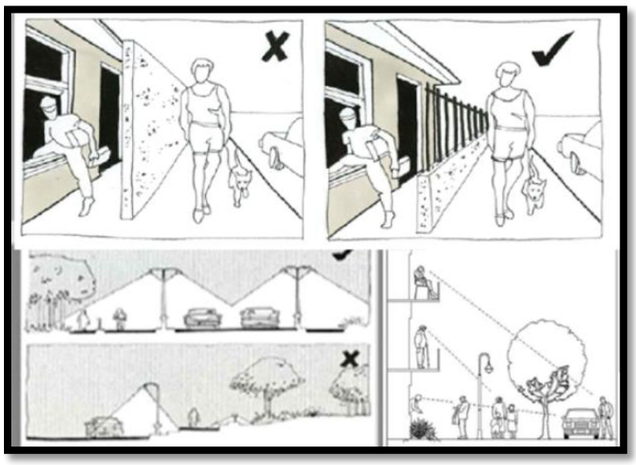

Figure 3.0: Solid and permeable fencing Source: Google images (2017)

Maintenance:

This involves regular cleaning and clearing of any obstructive objects that could impede visibility, with regular maintenance of building, its surrounding and its components.

Figure 4.0: Maintenance Source: Google images (2017)

METHODOLOGY

The research work leans on data collected through field observation conducted on housing estates in Minna. Sample frame of ten (10) residential estates was selected from the fifteen (15) available residential estates in Minna metropolis. Table 1.0 shows the list of residential estates visited. These residential estates were selected primarily due to the fact that they are located within the Minna metropolis which in itself is the study area. Descriptive statistics function of the SPSS was used to analyse the data collected, as well as showcase the pattern of CPTED in the housing estates. Pictures of some residential estates were also presented as plates to buttress further, the issues within the discussion of results.

Table 1.0: Names of residential estate visited

S/N	NAME
1	GEN. M.I. WUSHISHI HOUSING ESTATE
2	TALBA HOUSING ESTATE
3	CBN QUATERS
4	OLD-AIRPORT QUARTERS
5	INTERMEDIATE QUARTERS
6	TUNGA-LOWCOST
7	SENIOR QUATERS
8	SHEHU MUSA ESTATE
9	BOSSO LOWCOST
10	BOSSO ESTATE

Source: Author's fieldwork, 2017

DISCUSSION OF RESULTS

Access control into the estates

From the observation taken, the amounts of vehicular access points as well as access control points were examined and the result is shown in figures 5.0 and 6.0. Observations analysis from the selected residential estates in Minna shows that 70% of the estates studied had four or more vehicular access roads while 20% and 10% had three and two respectively. Multiple access into a facility it makes it difficult to control security to an extent. Yet, having more than one entrance can ease evacuation. Vehicular Access Control Points (VACPs) however help in the limiting of unwanted access or exit. This too from figure 6.0 reveals that a higher number of estates (60%), lack this important feature and even some that have it present are often un-manned, hence rendering movement within the estates unchecked. Plate 1.0 and 2.0 show CBN quarters and Bosso estate, with a manned entrance access point and an unmanned VACP respectively.

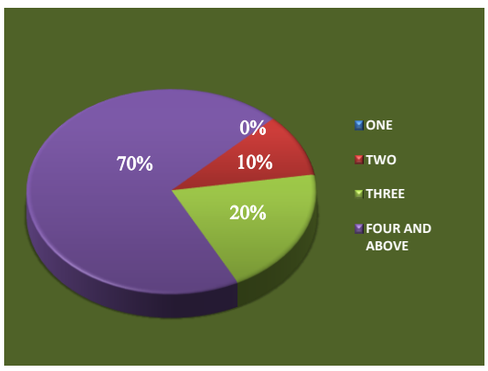

Figure 5.0: Number of vehicle-access roads into estate.
Source: Author's Field work (2017)

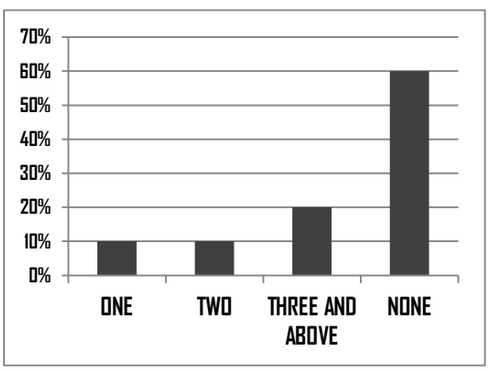

Figure 6.0: Number of vehicle-access control points.
Source: Author's Field work (2017)

Plate 1.0: CBN staff quarters
Source: Author's Field work (2017)

Plate 2.0: Bosso estate
Source: Author's Field work (2017)

The vegetative cover

Crime prevention can also be enhanced by ensuring that planting does not grow to obscure the view. Hence the vegetative cover within the residential estates was also examined regarding the types present as well as the heights and the results are shown in figure7.0 and table 1.0 as well.

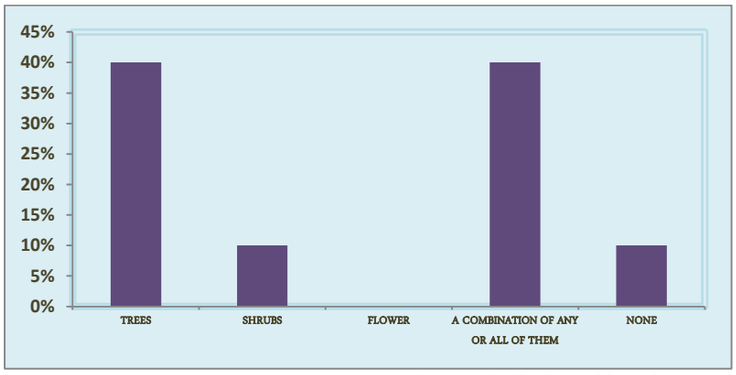

Figure 7.0: Existing vegetative cover. Source: Author's Field work (2017)

Table 2.0: Height of Vegetative Cover

S/NO.	ESTATES / TOTAL	HEIGHT OF VEGETATIVE COVER			
		<1m	1-3m	3-6m	>6m
1	M.I WUSHISHI HOUSING ESTATE			•	
2	TALBA HOUSING ESTATE				•
3	TAIBI QUARTERS			•	
4	BOSSO ESTATE		•		
5	OLD-AIRPORT QUARTERS				•
6	TUNGA-LOWCOST	•			
7	INTERMEDIATE QUARTERS			•	
8	G.R.A. MINNA				•
9	BOSSO LOWCOST			•	
10	CBN QUATERS			•	
11	TOTAL	10.0%	10.0%	60.0%	20.0%

Source: Author's Field work (2017)

Figure 4.0 shows that 80% of the estates sampled had either only trees or a combination of trees, shrubs, flowers or grass as landscaped element. Most however served as aesthetic elements only. Not as barriers to deter un-authorised access. Furthermore, from table 2.0, it can be seen that 60% of the residential estates had vegetative covers of which the heights fell between 3 to 6 metres. This means that some estates which had shrubs with heights falling in the 3 to 6 metres category had problems of blocked sight-lines. Also, those that had either the trees or shrubs falling in the 1 to 3 metres category had problems of interrupted sight-lines too. In addition, some estates had trees planted just by the fence, growing very taller than the fence, hence giving access to intruders into the houses via these trees.

Plate 3.0: Tunga low-cost

Plate 4.0: G.R.A

Plate 5.0: Bosso estate

Plate 3.0 and 4.0 shows Tunga low-cost and G.R.A, with tunga low-cost having a row of trees and a good sightline while G.R.A has an undulating sight-line. Plate 5.0 shows bosso estate, with trees planted just by the fence in a way that grants intruders access over the fence.

Fence design

Although high fences provide privacy, they restrict natural street surveillance of potential intruders. Fencing below 1metre in height, or open design fencing allows for adequate privacy and natural surveillance as well. In table 3.0, virtually all estates use block walls in fencing of individual dwelling units. Also, 90% of these fenced units have their fences spanning up to 3metres in height as seen in figure 9.0. They however do have security features which will aid in deterring climb-overs such as spikes and barbed wires as shown in figure 10.0. Thus, it shows that most dwelling units in residential estates in Minna are secluded from one another, giving criminals an edge of committing crime in one dwelling unit without necessarily been seen or caught.

Table 3.0: Type of fence around dwellings

TYPE OF FENCE AROUND DWELLINGS		
BLOCK WALL	**PICKETS OR METAL POLES**	**VEGETATIVE LANDSCAPE**
90.0%	**0.0%**	**10.0%**

Source: Author's Field work (2017)

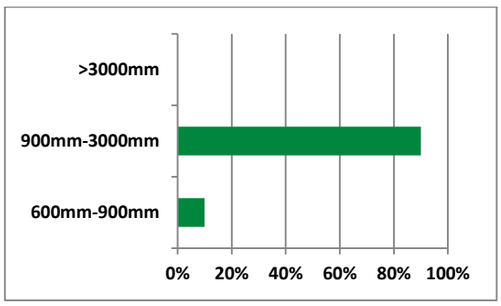

Figure 9.0: Height of fence around dwellings.
Source: Author's Field work (2017)

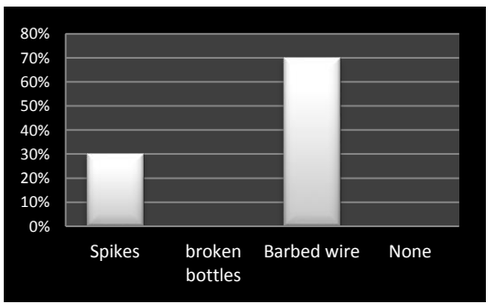

Figure 10.0: Security features on fence and gate.
Source: Author's Field work (2017)

Plate 6.0: Bosso estate
Source: Author's Field work (2017)

Plate 7.0: GRA
Source: Author's Field work (2017)

Plate 8.0: Use of open fencing
Source: Author's Field work (2017)

From plates 6.0, 7.0 and 8.0 above, some dwellings have their perimeter fences up to 3metres in height using block wall. However, plate 8.0 shows a well fenced dwelling which gives room for adequate natural surveillance using see-through fencing system of metal poles.

The use of security lighting

Lighting for security purposes helps prevent crimes which may be perpetrated most specially after work hours by distracting the criminals, enhancing physical security and other installed systems such as the CCTV. Both interior and exterior lighting are essential for effective security in building. Improved lighting is found to be extensively useful in boosting security. From figure 11.0, it is evident that, 50% of the estates examined had stand-by lighting systems, while others had none. Of those that had, most of the units were bad and the areas were mostly dark at night. This in turn gives an insight of the possibilities of crime perpetration to be very high.

Adequate lighting is essential in making people feel safe and in deterring illegitimate users of a space. It allows people to see what is ahead. Good lighting encourages legitimate users to use a facility after daylight hours. This in turn deters potential illegitimate users. Lighting therefore aids natural surveillance after daylight hours and facilitates formal surveillance (by police or security patrols).

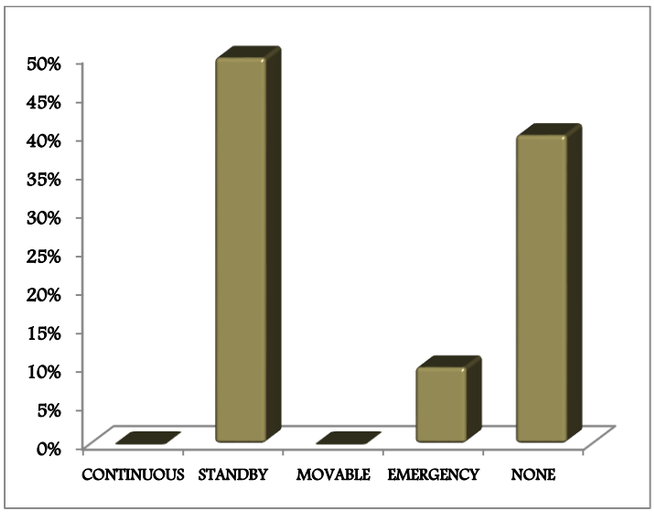

Figure 11.0 Type of security lighting available. *Source: Author's Field work (2017)*

The condition of building exterior and environment

The regular cleaning and clearing of any obstructive objects that could impede visibility, with regular maintenance of building, its surrounding and it components are very key to the deterrence of crime in an environment because a well-kept environment gives a cue of staying off a property because it is in regular use.

From figure 12.0, 50% of the dwelling units in the estates either had their paints fading/ stained, or even peeling off/ damaged. Some areas within these residential neighbourhoods are so unkept. They have grasses and shrubs growing wildly without proper culturing.

Plates 10.0 and 11.0 shows different residential neighbourhoods in an ill-kept manner with shrubs growing wildly in the children's playground in CBN staff quarters, as well as around a dwelling unit in Talba estate respectively. When areas are unkept as these above, it invites criminal activities to them instinctively, hence it should be avoided.

Plate 10.0: CBN staff quarters
Source: Author's Field work (2017)

Plate 11.0: Talba estate
Source: Author's Field work (2017)

CONCLUSION AND RECOMMENDATION

The standpoint that the physical environment affects criminal behaviour is an undisputable one as it covers elements that can be revised through planning and design in order to reduce opportunities for the occurrence of crime. As shown by this study, most residential estates in Minna have deficiencies in terms of crime prevention through environmental design (CPTED) such as; lack of vehicular access control points (VACPs); hindered street surveillance due to high block-wall fencing practices and undulating vegetative cover; uncontrolled multiple entrance and exit points and improper environmental maintenance practices especially of the old buildings. The problem as observed, may be associated with the fact that initial designs were made only to cater majorly only for inhabitance needs, with little attention being paid to security as demonstrated by the findings. Also, obsoletion was also observed as one major factor responsible for the vulnerabilities pointed out.

The paper therefore recommends various means of achieving a better secured residential neighbourhood through the adoption of the use of gated entrance access; use of only one access road leading into and out of the estate and establishment of access control points be within the neighbourhoods intermittently at strategic points in order to check for unwanted movements within the neighbourhoods. Also, planting of vegetative cover which does not intercept a clear sight-line for surveillance within the neighbourhoods and the use of a see-through fencing system of metal poles will improve natural surveillance within the neighbourhoods. Finally, proper maintenance of standby lighting systems provided, as well as proper care and maintenance of the surrounding environment within the neighbourhoods should be encouraged as inattention and signs of physical despair often encourage further mishap around such surroundings.

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IMPROVING AND SUSTAINING ACCESS TO WATER AND SANITATION IN NIGERIA: OPPORTUNITIES AND CONSTRAINTS

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Access to water and sanitation is fundamental to environmental and human development. The picture of developing countries in relation to access to water and sanitation is particularly worrisome. WHO/UNICEF, (2012) estimated urban safe water coverage in Nigeria at 74% while the rural estimate stand at 43%. Improved sanitation updated in 2012 shows that 65% of urban and 73% of the rural areas lack improved sanitation. At the end of 2015, the millennium development goal year, 71% and 41% of the people in Nigeria had access to water and sanitation respectively. These figures are less than the 85% and 60% targeted at the end of 2015. The Sustainable Development Goals (SDGs) were launched, particularly, goal 6 to improve and sustain access to water and sanitation between 2016 -2030. This paper aims at examining the prospects and constraints to achieving this goal with the view to recommending various ways to ensure sustainable access to these services in Nigeria. The paper is basically a literature review depending on content analysis-publications from both national and international organizations involved in researches in water and sanitation to draw conclusions. It was discovered that despite the opportunities available for Nigeria to improve on access to water and sanitation, lack of funding, weak institutions in- charge of water and sanitation and weak cost recovery will impede the attainment of the SDGs on access to water and sanitation. It was recommended therefore, that government must as a matter of priority, fund and strengthen the agencies and institutions responsible for the provision of these services and organize both the private sector and the community towards achieving and sustaining access to water and sanitation to all, even before the year 2030.

Keywords: Access, Constraints, Millennium Development Goals, Sustainable Development Goals and Water and Sanitation.

INTRODUCTION

Water and sanitation are among the basic services that support man's healthy and continuous existence and are important components of human development. According to UNDP (2006), water is not only a substance that supports life, but that water and sanitation are among the most powerful drivers for human development. Safe drinking water and sanitation are indispensable to sustain life and health and fundamental to the dignity of all. Lack of safe water and sanitation predispose people to water and sanitation related diseases and illnesses such as cholera, malaria, dysentery and typhoid among others. Water and sanitation related sicknesses put severe burdens on health services and keep children out of school (Christophe, Hommann, Rubio, Sadoff and Travers, 2001). Also, according to UNDP (1997) in Mobie and Masango (2009), access to safe water and adequate sanitation is the foundation of development. For the urban areas, life and economy rests heavily on the accessibility of water and sanitation. Although 2.1 billion people have gained access to improved water sanitation since 1990, dwindling supplies of safe drinking water is a major problem impacting every continent. UNDP (2017) observed that, ensuring universal access to safe and affordable drinking water for all by 2030 requires we invest in adequate infrastructure, provide sanitation facilities, and encourage hygiene at every level.

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Protecting and restoring water-related ecosystems such as forests, mountains, wetlands and rivers is essential if we are to mitigate water scarcity. More international cooperation is also needed to encourage water efficiency and support treatment technologies in developing countries. Water is closely related to sanitation and together they both influence human health and development (Sanusi, 2010).

In spite of this concern, 1.1 billion people did not have access to improved sources of drinking water, while 2.5 billion lack access to improved sanitation facilities (UNICEF/WHO, 2008, WSP, 2012). In a bid to deliberately chart a feasible course towards achieving accessibility of water and Sanitation; the Millennium Development Goal number seven (7), target ten (10) was conceived so that in the year 2015, the number of people deprived of safe drinking water and basic sanitation would have been halved. However, in 2015, WHO/UNICEF in their report on "Progress on Drinking Water and Sanitation" stated that 663million and 2.4billion people worldwide still lack access to water and sanitation respectively. The Sustainable Development Goals (SDGs) which was launched as a follow-up to the MDGs also intends to enhance and sustain the achievements of the MDGs. It aims specifically, to ensure that everyone has access to water and sanitation after 2015 and this would be done through the instrumentality of goal 6 of the SDGs. It is therefore, the focus of this paper to examine the efforts the public sector has made so far, and suggest possible ways to improve and sustain access to water and sanitation in the SDGs years.

Aim of the Study

This study aims at examining the prospects and constraints to attaining sustainable access to water and sanitation in Nigeria with the view to recommending way of improving their accessibility.

This aim is to be achieved through the following objectives:

1. Examine the accessibility to water and sanitation from 1990-2015
2. Review past and present efforts towards achieving accessibility to water and sanitation in Nigeria
3. Identify prospects and constraints in achieving access to water and sanitation
4. Recommend ways to improve accessibility to water and sanitation in line with the Sustainable Development Goals (SDGs) agenda.

METHOD OF DATA COLLECTION

Data needed for this study were available from national and international publications on researches carried out on accessibility to water and sanitation and the documents on Millennium development Goals as well as the new Sustainable Development Goals. Therefore, Content Analysis was employed to critically observe the changing rates of accessibility to water and sanitation over the years. National documents on water supply and sanitation and also, government commitments and budgetary provisions were analysed; all of these provided a focal lens to determine where we are now, what we are doing and what should be done relative to SDG target at the end of 2030.

The Concept of Accessibility to Water and Sanitation

Accessibility is a multidimensional concept used in many disciplines including planning, geography, architecture, medicine, building technology, engineering among others (Jones, Parker & Reed, 2002). This has given rise to differing meaning of the concept. Within the boundaries of water and sanitation, therefore, Kaushik (2011) identifies the meaning of accessibility to distance and time involved in obtaining water and sanitation infrastructure. The Office of the High Commissioner for Human Rights [OHCHR], (2007) on the other hand, contends that accessibility refers to the right to equal and non-discriminatory way to an adequate amount of safe drinking water for personal and domestic uses including drinking, personal sanitation, washing of clothes, food preparation and personal and household hygiene with the aim to sustain life and health of the users.

According to Simons, Kimwaga, and Mashauri, (2009) water accessibility involves being able to physically reach the source and afford the charges which should be sustainably accessible, both financially and in terms of the reliability of source yield. It could be distinguished that accessibility to a facility can be either high, Medium or low. That is, within a particular country, region, or even a community, accessibility to users of a particular

facility would differ being high, medium or low. Cooperative Housing Foundation [CHF] International (2010) explains that, when users of a facility are within reach of that facility or service in question within a given reasonable travel time, accessibility is said to be high; whereas on the other hand, accessibility to a facility is deemed to be low when users are out of reach of the facility or service in question within the given travel time. It is therefore important that these levels of accessibility are given prominence and not the mere availability of presence of the facility in a given area.

Accessibility to water and Sanitation involves both physical and economic dimensions. Physical accessibility to water and sanitation infrastructure refers to the ease at which safe and adequate water and sanitation facilities are within the physical reach of all segments of the population at their immediate or within the vicinity in terms of distance and time (Kaushik, 2011). The concept of economic accessibility to water infrastructure relates to the ease at which water facilities are affordable to all persons including the poor in a way which does not limit their ability to afford other essential basic services such as food, housing and health care (Frone and Frone, 2013). Consequently, when the fees charged on water is so exorbitant that the household must sacrifice other equally basic human needs such as education, housing, health care, food, clothing, among others, then there is economic inaccessibility to water infrastructure. In the light of this, water is deemed economic accessible if a family's or household's monthly income spent on it does not exceed 5%. (Allen, Davila and Hoffman, 2006; WaterAid, 2011). The authors however, failed to provide any clue to what economic accessibility to sanitation means. This is primarily because sanitation is thought to be very complex and difficult concept that authorities are grappling with.

As identified by Jones, et al., (2002) physical accessibility to water and sanitation infrastructure implies the use of less time spent in identifying the infrastructure leading to the saving of time for every household to spend on other productive activities such as cooking and cleaning. DFID (2011) identified the following as constituting accessibility of water and sanitation and include: available and safe, accessible and affordable, acceptable quality, adaptable and culturally sensitive. Swiss Agency for Development and Cooperation, (SADC, 2008; Gognaje, 2016), also observed that access to water as a matter of human right is to be available to everyone in sufficient quantity, safe, affordable for domestic and personal uses.

Accessibility Statistics for Water and sanitation in Retrospect

Several studies had been done on access to water and sanitation at various levels (International, National, Sub-national and settlement levels) using varying methodologies and results. For instance, at the global level, the JMP report by WHO/ UNICEF (2016), was on meeting the MDG drinking water and sanitation target which was described as the urban and rural challenge of the decade. It was discovered that the proportion of the population with at least basic drinking water services has increased by an average of 0.49 percentage points per year between 2000 and 2015, but the increase was substantially faster in Eastern Asia and South-eastern Asia (0.97) and sub-Saharan Africa (0.88). Australia and New Zealand and North America and Europe are already very close to achieving universal basic drinking water services, while Latin America and the Caribbean, as well as Eastern Asia and South-eastern Asia, are on track to achieve universal access by 2030. Table 1 shows the values in percentages and absolute population figures of the accessibility to water and sanitation for selected years from 1990 to 2015.

Table 1: World Access to Water and Sanitation; 1990-2015

Year	Water		Sanitation	
	% pop with access	% pop without access	% pop with access	% pop without access
1990	47(4bill)	23 (1.1bill)	37 (2bill)	40 (2.8bill)
2004	54 (5.3bill)	22 (1bill)	37 (2bill)	38 (2.2)
2008	58 (5.6bill)	27 (888mill)	32 (1.8bill)	41 (2.5)
2015	91(6.1bill)	664mill	68 (2.1bill)	37 (2.4bill)

Source: WHO/UNICEF (2006), WHO/UNICEF (2015)

Table 1 shows that by 1990, 4billion people representing 47% of the world population, had access to drinking water, while 2billion (37%) had access to improved sanitation services. The WHO/UNICEF assessment for that year gave an indication that there was a great need to step-up access for these services in order to improve human health as well as promote development world-wide. In the year 2004, the access rate had increased to 54% and 37%

for water and sanitation respectively. By this period, the Millennium Development Goals (MDGs) were in operation and individual governments and international agencies had set machineries on motion to achieve universal access to water and sanitation in line with Goal 7 of the MDGs. Also, from Table 1, access to water increased slightly from 54% to 58% while access to sanitation declined from 37% to 32%. This decline according to Joint Monitoring Program of WHO/UNICEF (2010) was due to non-commitment to provision of sanitation facilities by some countries that did not see it as priority as they would to water. This lack of priority in the sanitation sector led to low budgetary provision to improving sanitation in these countries thereby, resulting to decline in the overall access rate of sanitation. The year 2015, the endpoint of the Millennium Development Goals, 91% and 68% had gained access to water and sanitation respectively (WHO/UNICEF, 2016).

However, according to WHO/UNICEF (2017), globally, use of basic sanitation services has increased more rapidly than use of basic drinking water services, at an average of 0.63 percentage points per year between 2000 and 2015. Although, coverage is generally lower for basic sanitation than for basic water, and no SDG region is on track to achieve universal basic sanitation by 2030, with the exception of Australia and New Zealand, where coverage is already nearly universal. The majority of the 2.3 billion people who still lacked a basic sanitation service either practise open defecation (892 million) or use unimproved facilities such as pit latrines without a slab or platform, hanging latrines or bucket latrines (856 million). The remaining 600 million use improved sanitation facilities that are shared with other households. These limited sanitation services reflect both cultural practices and socioeconomic constraints in densely populated areas. While universal use of private toilets accessible on premises remains the ultimate goal, high-quality shared sanitation facilities may be the best.

Access to water and sanitation in Nigeria as it is with most of the Sahara-Africa, have been dramatic. While access to water continued to rise from 1990-2015, access to sanitation was fluctuating, particularly, between 2000-2008 where access dropped from 37% in 2004 to 32% in 2008 (see Table 2)

Table 2: Nigeria's Access to Water and Sanitation; 1990-2015

Year	Water		Sanitation	
	% pop with access	% pop without access	% pop with access	% pop without Access
1990	47	37	40	58
2004	38	42	37	61
2008	58	27	32	68
2015	71	9	41	47

Source: USAID (2010), WSP/UNICEF (2012)

Access to water declined from 47% in 1990 to 38% in 2004 (Table 2). This period marked a transition between conceiving and launching the National Water Policy in 2002. Commitment to water supply in this period was also transitory. However, the access rate increased between 2004-2008 to 58% and to 71% in 2015; the end point of the MDGs target. However, it is worth mentioning that the Nigerian – MDGs target at the end of 2015 of 80% was not met, but during this period, there were some commitments towards achieving accessibility to both water and sanitation.

The story of accessibility to sanitation in these periods was not different from that of water. From Table 2, access to sanitation declined from 40% to 37% and then to 32% in 1990, 2004 and 2008 respectively. This decline also, is not unconnected with the neglect of the sanitation sector by the government and nearly no budgetary allocation to the sector. However, at the end of 2015, the accessibility to sanitation had improved to 41% although, the Nigerian – MDGs target of 60% was not met (WaterAid, 2016).

Comparing the urban-rural differential in terms of access to water and sanitation, it is discovered that the urban areas have fared better that the rural areas (Figure 1 and 2).

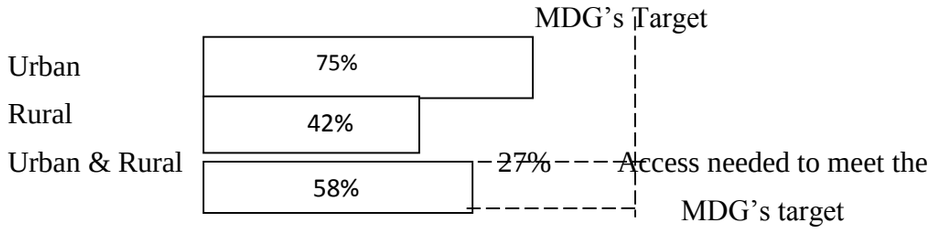

Figure 1 : Level of Access to Water in Nigeria, 2008
Source: WHO/UNICEF, 2010.

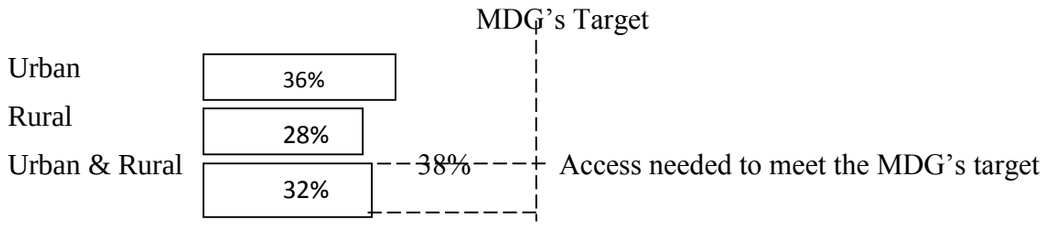

Figure 2 : Level of Access to Sanitation in Nigeria, 2008
Source: WHO/UNICEF, 2010.

Figure 1 show that urban areas had an access rate of 75% to water and the rural areas had 42% access. The combined access however, was 58% in 2008 with 27% gap left to meet the MDGs target of 85%. Figure 2 gives an indication of the proportion of those with access to sanitation in the urban and the rural areas (36% and 28% respectively). However, 38% was needed to reach the MDGs target of 70% in 2008. The disparity between the urban and the rural areas in terms of their access to both water and sanitation has to do with the importance the government practically attach to them. While the urban areas enjoy the privileges of the seat of government, the rural areas are often neglected to the national hurt. The gap between those areas that have reasonably safe access to water supply and sanitation (WSS) and those without is growing wider. Urban areas experience greater coverage, whereas peri-urban, semi-urban, and rural areas are experiencing stagnation or a decline in service (USAID, 2016).

Nigeria's Efforts so Far

The rapid population growth has not been accompanied by an increase in the delivery of water supply, sewerage and sanitation services. More so, Nigeria's water and sanitation infrastructure has suffered from years of poor operation and maintenance (O&M), and the very low access to improved sanitation constitutes a serious public-health problem. Weak and inefficient institutions, unsustainable public sector spending, and persistent implementation failures have also contributed to poor access rates and sustainability. Despite these outcomes, it is worth to note the past and present efforts in order to seek a way forward.

In 2000, Nigeria's federal government launched a National Policy on water supply and sanitation (NWSP). The policy encourages private sector participation, expansion of rural water supply systems and reforms of urban water service providers. Subsequently, in 2003, the government introduced the National Economic Empowerment and Development Strategy (NEEDS), which targets poverty reduction and development. NEEDS recognizes the low level of sanitation in the country as a critical issue. The same year, the country introduced the "Presidential Water Initiative (PWI); Water for People, Water for Life". The initiative aims to increase access to water supply and sanitation (WSS) services to 100% in state capitals, 75% in other urban and peri-urban areas and 66% in rural areas. Nigeria also introduced a National Water Supply and sanitation Program (NWSP) which provides a framework for all WSS projects in the country. (USAID, 2010)

Nigeria's three tiers of government share responsibility for managing water resources and for providing water, which results in confusion and inefficiency. The Federal Ministry of Water Resources (FMWR) is responsible for policy formation, data collection, monitoring and coordinating water supply development, and funding research and development. The state water agencies (SWAs) are responsible for establishment, operation, quality control, and maintenance of urban and semi-urban water supply (and sometimes rural). The Local Government Authorities (LGAs), o f which there are 774, are responsible for the

establishment, operation, and maintenance of rural water supply schemes and sanitation facilities in their areas although only a few have the resources and skills to address the sector. Only few LGAs have rural water supply divisions able to construct small water systems such as open wells and small impoundments of surface water.

Sanitation access has gradually grown in importance despite persistently low access rates, particularly in urban areas. By 2004, the FMWR began the process of revising its sanitation policy but the policy has not yet been adopted. Sanitation remains a state government responsibility, but piped sewerage is almost non-existent except for Abuja and some state capitals in the country. WaterAid International's Chief Executive, Barbara Frost, who was on a working visit to the country, added that: "WaterAid Nigeria's 2016-2021 Strategy is a monumental and impressive roadmap to changing the course of history and reaching those who are poorest and most vulnerable in Nigeria with safe water, sanitation and hygiene. These life-saving and essential services are fundamental to both human and national development and delivering on them will transform the lives of millions of Nigerians. Achieving universal access for all in Nigeria is possible with the right political commitment, funding, collaborations and innovative thinking" (The Guardian Newspaper, 2017)

Nigeria has made substantial progress in developing policies and strategies (WSP, 2000) for water and sanitation service delivery however; inability to translate policies into deliverable actions remains a major challenge. In 2013, UNICEF estimated that 70million and 10million lacked access to water and sanitation respectively. The Guardian Newspaper, March 23, 2017, reported that N85bill was allocated to water sector in 2017 budget. Ms Tlani Busari in the Newspaper said that government should spend on projects that would benefit the people directly in terms of water supply and not just building dams and other infrastructures which are always abandoned. Less attention was given to sanitation sector in 2017 as little or nothing was appropriated to this sector in 2017 budget. Presently, a road map is being developed for water sector to cover up 2030 by ministry of water sources. The ministry will identify alternative sources for funding the delivery of water supply and sanitation through enhanced collaboration with developing partners, states and local government authorities, communities and private sector.

The capital funding requirement up to 2019 for the ministry for water projects is N261bill and the outstanding liability of N88.87bill. There are 116 ongoing projects in the ministry, comprising of 38 irrigation projects, 37 dams, 41 water supply schemes, 15 prioritized water supply projects to add to 620,400m3/day of treated water. The ministry has launched the partnership for expanded water, sanitation and hygiene (PEWASH) between 2016 and 2030; a national multi-sector collaboration aimed at improving water supply. This is a collaborative intervention model for water and sanitation service delivery. The first phase spans from 2016-2020 and water supply cost is estimated N108bill and sanitation will cost N72bill. In the second phase (2021-2025), water supply will cost N130bill and sanitation will cost N86bill. And the third phase (2026-2030), will cost N147bill for water supply and sanitation will cost an estimate of N97bill.

Opportunities for Increasing and Sustaining Access to Water and Sanitation in Nigeria

In May 2005, the Nigerian Minister of Water Resources said that increased spending on water programs resulted in a huge increase in the access to safe water supply, from 35 percent in 1999 to 65 percent in 2004. A year later, the Ministry revised its access figure upwards to 68 percent. The World Health Organization (WHO), however, estimates that the figures are closer to 48 percent for improved drinking water and 44 percent for improved sanitation. The multilateral banks, led by the World Bank, have focused efforts on tackling urban water supply with less focus on sanitation services. Although WaterAid and Unicef are more concerned with rural water and sanitation services. European Union (EU) and Department for Industrial Development (DFID) channel their funds through UNICEF and WaterAid. The role of national and state governments in the WASH sector in Nigeria is complex. Initially, most implementation work was the responsibility of the federal government, there has been significant decentralization over the past 20yrs. For implementation purposes, the WASH sector is now a state matter with a total of 36 separate states and the capital territory, Abuja. In rural areas, water supply and sanitation services are delegated to the 774 local government areas.

The Nigerian water and sanitation policy (NWSP, 2000) framework is a document that has been put in place to provide a roadmap to achieving sustainable access to water and

sanitation in Nigeria. Its targets and provisions could guide all stake holders on the roles each of them is to play and specifies the policy directives on governmental and non-governmental involvement in provision of water and sanitation services to the Nigerian people. If the document is implemented duly, access to water and sanitation would be improved and sustained.

World bank and other multilateral international institution such as USAID, UNICEF, and WHO, to mention but a few, are committed to provide both technical and financial support for member countries including Nigeria in achieving an improved and sustained access to water and sanitation by the end of 2030. In this arrangement, Nigeria is to provide counterpart fund for the realization of these Goals set by the international community.

WaterAid Nigeria has launched its 2016 – 2021 country programme strategy – laying the foundation for the fifteen year path to achieving universal access to water, sanitation and hygiene for everyone everywhere in Nigeria by 2030. Over the next five years, the organisation will focus on increasing citizens' access to quality, equitable and sustainable water, sanitation and hygiene services built on a strong sector and engaged communities (WaterAid, 2016).

The federal ministry of water resources has launched the Partnership for Expanded Water, Sanitation and Hygiene (PEWASH) between 2016-2030; a national multi sector collaboration aimed at improving water supply. This is an example of a Collaborative Intervention Model (CIM) for achieving Sustainable development Goals in Nigeria. The program is arranged in phases from first to third phase, with activities and cost spelt out in each of the phases.

Constraints

Nigeria has opportunities to improve and sustain access to water and sanitation, however, there are likely and impending constraints that would limit and set boundaries to achieving the Sustainable Development Goals number 6; targets 2 and 3-achieving and sustaining equitable access to water, sanitation and hygiene by the year 2030.

One of the major constraints is the cost involved to improve and sustain access to water and sanitation between now and 2030. A WSP/UNICEF (2012) report revealed that a yearly investment of $2.5bill was needed in the water sector to meet the sustainable Development Goal by 2030 unfortunately, what is available to the government as at 2014 was $50mill and $100mill from development partners, which only represent one-third of the money required. The Federal Ministry of Water Resources who are directly the coordinating agency for water supply in Nigeria, needs a capital funding of N261billion and an outstanding liability of N88.87billion for water supply project up to 2019. However, only N85billion was allocated to water sector in 2017 and virtually nothing for sanitation sector (The Guardian Newspaper, 2017). With continued low budgetary provision for both water and sanitation sectors, the likelihood of achieving access and sustaining these services to the people equitably by 2030 might just be a mirage.

Lack of political will to implement the international and national policy frameworks for the improvement and sustenance of access to water and sanitation on one hand, and the SDGs on the other hand will hamper the achievement of goal 6 of the SDGs. Every State Water Agencies needed to work effectively to supply water to the urban and semi urban areas whereas; the local government Water and Sanitation departments would also be expected to perform their roles. The performance of these water and sanitation agencies will be dependent on the willingness and disposition of the political class.

The water and sanitation sector are bedevilled by weak and inefficient institutions in Nigeria. The Federal Ministry of Water Resources (FMWR) is responsible for policy formation, data collection, monitoring and coordinating water supply development, and funding research and development. The state water agencies (SWAs) are responsible for establishment, operation, quality control, and maintenance of urban and semi-urban water supply (and sometimes rural). The Local Government Authorities (LGAs), o f which there are 774, are responsible for the establishment, operation, and maintenance of rural water supply schemes and sanitation facilities in their areas although only a few have the resources and skills to address the sector. Only few LGAs have rural water supply divisions able to construct small water systems such as open wells and small impoundments of surface water.

The inability to recover cost of providing services in Nigeria is a major deciding factor in improving and sustaining access to water and sanitation services. These services are

provided as social services to the populace with reverberating effects on the sustainability of their provision. The capital and maintenance cost for the provision of these services are quite high, only cost recovery can ensure efficient service delivery which is nearly absent in Nigeria.

CONCLUSION

Water and sanitation services are key to sustained human development and environment. Access to water and sanitation in Nigeria has been dwindling from 1990 to 2015. Assessment of water and sanitation sectors shows that at the end of 2015 (MDGs year), 71% of the targeted 80% have access to safe drinking water and 41% of 60% targeted by the MDG-Nigeria, have access to sanitation. The sustainable Development Goal number 6 is aimed at improving and sustaining access to water and sanitation by 2030. However, in Nigeria, despite the opportunities available for us to achieve goal, several factors such as lack of funding, weak institution and lack of political will prohibit the attainment of this goal and its attendant targets. Some drastic and deliberate steps must be taken to ensure the attainment of this goal in Nigeria.

RECOMMENDATIONS

The following recommendations are made in line with the findings of this paper to ensure an improved and sustainable access to water and sanitation in the developing context, and particularly, Nigeria:

1. The government at federal and state levels must improve on their budgetary allocation to these sectors to carter for the establishment of new water and sanitation projects as well as the rehabilitation of the old ones. Proper monitoring is also needed to ensure that the funds appropriated are judiciously used for these purposes.
2. The political officers as well as the urban managers must imbibe and be committed to the culture of "good governance" particularly, in these sectors to eliminate corruption, abandonment and non sustainability of water and sanitation projects in Nigeria.
3. The weak water and sanitation providing agencies should be strengthened such as water corporations/boards at the state levels and the water and sanitation departments at the local level to function effectively to the attainment of the SDGs.
4. It is high time for the government to begin to consider cost recovery as sustainable means of providing services not only in water and sanitation sector, but in the provision of other facilities in Nigeria. Cost recovery is a way to ensure continual operation and maintenance of water and sanitation services.
5. People at the community level should be enlightened and encouraged to perform roles complimentary to the government's and donor organizations to ensure the achievement of goal 6 of the SDG, come 2030.

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ACHIEVING A SUSTAINABLE CITY GROWTH THROUGH NEIGHBORHOOD LEVELS IN BOSSO ESTATE, MINNA NIGER STATE

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The rapid rate of urbanization and the increase in population growth in Nigeria has been generating serious social, economic and environmental concern for both the government and concerned stakeholders. Part of these problems which include housing problems, traffic congestion overstretched and poorly maintained facilities, poor drainage systems etc are few of the problems plaguing most of the country's urban centres. This has resulted in concerns about the sustainability of most Nigeria cities.This paper examines the importance of achieving sustainability first at neighbourhood levels by analysing the neighbourhood quality of Bosso estate. Secondary data was obtained from books, journals and seminar papers while primary data relating to building and environmental quality from Structured questionnaire was administered on a sample size of 300 household heads, from sampling frame of 740 units, as well as oral interview with relevant planning authority. The paper finds that neighbourhood are well recognised unit of urban hierarchy. Neighbourhoods make up the urban centres and have become undisputed centres of social and economic growth of any county. The overall sustainability of a city depends on its neighbourhood sustainability and so, to achieve a sustainable city, our neighbourhoods first have to be sustainable. In this way, neighbourhoods' development can be approached as pilot projects. The paper concludes that sustainability of city growth and development can only be anchored on the sustainability of our neighbourhoods made possible by proper urban planning and also partly on government serious and committed political will.

Keywords: buildings, flexibility, office space, satisfaction, user

INTRODUCTION

Cities have become a primary space for living and other human activities. There are diverse definitions of what constitutes a city, given that urban realities around the world are not the same. Cities provide many socioeconomic benefits. By concentrating people, investment and resources (through agglomeration), cities increases the possibilities for economic development, innovation and social interaction. More specifically, cities also make it possible to lower unit costs so as to provide public services such as water and sanitation, health care, education, electricity, emergency services and public recreational areas (Polèse, 2009; Satterthwaite, 2010). But to be able to provide facilities and services efficiently and effectively, it requires a functional government to both ensure that such benefits are realized, and adopt a sustainable framework that will encourage the growth of a city within its ecological limits.

However, many challenges threaten the ability of cities to become practicable pillars of sustainable development and growth. The rapid rate of urbanization and the increase in population growth in many African cities including Nigeria, without a corresponding increase in infrastructural facilities and services, the high rate of environmental waste and degradation amongst other problems of urbanization has been generating serious social, economic and environmental concern for both the government and concerned stakeholders. There is an urgent need for both government and stakeholders to begin to work not just towards environmental sustainability but also economic and social sustainability.

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Shaibu, et al., (2018). **ACHIEVING A SUSTAINABLE CITY GROWTH THROUGH NEIGHBORHOOD LEVELS IN BOSSO ESTATE, MINNA NIGER STATE.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

The concept of sustainability has become a major subject of focus in almost every aspect or sector. Since the 1992 Earth Summit in Rio de Janeiro, it has been used in different forms and definition. But the most widely used definition of sustainable development or sustainability is the one by Brundtland Commission. It defines sustainable development as a development that meets the needs of people without compromising the ability of future generations to meet their own needs. Conventionally, initial focus of sustainable development has been on the issue of environmental degradation, therefore; environmental concerns have been the foundation of sustainable development. However, during the twenty century, the concept of sustainable development has developed and increased its interconnection to economic and social elements of development. Accordingly, sustainable development is an interface between environment, economic, and social sustainability. For Nigeria cities to achieve sustainability, there is a need to start from the grass root; the neighbourhoods. Many issues faced by cities are accumulative in nature because of the poor planning at the micro level.

Therefore for sustainable city growth, there is need for sustainability at neighbourhood levels. Neighbourhoods make up our urban centres and have become undisputable centres of social and economic growth of any country. They are main units of city which play important role in the formation of cities. Neighbourhoods are where people live and spend most of their time. Thus, planning and design neighbourhood must be wide-ranging so as to meet resident's requirements and accommodate new development by considering the needs of future generation. Accordingly, planning and designing our neighbourhoods as a significant geographic and social unit is a vital role for creating a sustainable city growth.

A sustainable neighbourhood is a multi-purpose area in which people aim to live and work at present and in the near future. Subsequently, designing sustainable neighbourhoods and taking actions towards making already existing neighbourhoods sustainable is initial steps towards achieving sustainable urban cities. (Gildroy,et al; Al-Hagla, 2008).

The aim of this study is to analyze the neighbourhood quality of Bosso estate with a view of examining the factors responsible for the current state of the Neighbourhood and providing solutions towards sustainable neighbourhood development. The specific objectives are (1) Identify and analyze the spatial distribution of existing facilities and services. (2) Examine the adequacy and quality of infrastructural facilities in the area. (3)Examine the urban development polices with specific reference to neighbourhood development in Minna Niger state. (4) Propose an upgrade plan for which will highlight the provision of facilities and services in a sustainable manner.

Statement of Problem

Neighbourhoods, which make up the urban centre, have become undisputable centres of social and economic growth of any country. Neighbourhood quality no doubt has a significant impact on the socio economic development of any economic. However, neighbourhood development is neglected in many developing countries of the world including Nigeria. In most towns and cities of Nigeria as well as in Bosso Estate Minna, neighbourhoods are faced with significant challenges rising from the absence and inadequacy of infrastructural facilities and services to neighbourhoods' degradation, neglect by government, stakeholders, and lack of policies guiding neighbourhood development. If effective and sustainable development can be achieved at neighbourhood level across the county, it would positively affect the overall development of urban centres. It is therefore important that a study is carried out so that factors affecting neighbourhood quality can be better understood by policy makers and planning authorities, for a functional, convenient and aesthetically pleasing neighbourhoods and urban areas. It is against this background that this study seeks to analyse the neighbourhood quality. It focuses on the provision of neighbourhood facilities in a sustainable manner and as well as the formulation and implementation of neighbourhood development policy

Study Area

Bosso Local Government Area which is one of the LGA in Niger state, lies at latitude 9º52'N and longitude 6º50'E. Local government is bounded to the North by Shiroro local government area and to the East by Minna local government. To the South is Katcha local government area and Paiko local government to the South East. Bosso is also bounded to the North West and the South West by Wushishi and Gbako Local Government Area respectively.

Bosso town enjoys the status of both the seat of the traditional leaders (Mai Anguwa) and the executive council system**.**

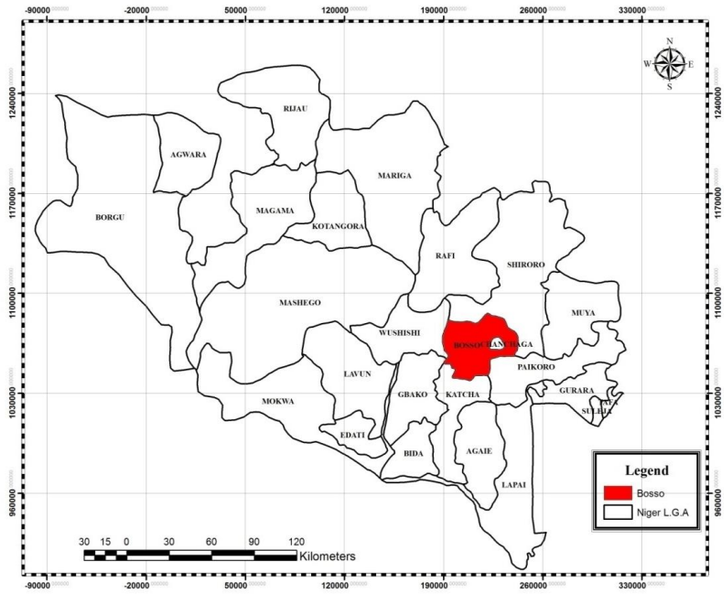

Figure 1.2: Minna in Niger State
Source: Department of Urban & Regional Planning, F.U.T, Minna 2017

LITERATURE REVIEWED

Sustainable Neighbourhood; What is it and why does it matter?

A sustainable neighbourhood is a multi-purpose area in which people aim to live and work at present and in the near future. Many future neighbourhoods can meet the demands of their residents and promote a high quality of life by implementing the sustainability concept. Some of these sustainable neighbourhoods are equipped with excellent services, provide their residents with equal opportunities, and are characterized by excellent planning (Bristol 2005).

The quest for sustainability of residential neighbourhoods is more than a century old (Clarke 2004), and mostly relates to integrating land use, transport systems and the environment (Kamruzzaman and Yigitcanlar 2015). The Garden City movement led by Sir Ebenezer Howard is considered as an early initiative and emerged as a response to unsustainable condition of the then residential neighbourhoods; and consequently, the concept of the three magnets was developed to combine the nature and environment with economic and social life (Howard 1902).

Similarly, the need for a sustainable urban form at the local level has long been advocated by the United Nations through its "Local Agenda 21" programs. Neighbourhoods are considered as the building blocks of cities where most development takes place, and therefore, the overall sustainability of a city depends on the sustainability of its neighbourhood (Choguill, 2008.)

The inclusion of sustainability principles in sustainable neighbourhood design has been proven meaningful because most of the issues that are faced by cities are accumulative in nature because of the poor planning at the micro level. A neighbourhood scale analysis can help to develop efficient and sustainable local green infrastructures, such as buildings, transportation, urban flora, and water systems. However, sustainable neighbourhood indicators must be first addressed in the design and planning processes because such limitation affects a significant portion of lands that provide accessibility from and within the neighbourhood as well as the major decisions on the issues within the neighbourhood (Engel–Yan, 2005).

A World Bank report shows that some 90% of global urban growth now takes place in developing countries—and between the years 2000 and 2030, developing countries are projected to triple their entire built-up urban areas. This unprecedented urban growth possesses great concerns for policymakers on how to steer growth in a sustainable way in future, because urban growth is attractive as it leads economic growth of cities (Shen et al 2011), the urbanization can provide an opportunity for developing countries by practicing

sustainability principles in their residentialdevelopments and thereby avoiding problems experienced by the developed nations (Vehbi and Hoşkara 2009).

Therefore, for sustainable city growth, the development of neighbourhoods in Minna must be monitored and guided by a State Neighbourhood Policy, which will advocatenot only for a clean, healthy, and productive environment but also for social and economic sustainability for both the present and future generations. The planning and designing stages of neighbourhoods must consider all necessary sustainable neighbourhood components in the design.

The Main Principles of Sustainable Neighbourhoods

A neighbourhood consists of the physical, economic and social attributes of any particular environment. The presence of these attributes results to a high quality and sustainable neighbourhood and also in the appreciation in property values within such neighbourhood; its absences affect the quality and sustainability of the Neighbourhood adversely. In other words, neighbourhood sustainability is directly proportionate to its quality. Sengupta and Tipple (2009) in measuring Neighbourhood quality suggests the use of these major variables below.

Housing Consumption:

Housing is one of the most important necessities and a pointer of neighbourhood quality. It is known to greatly affect human health and well-being. Housing constitutes the physical environment in which the family develops. Its improvement according to Okoro, (2009) represents a tangible, aesthetic and visible expression of the socio-physical environment Good housing entails the condition of the house, dwelling size and occupancy rates. Housing is an important component quality of neighbourhood. Agbola (1998) notes that housing is a combination of characteristics which provide a unique home within any neighbourhood; it is an array of economic, social and psychological phenomena. Osuide and Dimuna (2005) suggest that: "Having a safe place to live in is one of the fundamental elements of human dignity and this enhances human development".

Connection to Services and Infrastructural Facilities:

Connection to services such as water, sanitation, waste disposal and others is basic requirements of neighbourhoods. It is important that neighbourhoods are adequately connected to effective services and infrastructural facilities. The efficiency of any form of human activity system largely depends on the provision of efficient infrastructural facilities and services (Babarinde 1998). Hence, the significant of infrastructure in the proper functioning of any Neighbourhood cannot be dismissed. Apart from being a major pointer of Neighbourhood quality, Neighbourhood infrastructure is a critical socio-economic development of any urban area (Okusipe1999). It plays an important and crucial role in the economic social and environmental aspect of life of a Neighbourhood setting.

Neighbourhood Characteristics:

Neighbourhood characteristics such as playgrounds, open spaces and community facilities such as playgrounds, open spaces, outdoor and indoor recreational facilities and community centres are public locations where members of a community tend to gather for group activities, social support, public information and other recreational uses. It is important that neighbourhoods have such supporting facilities as it fosters good relationships between residents and improve social interactions among neighbours within the neighbourhood.

Location Characteristics:

A variable such as location which includes trade-off between journey-to-work time might not necessarily improve the quality of a neighbourhood directly, but it confers some measure of value on properties within the neighbourhood, which is why some people, no matter their socio-economic status, prefer specific neighbourhoods no matter the cost.

The UN-Habitat, an organization that supports for better urban future, recommended 5 principles in addition to the already listed variables for more sustainable neighbourhoods. They are;

- Adequate space for streets and an efficient street network,
- High density,
- Mixed land-use,

- Social mix and
- Limited land-use specialization

Achieving Sustainable Neighbourhoods

The UN Global Report on Human Settlements (2009)assesses the effectiveness of urban planning as a tool for dealing with the unprecedented challenges facing 21st-century cities, towns and neighbourhoods for enhancing sustainable urbanization. The Global Report's central argument is that, in most parts of the world especially in developing countries, current approaches to planning must change and that a new role for urban planning in sustainable urban development has to be found.

The Global Report argues that for sustainability, future urban planning must take place within an understanding of some of the following factors shaping 21st-century neighbourhoods. Some of these factors include;

- Increasing socio-spatial challenges, especially social and spatial inequalities, urban sprawl and unplanned peri - urbanization.
- The challenges and opportunities of increasing democratization of decision-making as well as increasing awareness of social and economic rights among ordinary people.

An important conclusion of the Global Report is that, even though urban planning has changed relatively little in most countries since its emergence about 100 years ago, a number of countries have adopted some innovative approaches in recent decades such as the strategic spatial planning, use of spatial planning to integrate public-sector functions, new land regularization and management approaches, participatory processes and partnerships at the neighbourhood level, and planning for new and more sustainable spatial forms such as compact cities and new urbanism.

With respect to the reconfiguration of planning systems, part of the Global Report's message is that urban planning needs to be institutionally located in a way that allows it to play a role in creating urban investment and livelihood opportunities through responsive and collaborative processes as well as coordination of the spatial dimensions of public-sector policies and investment. It has become clear that urban planning has an important role to play in organizing and assisting the government to meet neighbourhood challenges of the 21st century.

Public Participation

Hodge (2003) describes public participation as a process of taking decision in which a community or group of people or an individual can take decision for development of their surroundings, neighbourhoods or country. In addition, Smith (1993) explains that public participation is a continuous process that "allows those affected by a decision to have an input into that decision.'' The purpose of public participation in development projects is to integrate well-developed citizen's opinion into collective actions and decisions.

Smith (1993) describes that pubis participation has its own benefits in development activities and planning process. These benefits are given below:

i. The participation of the public in development process is the enhanced way to reflect the opinion. This gives social legality or acceptance and understanding

ii. It provides an opportunity to utilize the local public knowledge and understanding

iii. Knowledge which accumulated by public participation can be very valuable input in the preparation, implementation and evaluation of development process especially at neighbourhood level.

RESEARCH METHODOLOGY

The survey method involved a survey of Bosso estate neighbourhood, purposively selected for this work because it has an already existing neighbourhood plan. The survey adopted a systematic sampling technique. A total of 8-10 houses were randomly selected from each streets of the 22 streets depending on the number of houses on each street within the neighbourhood amounting to a total of 200 houses surveyed. A questionnaire was developed and administered to inhabitants of the neighbourhoods. The assessment process involved a number of steps: first, was to collect and examine the existing layout plan; second, was to determine the quality indicators (from the literature

and related studies); third, was to prepare the GPS to obtain coordinates of existing facilities and services.

The actual rating was implemented through resident's perception, observation and recording. Due to the wide scope of the survey and peculiar issues of privacy and local security, criteria related to the assessment of interiors of housing units were excluded. The quality indicators used in this survey and their main defects are the physical, social and economic indicators. The data gathered was entered in SPSS for analysis purposes while the results are presented in tables and charts. Pictures of some areas within the neighbourhood are presented as plates to explain further the issues within the discussion of the results.

RESULTS AND DISCUSSION

Interviewees of this study belong to different age groups of over 16 and sex, this is because perception varies by age and sex. House hold characteristics such as status of the house i.e. owner occupied or rent and time period of living in the neighbourhood plays a significant role in perception of neighbourhood quality by residence. Out of the total responses, 55% respondents were male and 45% were female. Many of the respondents have the highest level of education within their household as Tertiary level, putting the literacy level in the neighbourhood at 90%.

Composite Physical Indicator of Neighbourhood Quality

In determining the physical quality of the neighbourhood, Road Asphalt, Road Marking, Street Cleanliness, Sidewalks, Traffic Quality, Vehicle Parking, Tree and Landscaping, Parks and Natural Areas, Children Playground, Rate of Advertisement using Bill Sign, Noise pollution Housing Quality, Water and Electricity supply were used in assessing the physical quality of the neighbourhood. The table1.0 shows inhabitants perception of the physical quality of their neighbourhood.

Table 1.0: Residents Perception of the Physical Quality of their Neighbourhood

Physical Quality	Respondents	Percentage (%)
Good	10	4.5
Satisfactory	50	22.7
Poor	140	70.0
Total	**200**	**100**

Source: Authors' Field Survey October, 2017

It can be observed from Table 1.0 that majority of the inhabitants of Bosso estate perceive the physical quality of the neighbourhood as poor. From observations, it is discovered that the road asphalt of streets in the neighbourhood are old and worn out and having no sidewalks, some of the streets are littered with dirt and flits, absence of children playground, parks and natural areas or any form of recreational facilities, poor landscape quality with the exceptions of few private home owners, residents provide their own water either through private boreholes, wells or by water vendors as the water utility company is not functional, noise pollution from speakers of worship centres etc are some of the challenges facing the residents of the neighbourhood. It is concluded that Bosso estate is in need of a massive constructive improvement of its physical attributes.

Composite Social Indicator of Neighbourhood Quality

In determining the social quality of the neighbourhood, safety at home and while waiting for public transportation, accessibility to facilities such as health care, markets, schools, public reading facilities etc., community involvement participation were used. Table 2.0 below shows inhabitants' perception of the social quality of their neighbourhood.

Table 2.0: Residents Perception on the Social Quality of their Neighbourhood

Social Quality	Respondents	Percentage (%)
Good	40	20.0
Satisfactory	65	31.5
Poor	95	47.5
Total	**200**	**100**

Source: Authors' Field Survey October, 2017

In many of the areas, safety at home and while waiting for public transportation is perceived as good except for few places such as in Road 9 and Road 2. This is because these areas are not easily accessible to public transportation and to get to that, inhabitants have to work through public places which make inhabitants more unsafe especially after dark. Also, the neighbourhood has no streets light to provide light at night.

Accessibility to neighbourhood facilities such as market, health care, recreation, schools and others are very essential for the day to day human living. In the study area, except for schools which are easily accessed by many of the residents, other neighbourhood facilities such as health care, market recreation and others are not accessible to residents with the neighbourhood. Community involvement and participation in neighbourhood activities in the study area is also non-existence.

Here, it can be concluded that accessibility to neighbourhood facilities and services in the study area is poor.

Composite Economic Indicator of Neighbourhood Quality

In determining the economic quality of the neighbourhood, housing availability, housing cost and purchase cost of daily consumer's goods were used. The table 3.0 shows inhabitants perception of the economic quality of their neighbourhood.

Table 3.0: Residents Perception on the Economic Quality of their Neighbourhood

Economic Quality	Respondents	Percentage (%)
Good	50	25
Satisfactory	125	62.5
Poor	25	12.5
Total	**200**	**100**

Source: Authors' Field Survey October, 2017

From Table 3.0 shows a generally good and satisfactory attributes of residents within the neighbourhood. Cost of living in the study area which includes housing cost, cost of daily consumer's goods and other economic factors are relatively affordable and hence residents are better off on their basic salaries and wages.

Design Proposal

Bosso Estate which was designed to promote aesthetics and functionality to make life enjoyable for the inhabitants is now an irony of the neighbourhood it was designed for. The neighbourhood is faced with many changes rising from its physical attributes to its social attributes. Part of the problems identified in the study area includes;

- Absence of neighbourhood supporting facilities such as shopping complex, primary healthcare centres, water board and electricity stations, children playground, police station, light industry, hotel and neighbourhood square
- Road asphalt in the neighbourhood is old and worn out with no sidewalks, street light etc.
- Absence of any form of community participation and involvement in any neighbourhood activities partly because of the absence of a community centre
- Absence of any sporting or recreational facilities within the neighbourhood.
- Encroachment of some buildings into the right of way. Also, it was observed that some houses were constructed on flood plain.
- It was also discovered that there are no functional neighbourhood policy. Niger state has no neighbourhood policy that focuses on neighbourhood development and issues.

Proposed Bosso Estate Upgrade Plan

The propose Bosso Estate plan proffer solutions to all the highlighted problems. The proposal provides for better circulation andfor connectivity of all plots to neighbourhood facilities, guides development by specifying setbacks and building coverage for all undeveloped plots in the neighbourhood.

In providing for facilities and services, neighbourhood service radius as prescribed by (City Visalia General Plan 2014) was used. 51 structures were removed from the existing plan this was necessary to improve circulation to some areas within the neighbourhood and also to provide space for the provision of neighbourhood facilities. Buildings on flood plain were also removed

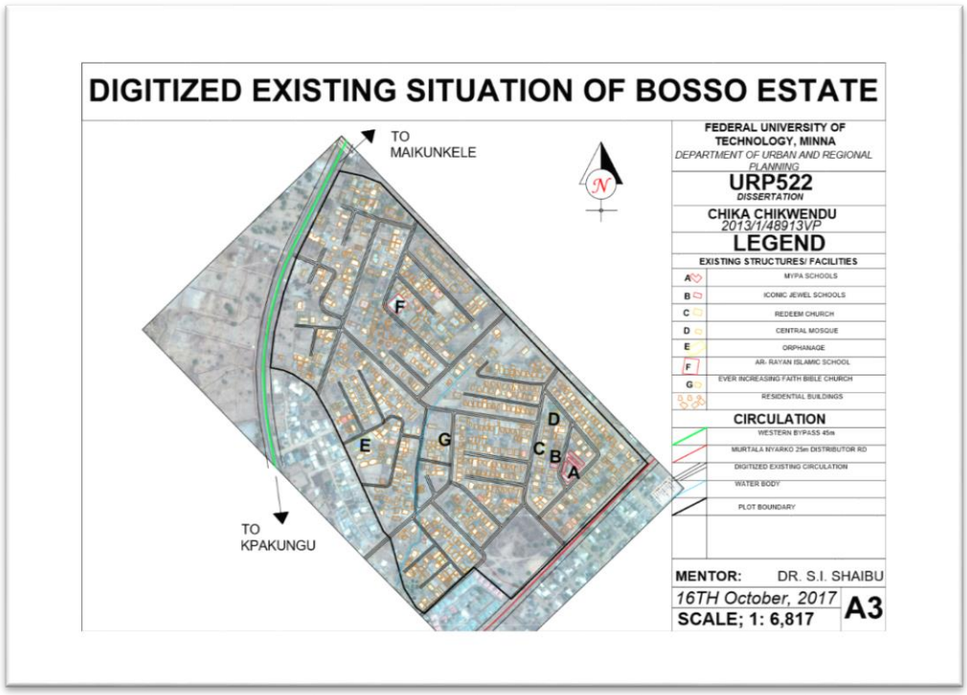

Figure 4.1: Existing Layout Plan of Bosso Estate
Source*:* Authors' Design October 2017

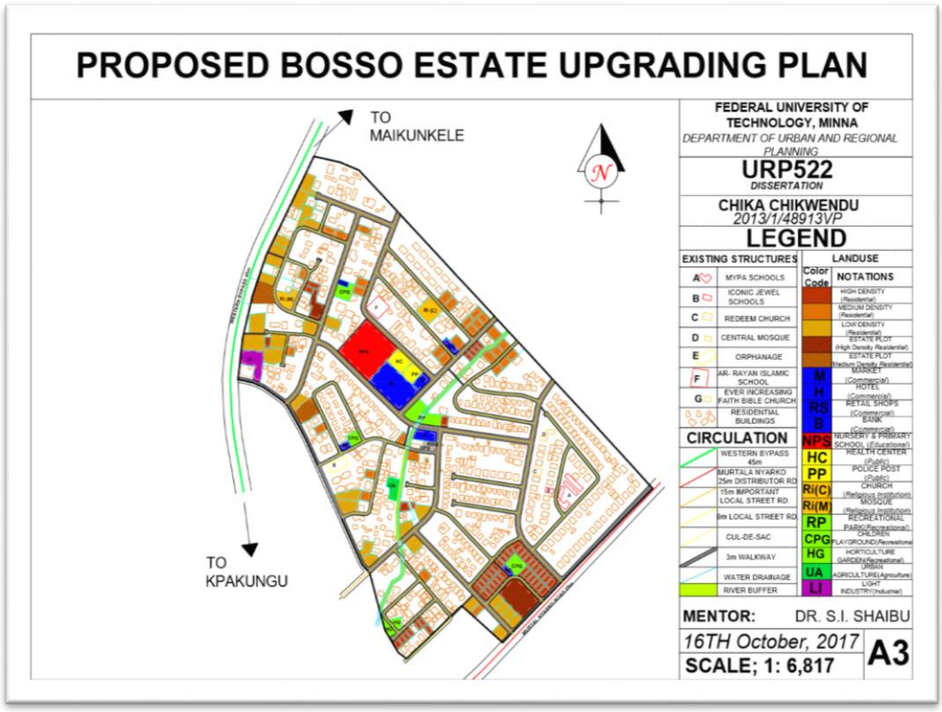

Figure 4.2: The Relationship between Proposed Buildings and Existing Buildings/ Facilities
Source: Authors' Design October 2017

Table 4.4 and 4.5 respectively show the length and hierarchy of proposed roads within the Neighbourhood and the Land Use Analysis for the proposed upgrade plan.

Table 4.4: Length and Hierarchy of Proposed Roads

Road	Length (Km)
15m IMPORTANT LOCAL STREET ROAD	4.09
9m LOCAL STREET ROAD	5.42
CUL-DE-SACS (DEAD END ROADS)	0.86

Source: Field Survey October, 2017

Table 4.5: Land Use Analysis

LAND USE		NUMBER OF PLOTS	AREA (Ha)	PERCENTAGE
EXISTING DEVELOPMENTS			53.74	64.62
RESIDENTIAL	LOW DENSITY	28	4.2	5.05
	MEDIUM DENSITY	31	2.6	3.13
	HIGH DENSITY	50	2.4	2.92
COMPREHENSIVE RESIDENTIAL	LOW DENSITY			
	MEDIUM DENSITY	2	0.64	0.77
	HIGH DENSITY	2	0.93	1.12
INDUSTRIAL		1	0.37	0.45
COMMERCIAL		7	1.54	1.85
RELIGIOUS INSTITUTION		2	0.55	0.66
PARKS AND RECREATION		5	1.06	1.28
EDUCATIONAL		1	1.48	1.78
CIRCULATION			12.28	14.77
PUBLIC SERVICES		2	0.45	0.54
URBAN AGRICULTURE		1	0.82	0.97
PUBLIC UTITLITIES		2	0.1	0.12
TOTAL		**134**	**83.16**	**100.0**

Source: Authors'Analysis October, 2017

CONCLUSION

The quest for sustainability of residential neighbourhood is more than a century old (Clarke 2004), and mostly related to integrating land use, transport system and the environment. (Kamruzzaman and Yigitcanlar, 2015). It is important that our neighbourhoods are sustainable. The inclusion of sustainability principles in neighbourhood design have proven meaningful because most of the issues that are faced by cities are accumulative in nature because of poor planning at micro level. The problems identified in the neighbourhood as with many other neighbourhoods in the country can be addressed effectively and efficiently by the implementation of the proposed design, the formulation and development of Neighbourhood policy that will focus on neighbourhood issues and development. But most importantly, future urban planning must take place within the understanding of factors facing 21st century neighbourhood and also the political will and commitment.

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APPRAISAL OF EU FINANCED RURAL WATER SUPPLY PROJECT IN SELECTED COMMUNITIES IN AKWA IBOM NORTH SENATORIAL DISTRICT, NIGERIA

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Access to safe drinking water has been a subject of discussion among policy makers and academia due to its social, economic and health significance. Thus, the European Union under the European Union Micro Projects Programme Six (EU-MPP6) carried out a number of micro development projects in some rural communities in the Niger Delta with the broad aim of reducing militancy and improving the quality of life in the rural communities. One of such project was the provision of safe drinking water. The main objective of this study is to evaluate the performance of the EU financed rural water supply projects in selected communities in Akwa Ibom North Senatorial District. Data were collected through administration of questionnaire; a total of 382 questionnaires were administered while 360 questionnaires were retrieved and analyzed using descriptive and regression analysis via SPSS version 20. The result of the analysis revealed that EU financed rural water supply projects as increased the access to safe drinking water in the benefiting communities. The three independent variables of training, local management practice and community participation account for 52.0% of the performance of the EU water project. Only training of the community water committee is statistically significant (P-value=.000). The study recommended the continues training of the community water management committee as it has a significant influence on the performance of water facilities and to improve on the level of community participation in the design, planning, implementation and monitoring of rural water projects. Finally, rural water projects should adopt local technology, for ease of management and maintenance through local maintenance practices.

INTRODUCTION

The level of development of a country has been measured via various parameters which include their access to safe drinking water. Studies have shown that basic infrastructure for safe drinking water are lacking in most rural areas of Nigeria (Nkwocha, 2009). Thus, the government has partnered with various NGOs and development partners, under various development programmes to address the inadequacy of safe drinking water mostly in rural areas. In order to address the inadequate access to safe drinking water, previous governments have adopted a top-down approach in which the level of community participation was very low. This has resulted in failure of more than 80% of public water projects in Nigeria after four years of implementation (Akpojaro and Ihesiene, 2015). The benefiting communities do not see the project as their own thereby taking full responsibility of its management and maintenance.

The European Union-Micro Project Programme (EU-MPP) in the Niger Delta was aimed at improving the condition of the rural communities by embarking on micro projects thereby reducing the rate of militancy and giving the rural dwellers improved access to basic amenities including safe drinking water (Onyekwewe and Emmanuella, 2014). The EU-MPP was implemented in three phases; the first three states were Delta, Rivers and Bayelsa that is EU-MPP3, followed by Akwa Ibom, Cross River, Imo, Ondo and Edo (EU-MPP6) while the third phase was the combination of phase one and two to form the EU-MPP9 (Onyekwewe and Emmanuella, 2014).

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The EU-MPP6 Programme was community centered as the Programme was designed to be community driven (Onyekwewe and Emmanuella, 2014) as benefiting communities were fully involved from the conception, planning, design, implementation and finally the monitoring and maintenance of the project. In addition to this, there was high level of sensitization and training of community representatives that formed the 'Community Water Management Committee' (CWMC). This committee interface between the community and the officials of the EU-MPP6 Programme. The EU through the EU-MPP has financed a total of Three Thousand, Nine Hundred and Seventy Nine (3,979) rural projects with a total sum of €40.6 million Euros from 2001 to 2012 (EU-Country Level Evaluation Report, 2012; Nnadi, et. al., 2012).

Since the completion of the EU-MPP6 programme in 2012, there has not been any study to appraise the performance of the EU financed rural water scheme. Against this backdrop, this research seeks to evaluate of the European Union-Micro Project Programme, aimed at appraising the level of performance of the EU financed rural water supply scheme in selected communities in Akwa Ibom north senatorial district, Akwa Ibom State.

Akpojaro and Ihesiene (2015), observed that over 80% of public water facilities breakdown, abandoned or dysfunctional after four years of their completion. This makes public water facilities unsustainable. Poor access to safe drinking water contributes to the poor health statistics in Nigeria. Over 40% of child mortality in Nigeria is caused by water borne diseases such as diarrhea (UNICEF, 2010; Atser and Akpan, 2010).

Majority of water projects have failed or are abandoned bearing the posters of different government agencies or political representatives eg constituency water projects of different LGAs, the River Basin Development Agency, Niger Delta Development Commission, Petroleum Trust Funds, Inter-Ministrarial Direct Labour as well as boreholes provided by Akwa Ibom Water Company Ltd and Akwa Ibom Rural Water and Sanitation Agency. There is no concrete effort to determine the present status of many of this water projects. Whereas, completion certificate has been issued and funds has been released for the payment of the contractors.

There insufficient empirical studies on these various water projects to determine if the projects meets it objective and how sustainable is the projects. Many of these projects are being evaluated immediately after their completion. Four years after the completion of the EU financed rural water project, this study seeks to appraise the performance of the project vis-à-vis its objective.

The broad objective of this study is to evaluate the performance of EU financed rural water supply facilities in selected communities in Akwa Ibom North senatorial district. The specific objectives include;

i. To determine the socio-economic impact of the EU financed rural water projects.

ii. To examine the relationship between community participation and the performance of the EU financed rural water supply project in the selected communities.

iii. To examine the impact of training of community water project management committee on the performance of the EU financed rural water supply project in selected communities.

The study hypothesized that, there is no significant relationship between community participation, local project maintenance practice, training of community water committee members and the performance of the rural water supply project.

The Study Area

Akwa Ibom State is one of the oil rich states in the Niger Delta Region of Nigeria. Located in the southeastern coast of Nigeria, Akwa Ibom State was created on September 23, 1987 from the former Cross River State of Nigeria. The State is wedged in between Rivers, Abia and Cross river States and the Republic of Cameroon to the Southwest, North, East and Southeast respectively while the Bight of Bonny bordered the State to the South.

Akwa Ibom state lies between longitudes 7º28' and 8º25' East of the Greenwich Meridian and latitudes 4º32' and 5º32' North of the Equator. According to NPC, Akwa Ibom State has a total land area of 6,187 km2, which represents 0.67% of the total land mass of Nigeria and a population of 3,920,208 while Akwa Ibom North senatorial district consisting of nine local

government areas has a total population of 1,249,209 (NPC, 2006). This population was projected to 2017 using 2.7% as growth rate, making the population of the study to stand at 1,674,596.

RESEARCH METHODOLOGY

The study adopted quantitative research paradigm in which field survey was conducted using questionnaire as the main instrument for data gathering. The sample size for this study was derived using Sample size calculator. The sample size of 382 respondents was arrived at using a household population of 69,913 (NPC, 2006) residing in various communities in the study area at 95% confidence level and 5% confidence interval using sample size calculator.

The study adopted systematic sampling approach in selecting subjects for the study. This entails systematically selecting 8 household heads from each community of the 47 selected communities. 8 questionnaires were administered in each community making a total of 376 and 6 questionnaires were reserved for the 6 communities with clan heads. 360 questionnaires were completed and returned.

Both primary and secondary sources of data were used in this study. The primary source includes questionnaire administration and field observation while secondary source includs EU-MPP6 publications, etc. The data gathered were analyzed using simple descriptive tools while Regression analysis was used to test the hypothesis via SPSS version 20.

The breakdown of the population and sample size is presented in table 1.1 below.

Table 1.1 Sample Size

LGA	No. of Communities selected	Projected Population (2017)	No. of House hold	Sample Size
Uruan	15	143,550	23,925(34.1%)	131
Itu	11	102,401	17,067(24.3%)	93
Ibiono Ibom	21	173,523	28,921(41.6%)	158
Total	47	419,474	69,913	382

Source: Nigeriazipcodes.com (accessed June, 2017); EU-MPP6 office AKS (2017); NPC, (2006)

RESULTS

From the data gathered by the researcher, 203 (56.39%) of the respondents were female while 157 (43.61%) were male. Also, 173 (48.05%) of the respondents were within the ages of 48 and above. 115 (31.94%) of the respondents indicated they have a household size of 3 – 4, while 108 (30% and 98 (27.22%) have a household size of 5 – 6, and 7 and above. The most common occupation in the study area was trading and agriculture 124 (34.44%) and 107 (29.72%) respectively.

Socio-Economic Impact of Rural Water Supply Project

Table 2.1 below presents the socio-economic impact of the EU financed rural water supply project on the benefiting communities. 456 (36.48%) and 410 (32.8%) of the respondents agreed and strongly agreed respectively that the project has greatly increased their access to safe drinking water with a mean value of 3.47. This is closely followed by improved community participation with mean score of 3.33. This implies that the design of the EU-MPP6 programme has encouraged community participation. 209 (58.06%) of the members of the benefiting communities were aware of the project while 183 (50.83%) of the respondents participated in the implementation. Other areas the project has impacted on the socio-economic activities include improving social relationships. People interact when they meet at public places, in this case at the water facility point.

The project also reduce time spent by various households in fetching water with a mean score of 3.23, thereby reducing lateness to school, absenteeism, and other risk associated with trekking a long distance to fetch water. The project has also increased the quantity and quality of water with a mean score of 3.19, thereby improving personal hygiene. Access to safe drinking water is important in the fight against water borne diseases and personal hygiene. Others include secondary job creation 2.96, such as water vendor, food processing, irrigation farming mostly for vegetables etc., improved sanitation 2.71, improved managerial skills 2.50 and reduction in travel distance to fetch water 2.05.

Table 2.1Socio-Economic Impact of Rural Water Supply Project

Impacts of EU water supply project	S/D (1)	D (2)	I (3)	A (4)	SA (5)	Total	Mean	Rank
Increased access to safe drinking water	23	124	237	456	410	1250	3.47	1st
Improved Community Participation	44	116	195	484	360	1199	3.33	2nd
Improved social interrelation among members of the community	34	152	258	396	325	1165	3.24	3rd
Reduction in time spent on fetching water	43	166	216	284	455	1164	3.23	4th
Increase in the quantity and quality of water consumed per capita per day	33	158	294	352	310	1147	3.19	5th
Improved personal hygiene	68	168	165	352	325	1078	2.99	6th
Secondary Job creation	58	176	237	324	270	1065	2.96	7th
Improved sanitation	88	196	165	272	255	976	2.71	8th
Developed technical and managerial potentials of the people	79	286	177	152	205	899	2.50	9th
Reduction in travel distance to fetch water	12	88	69	308	260	737	2.05	10th

Source: Field survey, (2017)

Community Participation in Planning and Implementation

Table 2.2below presents the opinion of respondents on the level of community participation during the EU financed rural water supply project. 31 (8.61%) of the respondents indicated that the community participation was very low, 68 (18.89%) of the sampled respondents indicated that the level of community participation was rather low. This means that about 26% of the surveyed respondents rated the level of community participation below average. On the other hand, 122 (33.89%), 125 (34.72%) and 14 (3.89%) of the sampled respondents are of the opinion that the level of community participation was medium, high and very high respectively. These sets of respondents are of the view that community participation was above average.

The researcher further adapted the Arnstein's Ladder of Participation to examine the level of community participation in the EU financed rural water supply project. The Ladder has 8 rungs but the researcher re-arrange the runks to have 5 rungs which are

i. Citizen Control 4.5 – 5.0
ii. Delegated Power 4.0 – 4.49
iii. Partnership/Placation 3.0 – 3.99
iv. Consultation/Informing 2.0 – 2.99
v. Therapy/Manipulation 1.0 - 1.99

Applying the Arnstein's ladder of participation, the mean value of the distribution is calculated to be 3.06. This means that the level of community participation could be said to be placed at the rung of partnership/placation which Arnstein described as tokenism. The study revealed that people were appointed as representatives of the community on advisory groups or decision-making bodies; however, these groups were highly influenced by the decisions of powerful and persuasive elite.

Table 2.2 Level of Community Participation in Planning and Implementation

Response	Frequency	Percentage
Very Low	31	8.61
Low	68	18.89
Medium	122	33.89
High	125	34.72
Very High	14	3.89
Total	360	100

Source: Field survey, (2017)

Factors Limiting Community Participation

The respondents were further asked of the hindrances to community participation in rural development projects as presented in table 2.3 below. Majority of the respondents indicated that poor funding of community meetings was the main hindrance to community participation. As funny as this may sound, rural dwellers are easily bought by incentives such as food, money among others. If they attend community meeting and food is not sheared, they will never attend such meeting again no matter how beneficial the outcome of the project will be. 70 (19.44%) of the respondents said poor information dissemination posed a clog in the wheel. This factor cannot be independent of the former. When people don't attend meeting they can't get firsthand information. Other factors were political pressure (18.6%), cultural factor (13.61%), others includes the patriarchy nature of our society, poor attitude toward developmental programmes due to many failed past

programmes, the ever busy nature of rural dwellers as people finds it difficult to leave their farm to attend community development meetings.

The participatory process, designed to promote community engagement in the planning process of the EU rural water project, prospectively was expected to improve the feedback and accountability mechanisms available to benefiting communities. However, the composition of community participation and the danger of local elite capture of the participatory process are important qualifications to the supposed correlation between service delivery and accountability.

Table 2.3Major Hindrances to Community Participation

Factors	Frequency	Percentage
Political Pressure	67	18.61
Cultural factors	49	13.61
Poor funding of community meetings	131	36.39
Poor information dissemination	70	19.44
Others	43	11.94
Total	360	100

Source: Field survey, (2017)

Community Training and Project Performance

The study sought to establish the influence of the training of community water committee training on the performance of the water project. 166 (46.12%) of the respondents indicated that training affected community ownership of the water project in their community while majority (53.9%) stated that training had no effect on ownership of the project. 76.9% of the respondents indicated that members of water committees were trained on operation and maintenance of water projects while 23% respondents indicated that training wasn't received. The table also shows that 91% of the respondents felt that the trainings offered were sufficient while 8.9% indicated that training wasn't sufficient.

Table 2.4Community Training and Project Performance

Impact of Training of community water management committee	Yes (%)	No (%)
Water management committee members have been trained on operation and maintenance and management of water systems	76.94 (277)	23.0 (83)
Trainings offered were sufficient and useful for water project management	91.12 (328)	8.88 (32)
The training stimulates community ownership of EU financed water supply project	46.12 (166)	53.88 (194)

Source: Field survey, (2017)

Test of Research Hypothesis

Ho: There is no significant relationship between community participation, local project maintenance practice, training of community water committee members and the performance of the rural water supply project.

Regression Analysis

Regression analysis was used to determine the relationship between the factors influencing performance of the rural water project and the level performance of the rural water project.

Table 3.1 below shows that the coefficient of determination R^2 square is 0.520 and R is 0.721 at 0.05 significant level this is further attested to by the 0.00 significant level as shown in table 3.2 below. The R value represents the simple correlation and is 0.721 which indicates a high degree of correlation. The coefficient of determination indicates that 52% of the variation in the factors is explained by the independent variables (Community participation, project management practices and community training.).

Table 3.1 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.721[a]	.520	.487	.331

a. Predictors: (Constant), Training , Mgt Practice , Community Participation

As highlighted in table 3.2 below, it can be observed that the independent variables have positive relationship with the dependent variable, as the performance of the EU financed water projects would be constant at 1.002.

Although, the three predictors (Training of community water committee, community participation and local management practices) contributed significantly to the performance

of the water project, training of the community water committee contributed more to the performance of the EU water project. This is in line with the findings of Willians (2013) who concluded that the functionality of rural water project depends on adequate technical knowledge of operation and maintenance.

Table 3.2: Coefficient results showing the relationship between the combined factors and performance of water projects.

Co efficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.002	.330		3.038	.004
	Local Mgt Practice	.116	.068	.191	1.722	.092
	Community Participation	.081	.053	.181	1.529	.133
	Training	.588	.128	.561	4.588	.000

a. Dependent Variable: Project Performance
P*< 0.05 Moderately Significant;
P**<001Fairly Significant;
P***<0001 Highly significant

DISCUSSION OF FINDINGS

The study revealed that the EU financed rural water supply project has impacted positively on the socio-economic activities of the selected communities. As indicated in table 2.1, the project has increased the access to safe drinking water in the communities with a mean value of 3.47. This finding is supported by Onyekwewe and Emmanuella (2014). In addition to this, other areas of positive impact are reduction in the time spent in fetching water for household consumption. Prior to the EU water projects, women and children spent up to 5 hours daily in fetching water from the stream. But with the EU water project, they spent between 30 minutes to 1 hour to fetch water needed by the entire household. This will reduce lateness to school and absenteeism from school among others. Also, women now have time to invest in other economic activities rather that spending the whole day fetching water. The EU rural water project has reduced the travel distance in fetching water; improve personal hygiene and sanitation as the rural dwellers now have more water to use for their domestic activities. Gatari, Jaya and Mbabazi, (2016) argued that without adequate water supply, it will be difficult to achieve personal hygiene and improved sanitation.

In terms of community participation, the study revealed that there has been a paradigm shift from the traditional top-bottom approach commonly used in government cycle. The EU water programme was designed to be a community driven project. The communities play a significant role in the design, planning and implementation of the water project. Communities were given the free-hand to choose their project, the location of the project, the unskilled laborers were hired from the community while the community provides the land and takes charge of the safety and security of the working materials. This approach gave the community members a sense of belonging and ownership of the project. The community leaders are at liberty to choose any management style they want. The field survey revealed that three management styles were common among the sampled communities. These are; where the water facility is solely managed by the community leaders, that is the village head and his chiefs. The second management style is where the water facility is managed by the EU water committee members that were set up during the implementation phase and thirdly is where the water facility is managed by an individual or group who reports to the village head.

The study revealed that the water facility that were managed by the community heads were not functional as at the time of this study. This poor performance can be attributed to the fact that the community heads has no managerial knowledge and financial records are not kept. The water facilities were operated without financial records which make it difficult to carry out major repairs.

The study also revealed that local project management practices also influenced the performance of the water projects. Local project management practices like project monitoring and evaluation, establishing skilled project team and ensuring effective communication structures routine maintenance and minor repairs. Atser and Akpan, (2010) argued that community ownership of water projects enhance local maintenance of such projects as they can easily access spear parts within their local markets. In the same vain, Obeta, (2016) argued that if local water supply projects should consider local technology

during the design phase rather than foreign and complicated designs. This will ensure ease of maintenance and repairs.

Training of community members especially those responsible for operation and technical maintenance of water projects influences the performance of water projects. Trained operators are more efficient while operating the water facility thus minimizes any breakdowns during maintenance or operation. In cases of breakdowns, availability of trained community members on maintenance ensures that maintenance are done more promptly and cheaply as opposed to when community members have to depend on hired skilled labor. The water systems and technologies established should be those that do not need heavy financial investments during operation and maintenance that may be beyond the capacity of the community members. If the operation costs are higher than the community's capacity to meet, then such water project can easily fail (Onyekwewe and Emmanuella, 2014). Also Willian A.K (2013) opined that training on issues like operation and maintenance empower communities to look after water supply systems thus aiding sustainability. Ademiluyi and Odugbesan (2008) identified lack of community education as one of the important factors which could lead to breakdown and poor performance of water supply projects in rural communities.

CONCLUSION

Rural water project has a positive impact on the social and economic life of the benefiting communities. There has been an increase in the access to safe drinking water, reduction in travel time and travel distance to fetch water which has resulted in reduction in lateness and absenteeism from school among students. Also, there is ease in doing business that needs water such as cassava processing, oil palm processing vegetable farms, local construction etc. The EU financed rural water supply project experienced a high rate of community engagement. In other words, the project adopted bottom – top approach which allowed the benefiting communities to be involved from the planning stage, the design and the implementation of the project. The study concludes that community participation in the planning, design and implementation phase of rural water projects, the training of community members especially those responsible for operation and management of the water projects and the local maintenance practice by the benefiting communities has a positive impact on the performance of the rural water project.

RECOMMENDATIONS

The following recommendations were arrived at based on the findings of the study;

i. There is need to sustain the training of community water management committee as it has a significant influence on the performance of water facilities.

ii. There is need to improve on the level of community participation in the design, planning, implementation and monitoring of rural water projects.

iii. Further rural water projects should adopt local technology, for ease of management and maintenance through local maintenance practices.

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USERS PERCEPTION IN THE PLANNING OF MARKETS: A CASE STUDY OF ABUJA, NIGERIA

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The quality of a market place is determined by the usability, and social interaction that takes place in it. This study aims to assess the perceptions of market users to upgrade and improve their service qualities and experience. The study also follows a market place user perspective angle, paying special attention to its user's perceptions and expectations and to the role of ideologies in the encounter given the description of the research subject matter, the evaluation followed a case study methodology. The findings show that expectations are exceptionally dynamic and play a relevant role in users' satisfaction. Satisfying and neutral attributes were identified, and the critical incident technique also revealed the importance of different ideologies in the encounter, so in order to provide such an environment the users have to be taken into consideration.

Keywords: Market, Perception, Public Places, Requirements, Users.

INTRODUCTION

The word market has transformed in implication as time passed and nevertheless varies in accordance to places. In America, a marketplace has conventionally been described as a community structure where retailers sell food from shops. Though some marketplaces still fit this characterization, marketplaces are now constructed in many forms and layouts, offering an extensive variety of distinctive produces, which are maintained and ran by different kinds of administrations, not only municipal authorities. An ideal characteristics of a marketplace comprise of dealers or traders who converge at a usual setting on a frequent basis under the regulation of a supporting body equipped with an authorized and commercial obligation to control market activities and, occasionally, buildings or services to assist the markets activities (Ford 2003).

The research area which will be associated with this paper will be "Users Perception in the Planning of Markets". This is to enable the design of market places to be effective, a place are where people mix, which can become the heart and soul of a community, its common ground, a place where people interact easily, and a setting where other community activities take place so in order to provide such an environment the users have to be taken into consideration.

It is also important to clarify the relation between quality and satisfaction. Although it is consensual that customer satisfaction is essential for organization success (cf. Andrews et al., 2011; Dabholkar et al., 2000; Fornell et al., 2006; Keiningham et al., 2003; Stradling et al., 2007; Vavra, 1997), not everybody agrees about the relation between those two constructs (Luo and Homburg, 2007) and what is more, there is no universal definition for satisfaction (cf. Peterson and Wilson, 1992; Yi, 1990). For some authors satisfaction is an evaluation process (cf. Fornell, 1992; Hunt, 1977; Oliver, 1980), but for others it is the response to that evaluation process (cf. Howard and Sheth, 1969; Oliver, 1980, 1997; Tse and Wilton, 1988; Westbrook and Reilly, 1983).

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People are communal beings that have unique and distinctive behaviors at different times and locations for example markets, restaurants, banks, public parks, and department stores. It is these differences in behaviors that form the variation of actions in compliance to the change in conditions of places. Therefore, there lies a great difficulty in creating a compatible market design to deal with the different perception of market users (Chayanit and Sukree 2008).

Assessing User Perception

(Carr, 1992) in *Public Space* constructed a human dimension to see relationships between places and people, aiming to manage the space more efficiently. The central argument is that public spaces' value grow out of an understanding of why people go to spaces, how they actually use them, and what they mean to their users over time. The human dimension system is to provide a general design and management guideline for public spaces. There are three critical dimensions: needs, rights and meanings .Basic user needs for public space include comfort, relaxation, passive engagement, active engagement and discovery.

User perception in architecture defines ethics and procedures for a user-centred design for projects. Relating this architecture in market project will offer benefits such as spatial perception of humans and features which stand recognised towards improving the efficiency of the market. The theories might look undemanding however, these principles happen to be frequently ignored in design processes, therefore, omitted in the market user's spatial perception and requirements brief. Furthermore, they help avoid common design mistakes and makes the design very functional (IBM 2001).

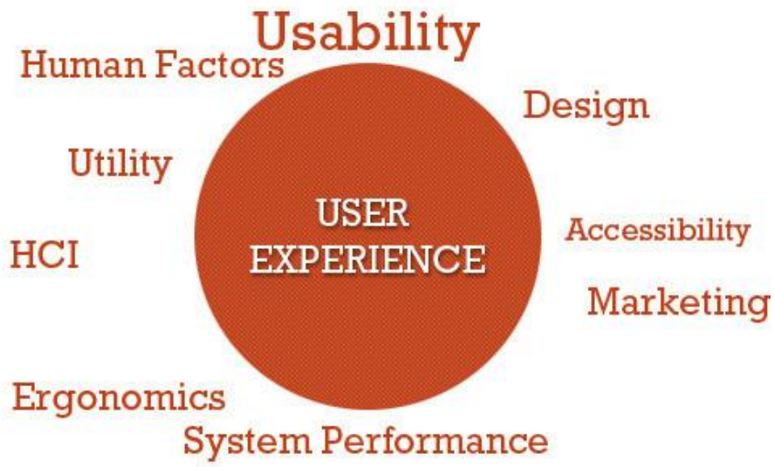


Figure 1: A diagrammatic representation of relationship between user perception and requirements (Source: Nasr 2008).

Based on the description on figure 1, these factors mentioned all revolves around people's perceptions about safety, cleanliness, and the availability of spaces and the importance of giving people the choice to choose they want is generally underestimated as it is a difficult quality for a place to achieve, but once attained it becomes an unmistakable feature. A successful public space is easy to get to and get through; it is visible both from a distance and up close, (Nasr 2008).

(Dana 2013) viewed perception as the primary stage take when interrelating with space. It is the interface, our first contact with the surrounding environment. Making it important, in a research, which is trying to form a connection between the people and their surroundings, therefore it becomes necessary to ascertain what ''perception'' is and how can this method impact relationship with space as both users and designers, as well. In discussing all about perception, perhaps the superlative word that could be used is that of concept or perspective.

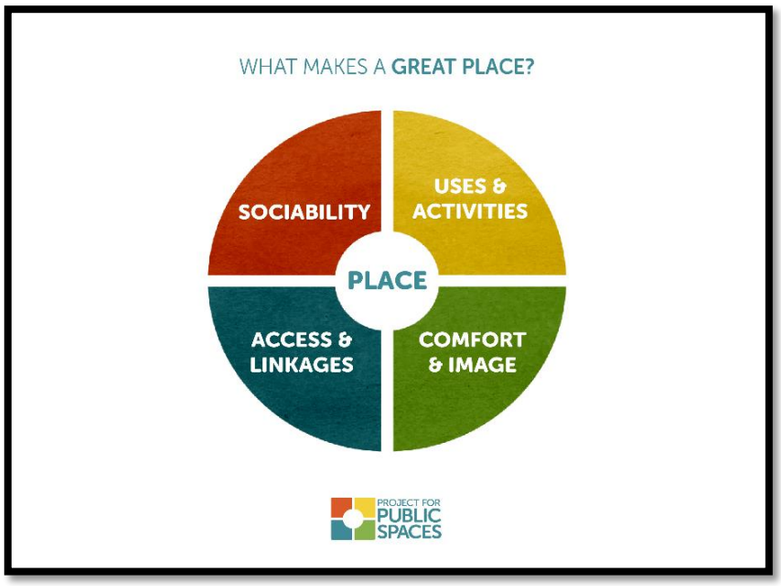


Figure 2: A representation of the interrelationship between human behaviors and space. (Source: Project for Public Places 2000).

(PPP 2000) stated in one of its publications that there are four important attributes for a place to be remarkable to the public, it must comprise of the following features namely activities and uses, sociability, comfort as well as image lastly access and linkages. Essentially linkages and access has to do with the chance for an area to remain noticeable afar away from the environment and also easily accessible. Hence, traffic movement goes freely, structural features around such spaces remain useful and as well harmless the users of such spaces.

Market as a Public Place

Markets play an important part in the commercial existence of a society. As they are necessary in the series of service and goods delivery. Markets support the economic foundation of a settlement and also aid the income tax support of the Indigenous Agency (Balogun 2011)**.**

Particularly in Nigeria It has been confirmed that there is the need to be aware that, numerous markets are inadequately planned or not planned at all. The majority of the markets expanded in a disorganized way in some very close to major roads, which as a result, they pose to impede the free movement of traffic which consistently interrupts the urban functionality and visual features (Adeyinka et al 2016).

The key goal of market place is meeting the satisfaction of human requirements and needs. Evaluation of human requirements and needs, and whatever such place provides for the public are the essential concerns in order to understand the factors that creates an environment suitable to public market users, factors that invites public towards these environment, as well as the reasons which have resulted to lack of activities in some market areas. Hence, it becomes imperative for designers to evaluate and appreciate the user's preferences and need s in the design of market places (Francis 2003).

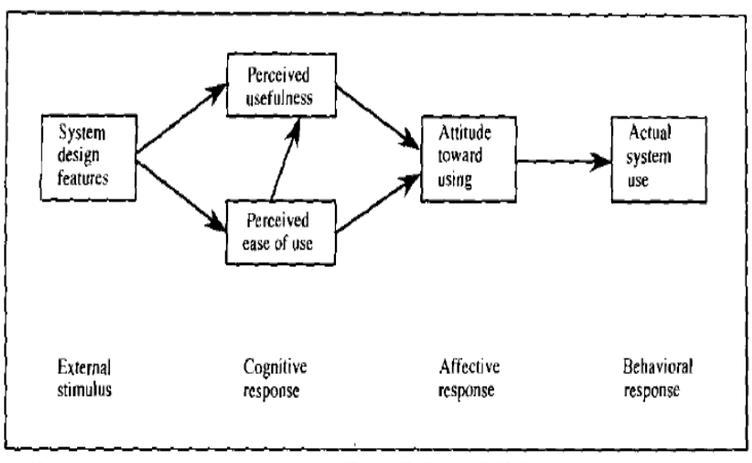


Figure 12: An acceptance model (source: Fred. D Davis 2004).

Also based on user perception of a market survey carried out by market ventures Incorporation most of the market users were asked what they felt were their major problems faced and alternative views on how to improve on these challenges in the market. Several market users disclosed unsatisfied with the inadequate car parks as it remained the main constraints to people who are trying to access the market premises. Certain market users also disclose that arriving early was the only way secure parking space or else no parking space will be vacant for parking. (MVI 2011).

Ziesel (2006), stated that it is difficult to understand how individuals perceive and experience the space except they are questioned. Ziesel (2006) also recommended the obligation of such study not only at a universal level, but also section-specific. Such research must connect to those individuals that are involved and use the space also the structure or area of experience and perception.

Tibbalds (2001) realizes that even though different ideas may be quite modest like the retailer who not only stock his shop, but also assembles his or her commodities on the walkway as they go a long way in personalizing the environment.

Overview of Markets in F.C.T Abuja

1. Dutse Market Abuja

Plate 1: *Used clothes vendors at dutse market*

Plate 2: *Block of shops at Dutse market*

The market is located along Bwari road Abuja, The new market consist of open and closed markets and provision was made for temporary stall owners to display their goods. Most of shops located above the ground floor are vacant due to the perception of shop owners to be able to display their goods and easy accessibility for buyers.

2. Wuse Market Abuja

Plate 3: shop owners displaying their goods outside

Plate 4: walking Aisle in between shops

The Wuse market is located in Central Business District (CBD), the market is a mixture of an open and closed market design, and it also has green areas and emergency exist. The market is also surrounded by access roads and banks for easy access to cash and cash deposit.

3. Wuye Market Abuja

The Wuye ultra-modern market is located at Wuye province in Abuja. Most of the market structure design are more of a closed market system (labelled A) on the site plan of which the vendors and buyers will experience during transactions due to lack of lightening into building and may as well can be stuffy due to heat island effect in the building. The market is equipped with basic amenities such as Admin Block, mosque, church, toilets and police post.

Plate 5: shop owners displaying their goods outside

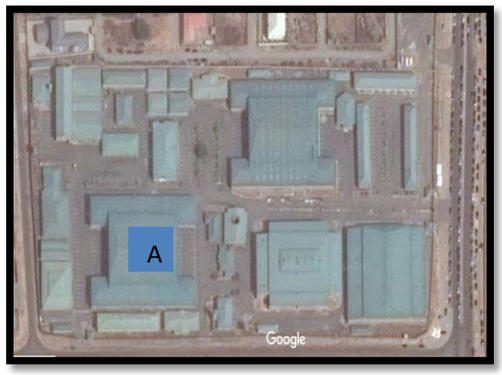


Plate 6: Market Layout (source: Google Earth)

RESEARCH METHODOLOGY

The study is a descriptive survey which is set to obtain qualitative data on the markets as well as its users. A combination of qualitative and quantitative data collection method was used in this study which is considered suitable for a study of this nature. The quantitative part of the data covers the number of quantifiable features of the markets. The sampling method employed in choosing the studied markets in the FCT, Abuja was purposive. An observation checklist was used to measure the study elements in the markets while an interview guide was used to obtain data from the different users of the markets. The physical variables studied in the markets include, width of walking aisle, parking spaces, nature of the buildings and supporting facilities. The physical variables were measured because they play an important in the study and also influence the market users. The data obtained was analyzed using the descriptive tool such as cross-tabulation and charts were developed. Pictures were presented to show the visual aspect of some of the data and explain the existing conditions in some of the markets.

RESULTS AND DISCUSSION

Based on some selected variable such as walking aisle, building type and parking areas were measured and observed, it indicates that users of the markets (vendors and buyers) were provided with basic needs of a market which did not meet the requirements of their needs such as walking aisle where buyers have to compete for space with goods haulers (wheel barrow pushers), high rise shops makes it harder for shop owners to transport goods and display goods, for buyers ground shops are more preferred for easy accessibility and window shopping. Space were not provided for small marketers who cannot afford renting shops and seasonal vendors.

PHYSICAL VARIABLES MEASURED

S/N	MARKETS	WIDTH OF AISLE	OPEN MARKET	CLOSED MARKET	SUFFICIENT PARKING	FIRE HYDRANT	BANK	TOILETS	LIGHTENING	NO OF FLOORS	SOFT LANDSCPE	SPACE FOR TEMPORARY STALLS
1	KURE MARKET MINNA	✓	✓	×	✓	×	×	✓	NOT REQUIRED	1	✓	✓
2	WUSE MARKET A BUJA	×	✓	✓	×	×	✓	✓	✓	1	✓	×
3	DUTSE MARKET ABUJA	×	✓	✓	×	×	✓	×	✓	3	×	✓
4	GARKI 2 MARKET ABUJA	✓	✓	×	✓	✓	✓	✓	NOT REQUIRED	2	✓	×
5	AREA 1 MARKET ABUJA	✓	✓	✓	×	×	✓	✓	×	1	✓	✓
6	WUYE MARKET ABUJA	✓	×	✓	×	×	✓	✓	×	2	✓	×
7	KUBWA MARKET ABUJA	✓	×	✓	✓	×	×	✓	✓	2	×	×

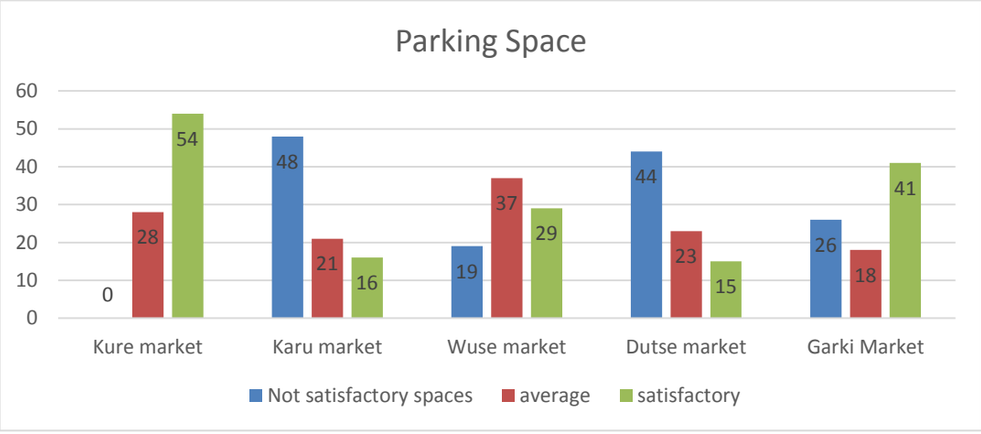
The major issues addressed in the survey include: comfortability during transaction, the type of products they sell, functionality of facilities, space adequacy, and other factors that impact user satisfaction. Statistics were also obtained and analyzed. Analyzing the data gathered, the descriptive analysis techniques using percentages and table presentations, charts and Relative importance index scale were used.

Table 1: Results of Respondent's

	Parking Space			**Width of walking Aisle**		
Facility	Not satisfactory	Average	Satisfactory	Not satisfactory	Average	Satisfactory
Kure Market	0	28	54	13	32	40
Karu Market Abuja	48	21	16	54	16	15
Wuse Market Abuja	19	37	29	38	18	29
Dutse Market Abuja	44	23	15	47	17	21
Garki Market Abuja	26	18	41	34	5	46

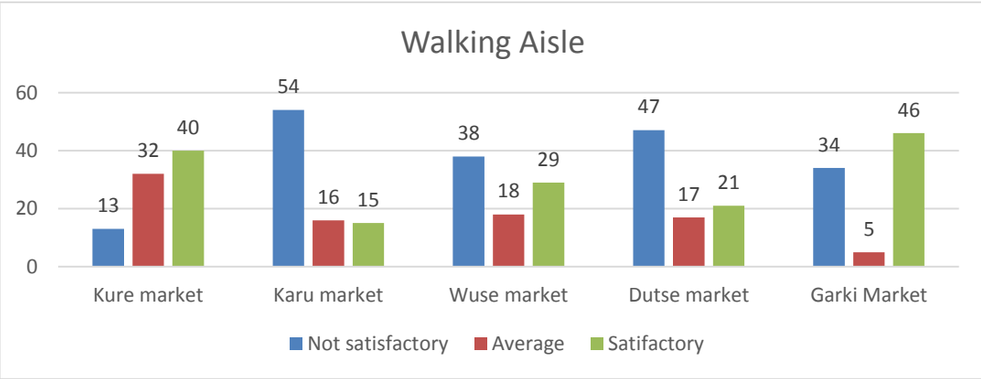
Source: field survey, 2016

Table 1 shows that twenty-eight (28) of the respondents in Kure are averagely satisfied parking space provided which represent 34% of the sampled population, (54) 66% are satisfied. None of the respondents was not satisfied representing (0%). In Karu market Table 1 shows that twenty-one (21) of the respondents in Karu are averagely satisfied parking space provided which represent 25% of the sampled population, (16) 19% are satisfied. Forty-eight (48) of the respondents were not satisfied representing (56%).



Source: field survey, 2016

Table 1 shows that twenty-three (23) of the respondents in Dutse market are averagely satisfied parking space provided which represent 28% of the sampled population, (15) 18% are satisfied. Forty-forty (44) of the respondents were not satisfied representing (54%). Table 1 shows that eighteen (18) of the respondents in Garki market are averagely satisfied parking space provided which represent 21% of the sampled population, (41) 48% are satisfied. Twenty-six (26) of the respondents were not satisfied representing (31%).



Source: field survey, 2016

Table 1 section B shows that thirty-two (32) of the respondents in Kure are averagely satisfied walking aisle provided which represent 38% of the sampled population, (40) 47% are satisfied. While 13 of the respondents were not satisfied representing (15%). Table 1 section B shows that sixteen (16) of the respondents in Karu are averagely satisfied walking aisle provided which represent 19% of the sampled population, (15) 18% are satisfied. While 54 of the respondents were not satisfied representing (63%).

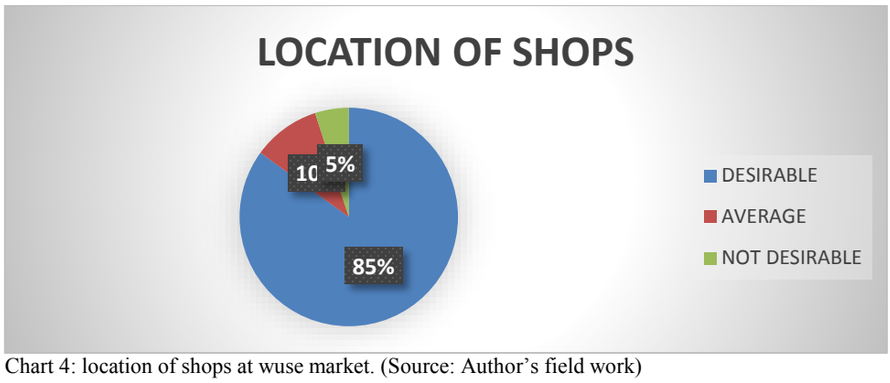


Chart 4: location of shops at wuse market. (Source: Author's field work)

The location of the shops was rated by 52(81%) occupants as satisfactory due to access to major roads while the 22(35%) of the occupants rated it as average due to proximity to the car parks.

CONCLUSION

Considering the central part of the model, it was discovered that users' perceptions are very sensitive to expectations. Most users of public spaces are often left out of planning processes. Public participation in planning processes means, that the opinions, needs and values of users are heard and the users are given a possibility to control their environment while their demands are respected. The planner should approach the project objectively, while the user will always perceive and understand subjectively. These facts were respected in this research and methodology as well as analysis of results.

In order to define the relationship between the size and function of the space and its user's, analysis on the level of complexity of form and function in market design and its influence on the users has to be taken into consideration in predesign stage. Proximity and adequate sizes of market shops, stalls and other supporting facilities are important if they are to offer a better quality of services in the market. Different facilities in the market have to be evenly distributed and interconnected in a system that allows users to freely pass from one zone to another. At the same time, public participation in the early stages of background research is reasonable and will help ensure the creation of quality and useful public markets.

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NEIGHBOURHOOD CRIME VULNERABILITY MAPPING IN ILORIN, NIGERIA

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In the last three decades, the unprecedented pattern of urbanization and high population growth rates in Nigeria have combined to fuel insecurity conditions, particularly increasing criminality within the neighbourhoods of the cities. It is against this background that this study seeks to assess households' crime experiences and their socio-economic, housing and environmental characteristics as they constitute crime exposure factors in Ilorin, Nigeria as basis of crime vulnerability mapping in the area. In carrying out this study a survey of 960 households spread across 35 aggregated neighbourhoods of Ilorin was conducted in October, 2015 to examine common crimes experienced as well as the socioeconomic, housing environmental characteristics of residents using a designed structured questionnaire. The questionnaires were administered through a systematic random sampling approach. A Google-Earth imagery of Ilorin was used as a base map after it was digitized using a polygon and line shape-file to produce a vector format of the map of the city. The neighbourhoods' crime incidences data were partitioned into four crime classes using Jenks' natural break classification technique. The Pearson Product Moment Correlation technique was used to analyze the relationship between crime incidences and the socioeconomic, housing and environmental (SHE) characteristics of the neighbourhoods. The results of the analysis was transferred into the Arc-GIS environment using the corresponding geographic coordinates of the neighbourhoods on the derived imagery of Ilorin to generate the crime vulnerability maps of the city. The study reveals that there is a spatial variation in crime in Ilorin and that there is an inverse relationship between crime exposure and neighbourhoods' socio-economic and housing characteristics. To reduce neighbourhood crime vulnerability in the area the study recommends a number of measures, including improved physical development control and urban renewal programmes.

Keywords: crime, housing, mapping, neighbourhood, socioeconomic, vulnerability

INTRODUCTION

Urbanization has become phenomenal in many parts of the developing world since the early 1980s (Schubel & Levi, 2000), including in Nigeria where current urban growth rate is estimated at about 4.4% (World Bank, 2015). Coupled with an equally high population growth rate, the country is as a result therefore, faced with myriads of social and economic challenges such as increasing hunger, poverty, inequality and unemployment amongst others (Cohen, 2006; UN-Habitat, 2007). These challenges are in turn increasingly responsible for several other social problems confronting the country, including increased drug usage and addiction among youths, prostitution, insecurity and general restiveness (Hove *et al*., 2013). More worrisome is the rising cases of crimes of various dimensions in many urban neighbourhoods across the country. There is a general pervasive feeling of insecurity in the country mostly as a result of fear of being victims of several crimes which are daily perpetrated (Ahmed, 2012; Ayoola *et al*., 2015; Fajemirokun *et al*., 2006).

The Nigeria Police Force which is statutorily responsible for maintaining law and order in the country has been described as inefficient and incapable of confronting the challenge of insecurity (Alemika, 2013; Karimu, 2014).

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As a result, many urban residents and households are increasingly adapting the design and construction of their houses to the threats of insecurity to the extent that many houses are so barricaded that they can be compared to prisons of sorts leading to what Agbola (1997) called the

emergence of "architecture of fear". The high level of insecurity in the country is partly responsible for her being consistently ranked low in the Global Peace Index (GPI, 2014). The country was ranked 151 (out of 162 countries ranked) in the world and 40 out of 44 countries ranked in sub-Saharan Africa

The pervading threats of insecurity in Nigeria are said to have done so much damage to the economy, productivity, cultural and communal values and networks of families, groups and the society (Achumba & Ighomereho, 2013; Igbo, 2015; Muggah, 2012). These threats are also beginning to place enormous burden on urban social fabrics (Agbola, 1997) and are said to be adversely affecting both local and foreign investments drives (Adebayo, 2013). The high level of criminality and increasing threat of insecurity has therefore, prompted the government to adopt several measures aimed at strengthening the security of lives and property. These include the formation of military/police joint patrol teams across the states, installation of close circuit televisions (CCTV) in strategic locations in some state capitals as well as the procurement of sophisticated equipments and gadgets for the various security services (Ibidapo-Obe, 2003; Oyemwinmina & Aibieyi, 2016), many of which are yet to yield noticeable results (Karimu and Osunyikanmi, 2012).

It has also been observed that the increasing expansion and unregulated growth of most of the urban areas in the country, including Ilorin the study area, coupled with poor physical development are not making crime prevention and management less easy. It is against this background that this study seeks to examine the common crimes experienced in Ilorin, assess neighbourhoods' socio-economic, housing and environmental characteristics as crime exposure factors and map neighbourhood vulnerability to crime in Ilorin, the capital city of Kwara State, Nigeria.

The Study Area

The setting of the study is Ilorin the Kwara State capital. Ilorin is regarded as the largest city in north central Nigeria with an estimated 2014 population of about 1, 029, 658. The city is located between latitude 8^0 30" and 08^0 50" North of the Equator and between longitude 04020" and $04^0$35" East of the Greenwich Meridian. As at 2011 the city occupied an area of approximately 150.59 square kilometres (Olaleye, Abiodun & Asonibare, 2012). Ilorin is about 500 kilometres to Abuja, the nation's capital and about 300 kilometres to Lagos, the largest commercial centre in the country. The city is generally regarded as the gateway between the northern and southern parts of the country. Ilorin is a relatively old city and traditionally a Yoruba settlement believed to have been founded in the 17th Century by an itinerant hunter called Ojo (Jimoh, 1994).

Following the creation of Kwara State in 1967 Ilorin was made its capital and has since undergone various development phases initiated mostly by both the federal and Kwara State governments (Zubair, 2008). The city boasts of a considerable number of both large and medium scales industries, in addition to a thriving commercial activities, factors said to have been the attractive impetus for numerous economic opportunities seekers who daily troop into the city. The city is also a centre of both Islamic knowledge and modern education as it boasts of a considerable number of institutions of higher learning, including three universities, a polytechnic and a college of education. Aside a good network of roads, Ilorin enjoys a railway route which passes through it to the far north and the southwestern parts of the country. Therefore, Ilorin, like many other state capitals in the country with numerous economic opportunities has recorded a growing number of crimes which are perpetrated across the numerous neighbourhoods of the city and which have become source of insecurity and concerns to both the residents' and government.

Crime and Its Impacts

Crime is generally seen as an anathema to societal development as it negatively affects people's lives and their property. It is an infraction of the basic principles of law and order and the norms which regulate civilized conducts (Eme, 2012). Crime violates the rules that guide societal conduct as expressed and interpreted by most criminal legal codes created by several social and political authorities (Siegel, 1995; UN-Habitat, 2007). There are many kinds of crime and have been categorized into basically three types. These are crimes against persons or personal crimes, property crimes and crimes against public order. Crimes against persons are those offences which usually involve causing bodily harm or injury or threat of it and sometimes death. These crimes are committed by person to person or between groups of persons. There are numerous types of this crime and they include homicide, manslaughter, armed robbery, kidnapping, assault and rape. Crime against persons can sometimes be committed by someone to him or herself as in the case of suicide. Property crimes are those involving forceful invasion or appropriation of someone else's property. Although these are sometimes considered less serious and violent compared to personal crimes they nonetheless have tremendous negative impacts on the people and quality of life generally. These crimes include theft, burglary or house breaking, arson, car snatching, vandalism and trespass. Crimes against public order are those involving moral infractions (UN-Habitat, 2007). These include fraud, forgery, gambling, conspiracy, perjury and disturbance of public peace.

It is acknowledged that irrespective of types, increasing crime rates is among the most devastating challenges confronting contemporary societies as high rates of crime often results in fear among the

people and sometimes causes trauma and death to victims (Adigun & Adedibu, 2013; Alemika & Chukwuma, 2005; Alemika, 2013). They are sources of serious personal sufferings, huge material loss and damage to individuals and groups and places enormous burden on urban social fabrics (Agbola, 1997). In many instances, effects of crime are believed to spread beyond the immediate victims as families and friends sometimes suffer its impacts too (Jahic & Mitrani, 2010; Marzbali *et al*., 2012). Crime, particularly when considered serious and heinous such as crimes against persons, undermines social coherence as it erodes residents' sense of safety and security (Onoge, 1988). There is also a general consensus that crime impedes societal development (Ayres, 1988; Fajnzylber *et al*., 2002; Glasson & Cozens, 2011; Moser & Holland, 1997). Increasing crime rates and violence worldwide have become source of great concern (Badiora & Fadoyin, 2014) and has the capacity of undermining democracy and rule of law, particularly in the developing countries (Adebayo, 2013).

Crime Mapping and Vulnerability Assessment

As part of global measures of addressing the menace of crime, its mapping and analysis has gained tremendous attention over the years. Boba (2001) described crime mapping and analysis as the study of crime and information related to law enforcement in combination with socio-demographic and spatial factors directed at apprehending criminals, crime prevention (or reduction), reduction of disorderliness and the evaluation of related organizational procedure. While highlighting that the history of mapping can be traced as far back as the 1800s when social theorists started the construction of maps to illustrate theories and research related to crime, Boba (2009) contended the New York City Police Department in the United States of America was the first police outfit to use the process to examine issues related to crime, poverty and demographic characteristics of the city in 1900s. Boba (2009) however, reported that not until the 1960s and 1970s that computer generated maps were produced, a process that was later to witness improved technological process in the 1990s when desktop geographic information system (GIS) became widely available and used by law enforcement agencies and criminologists.

Vulnerability assessment unlike mapping is however, a relatively recent process. The original usage of the term "vulnerability" is rooted in geography and natural hazard research to mean the degree to which a system is likely to experience harm due to exposure to some form of hazards (Cannon, 2000). It is generally conceptualized as a measure of the degree and type of exposure to risk which are generated by communities in relation to identifiable hazards. The term is used in contemporary research in connection to the characteristics of individuals and groups in relation to their natural, social or economic settings and by which they can be grouped into different classes (Cannon, 2000). According to Eakin & Luers (2006) the usage of the term "vulnerability" has been broadened in recent times and as therefore, become relative and contextual. As a result, the term is now increasingly adapted in many fields to describe varying conditions of susceptibility, particularly of environmental, social, economic and political circumstances of communities which expose them to a range of potential harmful conditions (Bohle *et al.*1994; Graz, 1997).

In this paper therefore, the term crime vulnerability is used to mean the aggregate level of exposure or susceptibility of households and neighbourhoods to varying criminal circumstances or attacks as a result of their peculiar social, economic and environmental circumstances or characteristics. It is thus, this vulnerability to crime in Ilorin neighbourhoods that this paper seeks to map given current exposure to crime.

RESEARCH METHODOLOGY

This study made use of both primary and secondary data. The primary data used in this study were obtained through the administration of a designed crime victimization survey questionnaire. These include the most common crimes experienced across the neighbourhoods as well as information related to households' socioeconomic, housing and environmental characteristics. The questionnaires were administered on 960 households selected through a systematic random sampling technique across the 35 aggregated neighbourhoods of the study area. Secondary data obtained include official crime records of Ilorin between 2005 and 2014 obtained from the Kwara State Command of the Nigeria Police, Ilorin. A Google-Earth imagery of Ilorin was also downloaded and used to generate the base map employing in mapping. This is in addition to the current map of the study area obtained from the Kwara State Bureau of Lands and Survey, Ilorin.

In analyzing the data obtained for this study both descriptive and inferential statistical methods were employed. The statistical product and service solution (SPSS) was used in generating the frequency counts and cross tabulations of the various data related to crime victimization and experiences as well as those related to households' socio-economic, housing and environmental characteristics. The Pearson Product-Moment Correlation (PPMC) technique was used to analyze the relationship between the socio-economic, housing and environmental (SHE) characteristics of the sampled households and crime occurrence. For the purpose of classifying the sampled neighbourhoods based on the density of crime incidences experienced by households the Jenks' natural breaks classification methods was employed. This method developed by George Jenks in 1967 is a GIS based method often employed in mapping. The method partitions data into as many classes as desired based on the

natural groupings in the data set distribution. It is particularly acknowledged as good at representing the spatial characteristics of values as it maximizes the variance between classes while also minimizing the variance within classes.

For the purpose of mapping the crime density and vulnerability of the study area, a downloaded Google-Earth imagery of Ilorin was used to provide requisite base map after the imagery has been geo-referenced. The geo-referenced image was then digitized on the Arc-GIS environment using polygon and line shape-file. The polygon shape-file was used to demarcate the neighbourhoods within the metropolis, while the line shape-file was used to digitize the major road network within Ilorin metropolis. Hence, a street guide map of Ilorin metropolis was produced in vector format.

To generate the crime density and vulnerability maps of the study area the evolved socio-economic, housing and environmental (SHE) scores based on the Jenks' natural breaks classification methodology were transferred into the Arc-GIS environment using the corresponding geographic coordinates of the locations of sampled neighbourhoods earlier picked in the course of questionnaire administration. .

RESULTS AND DISCUSSION

Common Crimes Experienced in Ilorin

In identifying the common crimes experienced by residents of the study area, the study examined both residents' perceptions and the Police official crime records of the area between 2005 and 2014. The common crimes identified by residents of Ilorin are shown in Table 1. The table shows that 72.59% of residents of Ilorin perceived petty theft/stealing as the most common crime experienced, closely followed by housebreaking (61.73%) and assault (46.38%). Other common crimes experienced in the study area are armed robbery (29.39%), rape/indecent assault (19.63%), automobile theft (19.19%), kidnapping (6.14%) and assassination (0.77%).

Table 1: Common Crimes Experienced in Ilorin

Crime Type	Frequency	Percentage (%)
Petty theft/stealing	662	72.59
House/shop breaking	563	61.73
Assault	423	46.38
Armed robbery	268	29.39
Rape/indecent assault	179	19.63
Automobile theft	175	19.19
Murder	56	6.14
	7	0.77

Source: Author's analysis

In spite of several limitations associated with police official crime records this study obtained records of common crimes from the Kwara State Command of the Nigeria Police. These limitations, particularly in the developing countries have been highlighted by several studies (Soares, 2004; Alemika, 2013; Olatunbosun, 1998; Gyong, 2010) and include low reporting rate of crime and other social and cultural inhibitions such as culture of settlements between parties to crimes. However, similar to what was obtained during the survey, the police official crime records of Ilorin highlighted in Table 2 shows that the most common crimes in Ilorin are stealing, house breaking, assault, murder and arson/mischief. Others are armed robbery, rape/indecent assault and kidnapping. Despite these limitations however, both the police records and empirical survey indicate that the most common crimes experienced in the various neighbourhoods of Ilorin include petty theft, house breaking, assault, armed robbery and murder.

Table 2: Police Profile of Common Crimes in Ilorin

Crime	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Stealing	321	461	532	689	548	710	173	381	278	231
House-breaking	109	209	321	271	301	321	331	309	296	319
Assault	94	124	249	315	416	237	321	410	396	413
Murder	92	75	42	34	41	32	27	31	41	43
Arson/mischief	21	17	121	13	210	181	138	109	98	117
Armed robbery	31	24	39	24	17	26	25	30	24	16
Rape/indecent assault	14	14	22	14	12	15	18	15	12	9
Kidnapping	7	9	NA	6	13	8	3	4	3	6

Source: Extracted from Records of Kwara State Police Command, Ilorin (2015)

Spatial Distribution of Crimes in Ilorin

For ease of analysis and neighbourhood comparison, the total sum of crime incidences experienced by households in each neighbourhood of the study area were summed up. The Jenks' natural breaks classification method was thereafter employed in partitioning the neighbourhoods into four crime densities of low, moderate, high and very high based on the sums of crimes recorded across the neighbourhoods. This distribution is highlighted in Table 3.

Based on the classification method employed, 7 neighbourhoods with a total of less than 35 crime incidences, irrespective of types, were classified as low crime neighbourhoods, while another 10 that experienced a total of between 47 and 68 crime incidences were classified as moderate crime areas. Sixteen neighbourhoods with total crime incidences of between 75 and 93 were classified as high crime areas, while 2 neighbourhoods were particularly classified as very high crime areas because they recorded total sums of crime incidences of 115 and 117 respectively.

When the various neighbourhood sums of crime experienced shown in Table 3 was subjected to analysis of variance (ANOVA) the result revealed a statistically significant variation in crime rate among the neighbourhoods. The ANOVA result of F = 160.676 with a level of significance P = 0.001 shown in Table 4 implies that there is a statistically significant variation in the incidence of crime among the neighbourhoods of Ilorin. Figure 1shows the map of Ilorin showing the four crime density classifications.

Table 3: Classification of Distribution of Crime Incidences

Classification	Neighbourhood	Frequency	Percentage (%)
Low Crime	Adewole Estate	32	1.37
	Federal Housing Estate	15	0.64
	GRA	11	0.47
	Irewolede Estate	35	1.50
	Olorunshogo Estate	26	1.11
	Airport Area	15	0.64
	Alagba Estate	31	1.33
	7	**165**	**7.07**
Moderate Crime	Fate	62	2.66
	New Yidi Road	47	2.01
	Okelele	64	2.74
	Oloje	52	2.23
	Olorunshogo	68	2.91
	Sabo Oke	52	2.23
	Saw-Mill	58	2.49
	Surulere	60	2.57
	Balogun Gambari	67	2.87
	River Basin Estate	65	2.79
	10	**595**	**25.50**
High Crime	Asa Dam Road	89	3.81
	Amilegbe	93	3.99
	Post Office Area	89	3.81
	Unity Road	77	3.30
	Tanke	86	3.69
	Sango	84	3.60
	Pakata	78	3.34
	Okesuna	79	3.39
	Oja Oba	91	3.90
	Oja Gboro	87	3.73
	Offa Garage	80	3.43
	Agbabiaka	87	3.73
	Maraba	87	3.73
	Idi-Ape	80	3.43
	Gaa Imam	79	3.39
	Gaa Akanbi	75	3.21
	16	**1341**	**57.48**
Very High Crime	Agbo Oba	115	4.93
	Taiwo Road	117	5.02
	2	**232**	**9.95**
Total	**35**	**2333**	**100.0**

Source: Author's Analysis, 2017

Table 4: Analysis of Variation in Criminality among Neighbourhoods of Ilorin

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	23085.234	3	7695.078	160.676	.000
Within Groups	1484.652	31	47.892		
Total	24569.886	34			

Source: Author's Analysis, 2017

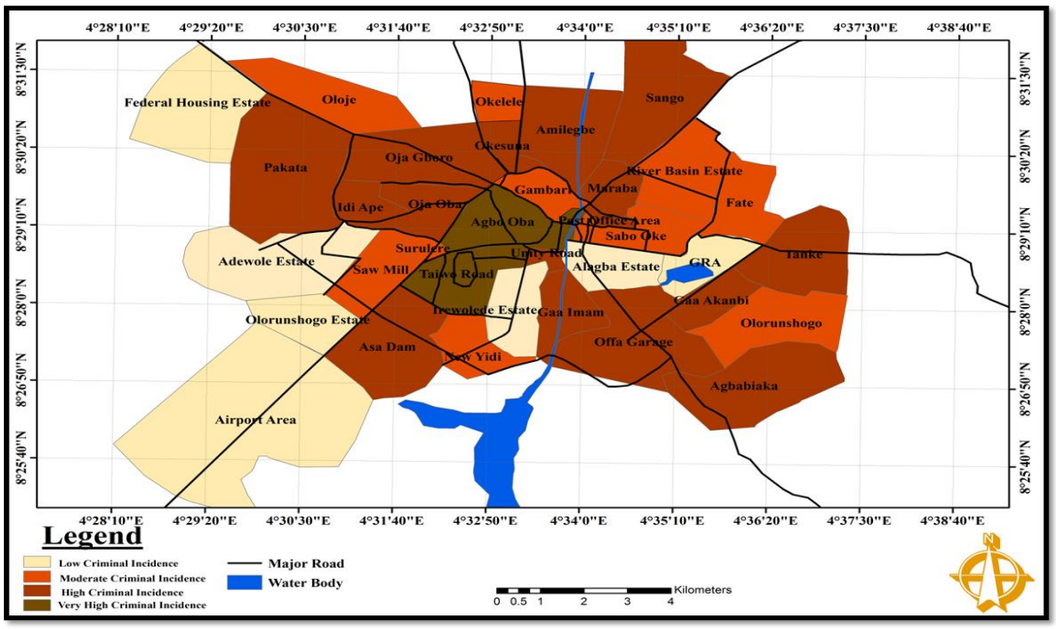

Figure 1: Crime Density Classification Map of Ilorin, Nigeria
Source: Author's analysis, 2017

Socioeconomic, Housing and Environmental Characteristics

The socioeconomic, housing and environmental characteristics of neighbourhoods of Ilorin as well as their relationship with crime exposure had earlier been established by Sanni *et al.* (2107). This study is therefore, adopting this characterization as well as its relationship with crime exposure as the basis of the crime vulnerability mapping. Tables 5 and 6 show the socioeconomic and housing characterizations of the study area. As shown in Table 5 residents of the study area within the age group 26 – 35 years old constituted 30.5%, closely followed by those within the age group 36 – 45 years old which constituted 29.7%, while those within the age groups 46 – 55 years and above 55 years constituted 22.7% and 10% respectively. Regarding the education characteristics of the residents, the distribution shows that those possessing either National Diploma (ND) or National Certificate of Education (NCE) constituted the highest residents with 34.9%, followed by those possessing either a Higher National Diploma (HND) or a university degree with 26.6%. Residents without any formal education and primary school leaving certificates constituted 3.2% and 6.0% respectively. However, when both the age and educational structures of the residents were viewed along neighbourhoods' distribution, a spatial variation was noticeable. For instance, majority of the neighbourhoods had significant proportions of residents that possessed ND/NCE and above, with a higher concentration in such neighbourhoods as Adewole Estate (81.48%), Olorunshogo Estate (78.26%), Federal Housing Estate (71.43%), Alagba Estate (84.62%), River Basin Estate (82.14%), GRA (87.5%), Irewolede Estate (82.61%) and Fate (80.95%).

As shown in Table 5, the patterns of occupation and income of residents of the study area were not quite different from those of age and educational qualification, although it is revealed that the highest proportion of occupation was public/civil servants which constituted 29.2%, followed by those engaged in trading activities, business owners and artisans at 19.4%, 18.6% and 10.4% respectively. Those engaged in farming constituted 7.2%, while 9.8% were unemployed as at the time of the survey. However, when the pattern of income level in the study areas was viewed along neighbourhoods, there is also a discernible spatial variation. For instance, while in many of the neighbourhoods more than half of the residents earned less than ₦ 41, 000 monthly, it was only in 11 of the neighbourhoods that 50% and above earned ₦ 61, 000 and above.

Table 5: Socio-economic Characteristics

Age	(%)	Education	(%)	Occupation	(%)	Monthly Income	(%)
18 – 25	7.1	None	3.2	Unemployed	9.8	<₦20, 000	16.7
26 – 35	30.5	Primary	6.0	Civil servants	29.2	₦ 20,000- ₦40,000	30.9
36 – 45	29.7	Secondary	23.9	Farming	7.2	₦41,000- ₦60,000	20.5
46 – 55	22.7	ND/NCE	34.9	Trading	19.4	₦61,000-₦80,000	19.4
Above 55	10.0	HND/B. Sc.	26.6	Artisan	10.4	₦81,000-₦100,000	7.3
		Postgraduate	5.4	Business owners	18.6	₦101, 000-₦120,000	3.8
				Retired	4.2	₦121,000-₦150,000	0.9
				Others	1.2	>₦150,000	0.4
Total	**100.0**	**Total**	**100.0**	**Total**	**100.0**	**Total**	**99.9**

Source: Sanni *et al*., 2017

Table 6 shows the various housing characteristics of the study area. The Table shows that the most common types of housing structures in the study area generally were blocks of flats (semi-detached) (29.5%), compound structures 20.9% and rooming houses 15.7%. However, there were a considerable numbers of bungalows (8.4%) too. The cross tabulation of housing types occupied by neighbourhoods also show a pattern of variation similar to socio-economic characteristics as some

neighbourhoods had preponderance of some types of structures than others. For instance, there were 6 neighbourhoods with a proportion of between 40% and 60% of bungalow houses and these are GRA (40.63%), New Yidi Road (40.91%), Alagba Estate (46.15%), Adewole Estate (51.85%), Irewolede Estate (60.87%) and Airport Area (60.87%). Similarly, neighbourhoods with a proportion of between 40% and 60% of compound housing include Idi Ape (56.67%), Agbo Oba (40.63%), Balogun Gambari (42.31%), Maraba (43.33%) and Agbabiaka (43.48%).

Table 6 also shows the number of rooms occupied by households in the study area. It shows that 10.2% of sampled households' occupied single rooms, another 31.9% lived in 2 rooms, while 36.2% occupied 3 rooms. Households that made use of 4 rooms constituted 18.3%, while 3.4% lived in more than 4 rooms. The number of households living in buildings is also shown in the same table. The Table shows that households occupying buildings alone accounted for 23.4%, while those residing in structures housing between 2 to 3 households accounted for 29.9%. Another 18.9% of sampled households' occupied structures housing between 4 and 5 households, while those in dwellings housing between 6 and 8 households accounted for 27.6%. The patterns of room occupancy and number of households residing in buildings are similar to most of the socio-economic characteristics considered as the numbers of rooms occupied by households and the number of households residing in buildings also varied across the neighbourhoods.

Table 6: Housing Characteristics

Housing Type	(%)	No of Rooms Occupied	(%)	No. of Households in Building	(%)
Compound	20.94	1	10.2	1	23.4
Bungalow	8.44	2	31.9	2 – 3	29.9
Semi-detached	29.50	3	36.2	4 – 5	18.9
Detached	8.66	4	18.3	6 – 8	27.6
Rooming house	15.67	> 4	3.4	> 8	0.22
Duplex	1.21				
Others	15.58				
Total	**100.0**	**Total**	**100.0**	**Total**	**100.0**

Source: Sanni *et al*., 2017

To establish the relationship between crime incidences and the socioeconomic, housing and environmental (SHE) characteristics of the neighbourhoods sampled households' SHE factors in the various neighbourhoods were weighted independently in ascending order of magnitude such that the highest value was attached to the best condition in any of the three variables of SHE and vice versa Thereafter, the generated SHE scores for the neighbourhoods were correlated with the sums of crime incidences using Pearson Product Moment Correlation technique. As shown in Table 7 the correlation analysis established that the three factors of socio-economic, housing and environmental (SHE) conditions produced a combined r value of -.810, wherein P-value = 0.000. This implies that together they correlate strongly with crime occurrence in the study area. Individually, however, the socio-economic, housing and environmental characteristics recorded r values of - 0.621, - 0.779, and - 0.574 respectively with P values of 0.000. This implies that there is a strong negative correlation of these factors with criminality pattern recorded in the study area. The negative sign implies that as the socio-economic characteristics, housing or environmental conditions improves, there is a corresponding decrease in crime recorded in the study area and vice versa. Individually however, housing characteristics factor has the strongest negative correlation with criminality pattern, followed by socio-economic and environmental condition.

Table 7: Correlation of SHE Characteristics and Exposure to Crime

Variables	Sum of Crimes	SHE	Socioeconomic	Housing	Environmental
Sum of Crimes	1	-.810	- . 621	- .779	- . 574
SHE Score	-.810	1	.785	.906	.779
Socioeconomic	- . 621	.785	1	.666	.543
Housing	- .779	.906	.666	1	.616
Environmental	- . 574	.779	.543	.616	1
No. of Observation	35	35	35	35	35

**Correlation is significant at the 0.01 level (2 –tailed)

Source: Author's Analysis, 2016

Crime Vulnerability Mapping of Ilorin

Since the correlation analysis of crime and SHE revealed that of the three factors housing and socioeconomic characteristics have stronger negative correlations of -0.779 and -0.621 respectively, it is thus rational to adopt these factors as the basis of crime vulnerability mapping in the study area. What the results of the analysis implies is that neighbourhoods with better housing conditions and relatively higher socioeconomic characteristics are less vulnerable to crime than those with relatively deplorable housing conditions and with lower socioeconomic variables. Therefore, in adopting the results of the analysis the generated SHE data for the 912 households who responded to the questionnaires were transferred into the Arc-GIS environment using each household's geographical coordinates earlier picked with the aid of GPS during the questionnaire administration to generate a heat map showing the varying pattern of vulnerability for each of the two factors. Thus, the crime vulnerability mapping of the study area based on the housing conditions and socioeconomic characteristics of the neighbourhoods are shown in Figures 2 and 3 respectively.

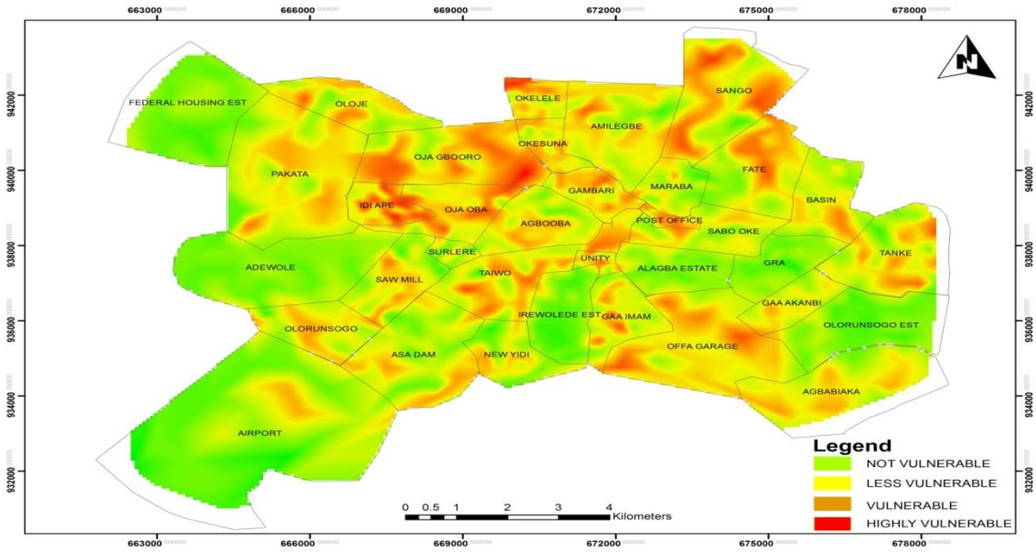

Figure 2: Neighbourhood crime vulnerability based on housing conditions
Source: Author's Analysis, 2017

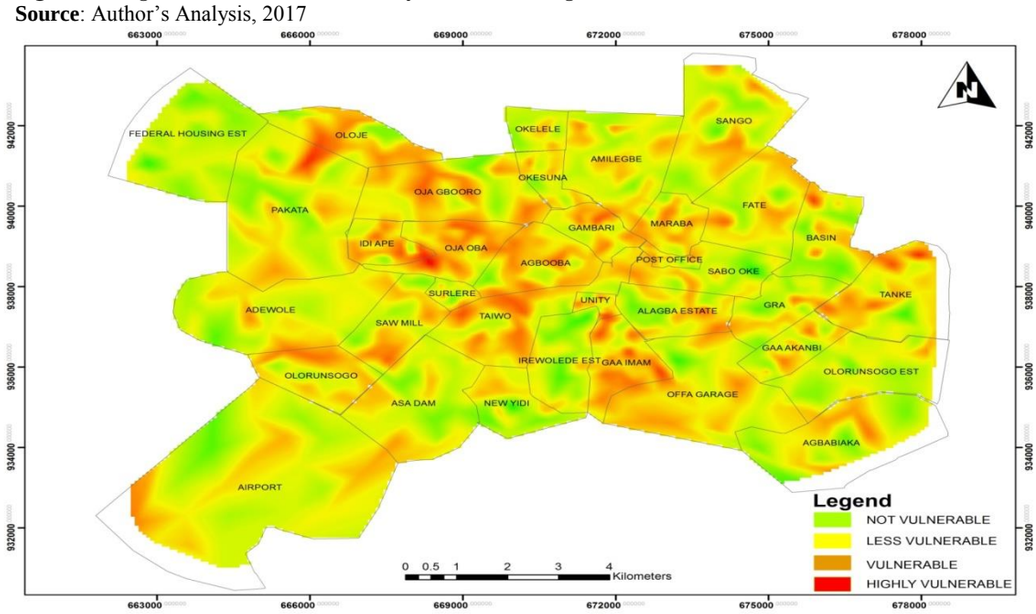

Figure 3: Neighbourhood crime vulnerability based on socioeconomic conditions
Source: Author's Analysis, 2017

Figures 2 and 3 which are generated heat maps of Ilorin show the pattern of crime vulnerability in the study area based on the two factors of housing and socioeconomic characteristics respectively. Although the maps show that vulnerability to crime cut across the neighbourhoods in the study area, this is however, in varying degrees when viewed along the two factors. For instance as discernible in Figure 2, while sections of some neighbourhoods such as Idi Ape, Oja Oba, Okesuna and Okelele with considerable patches of red colour were considered as very vulnerable to crime, others such as Olorunshogo, Asa Dam Road, New Yidi Road, Tanke and Gaa Imam with faint patches of brown colour were seen as less vulnerable. Yet, some other neighbourhoods such as GRA, Federal Housing Estate, Airport Area, Olorunshogo Estate, Irewolede Estate and Alagba Estate with considerable patches of green colour were considered not vulnerable to crime based on the conditions of housing in the neighbourhoods.

A similar pattern of crime vulnerability is discernible when the socioeconomic characteristics of the neighbourhoods are considered. For instance, neighbourhoods with relatively affluent households such as GRA, Adewole Estate, Federal Housing Estate and Olorunshogo Estate with considerable patches of green colour in Figure 3 were considered not vulnerable to crime, while others with faint patches of brown colour such as Airport Area, New Yidi Road, Asa Dam Road, Fate, Sabo Oke and Alagba Estate were regarded as less vulnerable. Neighbourhoods considered as very vulnerable to crime based on the relatively lower socioeconomic characteristics of the households are depicted with considerable patches of red in Figure 3 and include Oja Gboro, Oloje, Idi Ape, Agbo Oba and Gambari.

When the influence of the three factors of socioeconomic, housing and environmental characteristics combined were used as factors of crime vulnerability, the resultant pattern of vulnerability is mapped in Figure 4. The Figure shows that substantial parts of the neighbourhoods of the study area were very vulnerable to crime based on the combined effects of the three factors. These neighbourhoods with considerable patches of red colour in the map include Idi Ape, Oloje, Oja Gboro, Oja Oba, Sawmill, Agbo Oba and Gambari. Others in this category are Sango, Agbabiaka and Offa Garage.

Conversely, neighbourhoods depicted with considerable patches of green colour such as Federal Housing Estate, Airport Area, GRA, Irewolede Estate and Olorunshogo Estate were regarded as not vulnerable to crime.

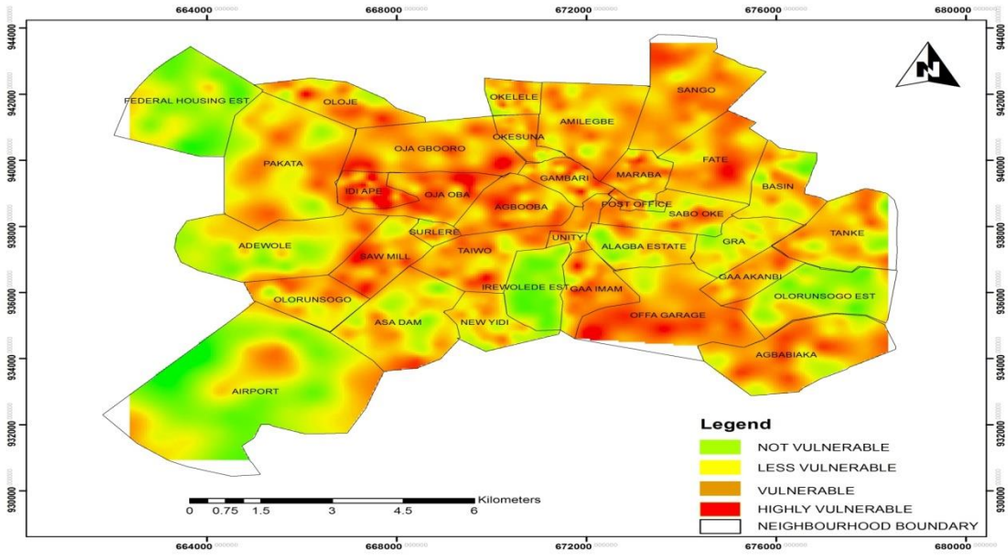

Figure 4: Crime vulnerability map of Ilorin based on socioeconomic, housing and environmental characteristics of neighbourhoods **Source**: Author's Analysis, 2017

CONCLUSION

The study as mapped the neighbourhoods' vulnerability to crime in Ilorin, Kwara State, Nigeria based on the socioeconomic, housing and environmental characteristics of households. The study therefore, concludes that there is an inverse relationship between crime incidences and the socioeconomic, housing and environmental (SHE) characteristics of the neighbourhoods of Ilorin. What this implies is that neighbourhoods with relatively good housing conditions and relatively high socioeconomic characteristics are less vulnerable to crime, while those with relatively deplorable conditions housing conditions and lower socioeconomic status are more vulnerable to crime.

RECOMMENDATIONS

Based on the outcomes of this study, particularly regarding the inverse relationship between crime exposures and housing conditions, it is recommended that urban renewal programmes be urgently instituted in the study area. This is especially required in the old, core and poorly developed neighbourhoods such as Oja Oba, Idi Ape, Oja Gboro and Gambari so as to improve the housing and environmental conditions of the area and lessen vulnerability to crime..

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URBAN DEVELOPMENT CONTROL AS A VIABLE MEASURE FOR ACHIEVING SUSTAINABLE DEVELOPMENT GOALS

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Developing countries are faced with rapid urbanization activities to foster economic growth but with significant effect on the global environment. As cities continue to expand, there is need to plan and effectively manage the growth such that human relationship with the built environment will not continue to degrade the environment. Common urban challenges include congestion, inadequate housing and deteriorating infrastructure. A peculiar and persistent challenge facing most Nigerian cities is the unsustainable urban development practices. This paper seeks to examine the relationship between urban development control measures and habitation as enshrined in the United Nations Sustainable Development Goals (SDGs). The study employed a quantitative research approach and a questionnaire survey data using purposive sample technique to select 167 experts working with Ministries, Department and Agencies of Niger State government that are involved with development control. Data was analyzed using SEM (AMOS) to test the main hypothesis. Findings revealed that development control measures have a significant influencing relationship with habitation at a level of 38%. It recommends that for effective and functional development control, the community needs to be carried along during policy formulation and implementation and by educating and enlightening the people towards adopting development control measures that would positively influence the environmental behavior of Nigerians in general and particularly inhabitants of urban areas in Niger state in particular.

Keywords: Habitation, structural equation modeling, sustainable development goals, urban development control

INTRODUCTION

Cities are centres for innovation and economic development, land resource aid development, many challenges exist and need to be surmounted without destroying land resources in course of ascending the fulcrum of development for the use of present and future generation. Urban centres in Nigeria have gone through great structural changes in their physical structure, economic, social and population constituent because of urban growth, and which have resulted to changes in urban land use structure (Saleh, Badr, El Banna, & Shahata (2014). Land as a scarce resource needs to be properly utilize, necessitates call for proper administrative system in line with town planning regulations (Lam and Man, 2013). Boamah (2014) posited that the harmonious coexistence of various degrees of land use in urban centres are monitored by planning policies and regulation.

Urban centres in Niger State serve as the administrative capital of local government areas as well as the centres of commerce and trade, resulting to rapid growth in population by extension increase in demand for accommodation. Increase in the demand structure for accommodation as lead to the proliferation of squalor settlement in the periphery and inner core of urban areas because property development have not been in line with laid down town planning development regulation as regard residential accommodation.

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Akinbabijo, (2012) attributed poor development control measures to insufficient funding, administrative bottlenecks and inadequate man power. Sustainable habitation is devoted to making cities and human settlements inclusive, safe, resilient and sustainable. Non-compliance by property developers are the genesis of poor habitation (Ndabula *et al*, 2013). In light of the above it became imperative to carry out a study on the influence of urban development control measures on habitation (Goal 11 of SDGs). The study establishes a link between urban development control measures specifically in urban centres of Niger state and the major problems of habitation which the SDGs seek to address.

LITERATURE REVIEW

Sustainability has been in the mainstream media lately. Relating the slogan to urban land use context connotes the use of guidelines within the confines of town planning regulation for inclusiveness use of land in perpetuity (Hilber & Nicoud, 2013). Urban challenges include congestion, lack of funds to provide basic services, shortage of adequate housing and declining infrastructure among others. These ills are mainly addressed with the aid of holistic urban planning. Development control measures expedite the realisation of sustainable urban neighbourhoods.

Boamah *et al*. (2012) believes that development control aid in improving urban areas and contributes to improving dwelling environment. It eradicates undesirable externalities and equate rapid population with infrastructural facilities; enhance use of land resources; increase neighbourhood structures and equality of right to use urban resources (Micheal & Palmquist, 2009), balances the performance of housing provision scheme and the entire urban economy (Mohammad *et al*, 2009).

The ability of development control to achieve its desired objectives is largely a function of the official system put in place to manage urban development; developers confidence in the development control scheme; and participation of the public in the planning system. Boamah *et al* (2012) argued that squalor development of habitation is in part a sign of manifestation of futile and inadequate development control processes.

Monkkanen and Ronconi, (2013) believed that stringent development controls stifle housing supply, while high building codes and other constraints in supply elasticity impose by the development control standard guidelines make dwelling within such neighbourhood on command a high price.

Though an enlightened population with a robust economy are key correlates to sustainable habitation, the political climate to a large extent determines the pattern of implementation of development control in cities around the world (Wilson & Song, 2011).

METHODOLOGY

Data and Method: Survey research design of quantitative research was adopted in order to achieve the objectives of the study. Creswell (2003) posited that when the problem involves factors influencing an outcome and hypothesis testing, it is the best research design to use.

Sample: The researchers used closed ended and partially ended structured questions, the administration of questionnaire was achieved by face to face handing out to 5 agency of government in charge of development control these include Niger state ministry of lands and housing(NSML&H), Niger state urban development board(NUDB), Niger state housing cooperation(NSHC), and departments of works and housing in selected local government areas of Minna, Suleja, Bida, Kontagora and New Bussa urban areas.

Table 1: Questionnaire retrieved

MDA's	**NSML&H**	**NSUDB**	**NSHC**	**LGDWH**
Minna	40	13	13	15
Suleja	5	6	-	14
Bida	6	7	-	9
Kontagora	5	7	-	7
New Bussa	6	8	-	6
Total	**167**			

Source: Author's field survey (2017).

The questionnaires were designed using five (5) point likert scale rank that is, strongly disagree-1, disagree-2, moderate-3, agree-4 and strongly agree-5. In survey research it is the most globally used scale, allowing for proportionality, objectivity of questions and less problematic for respondent in terms of finding variation between the scale (Allen & Seaman, 2007; Johns, 2010). The researchers employed purposive random sampling technique because of the unique homogenous characteristic of the population (Awang, 2012) to select 200 personnel from the planning agency within the five (5) designated urban centre, chi square test of fit and parameter estimate are sensitive to sample size, number of construct employed and population characteristics in a given model Hair *et al.*, (2010).

Instrument for this study was develop through extensive literature review, pilot testing was used to improve the question and scale, in order to establish the content validity of score on the instrument, the questionnaire were design to elicit information on development control measures and how it influence habitation(SDG 11 of united nation charter).

Questionnaire were administered (table 1) through face-to-face hand out to allied professional working in the MDA's of government under development control in the urban centres, out of the 225 structured questionnaires administered, only 167 were retrieved representing 74.2% of the administered questionnaire.

Empirical evaluation

The data on demography in table 2 indicate that majority (85.03%) of the respondent are male and (14.97%) female. Most (56.89%) of staff have Ordinary national diploma as their highest qualification, majority (49.10%) of the staff have less than 10 years serving the government. The Ministry's, departments and Agencies in charge of development control have shortfall of junior staffs (38.92%), senior staffs (61.08%). 74.85% of the staffs are aware of sustainable development goals, 68.86% are aware of habitation as target to be achieved by various government across the globe by 2030.

Table 2: Descriptive statistic.

demographic	Frequency	Percentage (100%)
Gender		
Male	25	14.97%
Female	142	85.03%
Educational level		
OND	95	56.89%
HND	31	18.56%
Bsc/Btech/PGD	30	17.96%
PG	11	6.59%
Category of organization		
State	116	69.46%
Local government	51	30.54%
Time in service		
Less than 10yrs	82	49.10%
11-20 yrs	42	25.15 %
21-30 yrs	40	23.95%
Over 30 yrs	3	1.80%
Designation		
Junior	65	38.92%
Senior	102	61.08%
Aware of SDG's		
Yes	125	74.85%
No	42	25.15%
Familiar with SDG no. 11		
Yes	115	68.86%
No	52	31.14%

Hypothesis: in order to achieve the set objective the hypothesis formulated is

H_1: Development control measures has significant influence on Habitation.

Analysis and result:

The data collected was coded and processed using SPSS version 23. The SPSS software was used to screen the data for singularity, outliers and normality.

To examine the relationship between the variables used in this study, Structural Equation Modelling (SEM), one of the most advanced second generation statistical tool (Hair *et al,*

2010) was used. Analysis of Moment Structure (AMOS) software (version 23) was employed to run the analysis, it is the newest software version developed for data analysis using SEM (Awang,2012).

The AMOS graphic provide the platform to model and analyse the influence between development control measures and Habitation. Confirmatory Factor Analysis (CFA) was also established for the latent construct in the study.

CFA is used to establish construct validity and unidimensionality is achieved when the recommended fitness index of the measurement model meet the acceptable benchmark. The model fitness are in three (3) categories, Absolute fit (RMSEA<0.08; GFI>0.90), Incremental fit (CFI>0.90; TLI>0.90; NFI>0.90) and parsimonious fit (Chisq/df <5.0).

The results for the test of convergent validity, the test for reliability; Cronbach's alpha coefficient (>0.70), value of composite reliability (CR≥0.60) and also Average Variance Extract (AVE≥0.50) are tabulated below for the construct as shown in table 3.

Table 3: fitness index of the construct after CFA

Construct	X^2/df	CFI	TLI	NFI	GFI	RMSEA
Dev. Control measures	1.400	.948	.940	.793	.877	.050
Habitation	3.01	.928	.855	.919	.908	.207

Table 4: result of reliability and convergent validity

Construct	Cronbach's alpha	CR	AVE
Dev. Control measure	.877	.884	.71
Habitation	.895	.896	.89

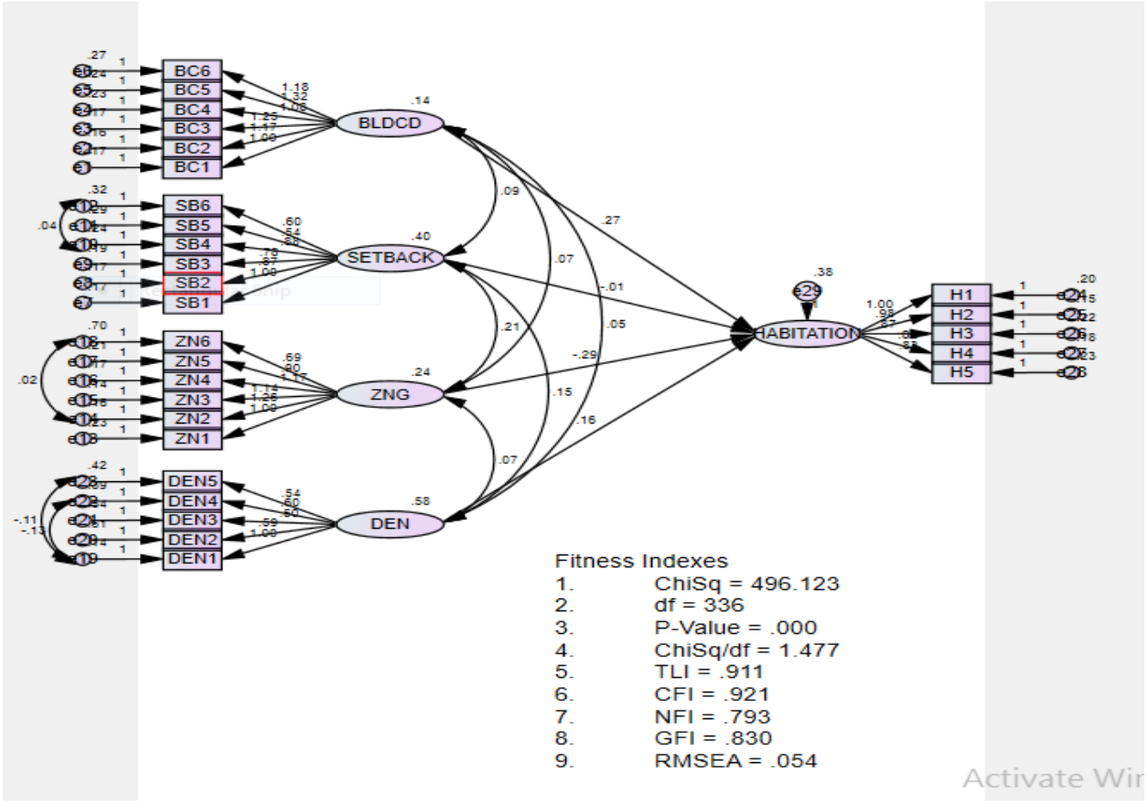

Figure 1 structured model with standardized estimates

Table 5: fitness index for the structural model

Categories	Index name	Index value	Comment
Absolute fit	RESEA	.058	Required level achieved
Absolute fit	GFI	.830	Required level not achieved but tolerable
Incremental fit	CFI	.921	Required level achieved
Incremental fit	TLI	.911	Required level achieved
Incremental fit	NFI	.793	Required level not achieved but tolerable
Parsimonious fit	X^2/df	1.477	Required level achieved

For every category of model fit at least one fitness index is required Hair *et al* (2010), as shown table 3 and 4 the accepted fitness index have been considerably met as well as the reliability convergent validity have turned out to be mostly achieved. Figure 1 shows the structural model for the study, construct validity for the model have been achieved since the requisite condition for all the categories of fitness index have been met as indicated in table 4. Threshold for the factor loading of items was adapted from the opinion of Awang (2012) that the newly developed item should have a threshold of 0.50 or more by this means achieving unidimensionality of the data.

The structural model clearly shows the R^2 value at 38%, that is, efficiency of Habitation could be estimated at 38% level by development control measures construct. In other words, development control has a very strong effect on sustainable habitation. Adams and Lawrence (2015) gave a lucid interpretation of R^2 value effect size range (%) in a model (1-4% as weak, 9-25% as moderate and 25-64% as strong).

Table 6: Regression weight and significance value

Construct	Construct	Estimate	SE	CE	P Value	Result
Development control measures	Habitation	0.991	0.99	1.001	***	supported

Table 7: Result of Hypothesis testing

Hypothesis statement of path analysis	Estimate	P-value	Hypothesis result
H_1: Dev control has significant influence on habitation	0.991	***	Supported

***P<0.01(given by AMOS indicate highly significant value)

Table 6: shows the regression weight indicting the beta value estimate which measures the influence of the exogenous (independent) construct on the endogenous (dependent) construct. The path value (coefficient) of development control measures to Habitation is 0.991. This indicates that for every 1 unit compliance to development control measures, its influence would contribute 0.991 unit increase in sustainable habitation, consequently the effect of development control on habitation is significant.

The result of the hypothesis testing in table 7 showing the influencing relationship between development control measures and habitation is significant, thereby supporting the study's hypothesis. Development control measures influence sustainable habitation by a strong effect of 38% (Adam & Lawrence, 2015).

The discovery of a strong relationship between the constructs used in the study are as a result of ever changing development pattern of settlement in most urban centers in Niger state. This is attributable to the economic activities on land which could either confirm to development control measures or otherwise. Communal sectarian violence between cattle rustlers and locals, the mass exodus from the North East region have the effect of changing the pattern of settlement along the urban periphery and congesting the inner cities of other regions. Consequently the dynamics of urban land use pattern have surfaced with attendant challenges inclusive are traffic congestion, land fragmentation, inadequate and over stretching of existing infrastructures, rapid and uncontrolled development, increase in air and water pollution and alteration of urban planning.

However, Households take safety, security, inclusive and resilient settlement as factors to consider when taking residency and relocating in residential neighborhoods. These are in line with the sustainable development goals agenda number 11 of the United Nation Charter (sustainable habitation).

CONCLUSION

This study has unveiled the quantum of influence development control measures have on habitation in Niger State, Nigeria, efficaciously with the aid of SEM (AMOS). It was unearthed that development control have influence on sustainable habitation at 38% level, pointing to the fact other factors are responsible for the remaining 62% of the effect on habitation. This calls for further study in that regard.

The objective of the study has been achieved. Findings of the study will contribute empirically to the frontier of academic literature on development control measures and habitation especially in a developing nation like Nigeria where there is dearth of such literature.

Secondly, data analysis was aided by SEM which is a breakthrough from virtually most earlier research on development control measure in Nigeria because they had limitation that might affect the outcome of deduction and result of the previous studies Awang (2012).

Urban centers in Niger State are rapidly expanding unabated and will continue in this direction. To ensure it develop in the right pivot, there is need for self-help community initiative, bi-lateral and multi- lateral cooperation in terms of funding development and redevelopment of urban environment especially neglected areas. This will enhance participatory policy formation and implementation by stakeholders and planning authority.

The rapid unabated demand for land resource and its utilization must be checked in other to achieved harmony by various competing land uses in the urban centers; therefore planning authority must be abreast with development and put in place mechanisms for planning, controlling and monitoring negative externalities that affect habitation.

Finally, the study serves as an absolute reference material for academics, town planning ministries, department and agencies of government and policy makers who are involved in provision and monitoring of the growth of habitation.

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CHALLENGES FACING THE DEVELOPMENT OF SUSTAINABLE PETROL FILLING STATIONS IN MINNA, NIGER STATE- NIGERIA

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The issue of Global warming responsible for climate change effects has become a topic of debate all over the world today. Buildings and fossil fuel emits carbon monoxide (CO_2) into the atmosphere which also contributes to climate change. The activities of Filling Stations has made them major contributors to land, water and air pollution. Petrol, kerosene, gas, oil lubricants and diesel which constitute high carbon monoxide (CO_2) and other chemical compounds can result to health complications after long time exposure. The application of sustainability principles in the design and construction of Filling Stations can help to reduce its negative impact on the environment. Reviewed literature on sustainability highlighted some of the challenges encountered by Architects and project managers in the implementation of sustainability requirements in the construction industry which includes lack of knowledge on sustainability, high cost of sustainable building materials and Technical know-how among others. This study therefore assesses the barriers encountered by Architects and building developers in the development of sustainable Filling Stations with a view to encourage the existence of ecofriendly Filling Stations in Minna, Niger State- Nigeria. A total of 50 Filling Stations were selected for the observation of their design and construction features. The data obtained was presented with the use of plates and figures to buttress physical descriptions. Some of the findings from the study revealed 48% of Filling Stations lacks adequate land size to incorporate sustainability features, 66% of Filling Stations made use of concrete as preferred building material due to the affordability and easy workmanship, influence of design by client and lack of maintenance plan in more than 75% of Filling Stations are some of the challenges encountered in the design and construction of sustainable petrol Stations. Recommendations were made for Architects and related professionals to acquire more knowledge on sustainability, while Nigerian Government should create more awareness on the importance of sustainability. Finally, government needs to revamp the existing laws in the construction industry and as well establish new laws if need be in order to facilitate the implementation of sustainability in the built form in Nigeria.

Keywords: Architects, buildings, ecofriendly, filling stations, sustainability

INTRODUCTIONS

The pressure from rapidly increasing world population, the over exertion of human needs and wants on the available natural resources is damaging the environment and threatening human existence (David, Huang, Cordova & Pimentel, n.d). The world is continuously being polluted by degradation of the ozone layer through the release of gases such as chlorofluorocarbons, and the burning of fossil fuels, coal, diesel and other oil & gases which is changing the natural climate of the earth (Ohio Environmental Protection Agency, 2011). The change in global climate directly affects rise in temperature and sea levels, which results in flooding, desertification, and other environmental damages. In a recently published study by the proceedings of the National Academy of Sciences, researchers predicted more extreme heat in the environment resulting from erratic climatic variations (Global Guardian News Paper, 2017).They further alerted that over 350 million people living in big cities will be affected by extreme heat yearly. Previous and subsequent studies on impacts on health of climate extreme carried out by the World Health Organization (WHO) (2003) in Australia has also proven that high temperature and humidity is dangerous to man especially children, infants and those with existing health challenges, coastal residents and those living in poorly located settlements (Global Guardian News Paper, 2017).

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Abdullahi & Adedayo, (2018). **ASSESSMENT OF THE LEVEL OF INTEGRATION OF ORGANIC ARCHITECTURE IN HOTEL BUILDINGS IN MAKURDI, BENUE STATE.** Contemporary Issues and Sustainable Practices in the Built Environment. School of Environmental Technology Conference, SETIC, 2018

Filling Station is a public facility where fuel and other lubricants are sold for motor vehicles (Olugen, **Olajide**, & Sunday, 2011). Most Filling Stations in Nigeria are located along major roads to maximize accessibility and marketability, which also means they could be close to some public, commercial and even residential areas. This contravenes the regulations for the siting of Filling Stations (DPR, 2007). Inhalation of benzene can result to irritation of the mucous membrane, cancer of the lungs, stomach leukemia, and aplasia, heart attack and bone marrow depression (**Hunter**, 1966). Similar studies carried out by Brugnone, Perbellini, Romeo, Bianchin, Tonello, Pianalto, Zambon, and Zanon (1998) further revealed that Filling Station attendants and car mechanics that are exposed to benzene for a long time are liable to series of respiratory health challenges. This has made it necessary to explore safety measures to mitigate these negative effects from the planning and design perspectives (Sangotola, Fasanmade, Ayanrinde, Olatinwo, Olaniran, 2015).

In many developing countries today, authorities and oil marketers are adopting modern sustainable technologies especially in the area of waste generation to reduce the negative effects of oil handling in the environment (Georgi, n.d). This paper therefore, seeks to examine the challenges facing the development of sustainable Filling Stations in Minna Niger State, it also highlighted some measures that can be adopted in order to break barriers so as to mitigate the effects of climate change through design and construction of environmentally friendly Filling Stations.

Overview of Filling Stations in Nigeria

Nigeria is one of the largest consumers of fuel and other oil products in Africa with about 40 million liters consumed daily (Kunle, 2015). This is because of the large number of cars plying the roads and the epileptic power supply in the country, which makes almost every home, shops, banks and restaurant owners operate generators powered with petrol or diesel (Darlington, 2016). According to (Udoh, 2013), the existence of Filling Stations in Nigeria began in 1907 when Soconomy vacuum oil company which is now known as Mobil Oil Nigeria Limited began marketing Sunflower Kerosene in Lagos, Enugu, Kaduna and Ibadan. Up until independence in 1960, oil marketers where responsible for sourcing their own petroleum products and after independence, there was an increase in transport infrastructure development which saw better roads networks across the country. These significantly increased the demand for fuel and other petroleum products. Udoh 2013, further opined that the increasing demand of petroleum product in the post-independence era is responsible for the upsurge of more Filling stations in Nigeria. The petroleum industry is made up of the upstream sector which deals with exploration, evaluation, assessments development, decommissioning and the downstream sector which deals with distribution of refined petroleum and retailing (Darlington, 2016). Major oil Marketers are involved in all stages of the oil and gas, and most of them operate under brand names like TEXACO, Mobil, AP, Oando, and Total. They also enjoy all the benefits therein, while an independent marketer sources for his products and operate under a chosen name (Darlington, 2016).

There are basic requirements for the siting and construction of Filling Stations in Nigeria. They include location, land area and type of design for proposed Filling Station. The department of Petroleum Regulations (DPR) is a federal agency responsible for the regulations of Filling Stations activity in the country while the respective state development control boards are responsible for granting approval for location and construction, in Niger State, it is the Urban Development Board (UNDB). Despite these regulations put in place by these agencies to check their activities, indiscriminate siting of Filling Stations in contravention of the extant rules has continued to be a source of concern. Ujjwal and Sokhi (2006) opined that Filling Stations are one of the contributors to traffic hazard, non-aesthetics and are liable to fire outbreak. The summarized guidelines for planning and operation of Filling stations in Nigeria according DPR (2007) are:

a. Land must be zoned for commercial/industrial use
b. Land area for filling station should not be less than 30x30m
c. There should be minimum of 400metres in between 2 Filling stations
d. A minimum of 50m should be maintained in all directions of Filling Stations to other buildings to serve as protection zone.
e. Number of Filling Stations to be located along 2km radius of site should not be above 4
f. Minimum distance from fuel pump to the center of the road is 15m

g. A minimum of 100m should be maintained between Filling Stations and public facilities

h. Site for proposed Filling Station should not encroach with NNPC/PPMC pipeline, rail lines, electric power lines or cables. (Procedure guide for grant of approvals to construct and operate a petrol products retail outlet by DPR, 2007).

Just as with many planning guide for building construction in Nigeria, the issues of environmental friendliness and challenges are not included in the planning guide by the regulatory bodies. And this is believed to be responsible for the lack of awareness of sustainability assessment by the developer, operator and regulator of filling stations in Nigeria.

Environmental Impacts of Petroleum Products Retailing

According to the world Health Organization (WHO, 2010) urban development contributed to the increase in number of petrol stations across the world. This has further endangered the health and life of people living within the vicinity due to constant traffic and exposure to harmful vapor emissions (United Nations, 2010). Most Filling Stations sell petrol (PMS), liquefied Natural Gas (LNG) diesel and kerosene (AGO). There are volatile organic compounds (VOC) present in these fuels especially petrol which contains benzene that makes it emits vapor even in the lowest temperature and it is highly flammable. This means, it is like a time bomb that can explode or catch fire at the slightest accident. Also, when it gets into water, it can float and travel long distances and cause harm to human and aquatic life away from their actual location (Menkes and Fawcett, 1997). According to National Fire Protection Association (2010), fire and explosions in service stations were projected at 7400 between 1994 and 1998. Some of the problems associated with existence of Filling Stations anywhere include; Fire Outbreak, road accident, traffic congestion, hazardous substances, electricity, security challenges, and pollution. The negative environmental impacts of the existence of filling stations can be reduced to the minimum by adopting sustainable control measures in the design and construction stage (National Fire Protection Association, 2010). Architects have come to a collective agreement that decisions and actions to reduce existence of CO_2 gas emissions by 80% from the environment is key to climate change effect by the year 2050 (Royal Institute of British Architects RIBA, 2012). Architects can make positive impact on effects of climate change through design and specifications of sustainable buildings. Though, seeking sustainability has brought series of challenges to Architects, this ranges from lack of awareness on sustainability principles, sustainability requirements of specific buildings, client request, and public responsiveness to sustainability and pressure to conform to professional ethics (Adedeji, Toyin and Damilola, 2012).

Challenges Facing the Sustainable Development of Filling Stations

Sustainable construction is derived from the concept of sustainable development applied to the construction sector. As defined by Kibert (1994), it is the creation of an accountable and healthy built environment based on cautious management and resourceful ecological principles. One of the most significant long-term impacts of sustainability is the ability for future generations to have the same resources and opportunities for the development that we enjoy today. There is little on literature regards sustainability and Filling Stations. Arif, Egbu, Haleem, Kulonda, & Khalfan, (2009) listed some of the challenges of developing sustainable buildings to include: limited knowledge on sustainability, Lack of finance, effect of culture and value, technology deficiency, and lack of sufficient research on sustainability, and financial constraints. Similarly, Dania, Kehinde, and Bala (2007) concluded that practicing professionals in the Nigerian construction industry are not aware of sustainability. These factors also relate to the development of filling stations in Nigeria.

On the other hand, with the spate of rapid urbanization and acceleration of construction activities in most developing countries, Du Plessis (2007) advocated for deliberate efforts to prevent the needless negative impacts of building construction activities by totally embracing the sustainability agenda. Despite this advocacy, evidence from the literature highlights limited progress in this regard in developing countries. One typical example can be found in Nigeria where, as in other developing countries, the construction sector is crucial and a leading driver of economic development (Zuofa, Ochieng, & Burns, 2015).

When put together, these barriers and challenges raises concern about the state of sustainability within the construction industry in Nigeria. As demonstrated from the reviewed literature, even with the higher level of advancements in developed countries, certain barriers affecting sustainability in construction were identified and these perhaps is

more serious in developing countries such as Nigeria (Zuofa, and Ochieng, 2016). All these means that sustainability among construction industry stakeholders needs to be examined and reviewed. Having reflected on the concept of sustainability within the construction industry and its current challenges, this study attempt to investigate the barriers to development of sustainable design and construction of Filling Stations in Minna Niger State.

MATERIALS AND METHODS

An extensive literature review was carried out to have a broad understanding of sustainability and how it relates to the petroleum industry and construction industry. The study was carried out to cover sustainability principles in the petroleum sector and the challenges encountered in the development of a sustainable Filling Stations in Nigeria. The descriptive research method was adopted for the study (meaning what and what) with a post occupancy evaluation approach. The study area is Minna- metropolis, Niger State, covering Bosso and Chanchaga Local Government Areas. From the reconnaissance survey conducted, there are a total of 78 Filling stations in the study area from which 50 Filling Stations with not less than 4 petrol pumps (8 nozzles) were purposively selected. Furthermore, a checklist was prepared to elicit information on those requirements that should be available in order to achieve eco friendliness in Filling Stations. This was in order to gather information on availability of sustainable features and the challenges associated with its planning and development. Some of the variables listed in the checklist include: Location, size of land, choice of building materials, waste management technique, alternative source of power supply and post maintenance Plan. The Filling Stations were grouped into 3 according to location, while research assistants where employed and allocated to each group. The information gathered was transferred into SPSS software where cross tabulations and tables of frequency were used to analyze the data. The result obtained from the SPSS was imported to Microsoft excel where tables and charts where generated for the study. The presentation of pictures in this study was done with cameras and the result was presented as plates to buttress some of the explanations. The discussion of result were presented in subheadings that suit the subject matter examined in order to achieve the purpose of the study.

RESULTS AND DISCUSSIONS

The results in Table 1 shows the land area occupied by Filling Stations in Minna, Niger State. About 5 Filling Stations representing 10% of the filling station in Minna metropolis occupy a plot size of 15x15m, 19 which is 38% of total Filling stations have plot size of 15x30m, 14 (28%) Filling Stations occupy a plot of 30x30m, 4 which is (8%) of Filling Stations are situated on a plot of 40x60m, while 2 (4%) have plot size of 50x100m, while 6 (12%) Filling Stations have a plot of 60x100. This findings have revealed that about 24 Filling stations representing 48% of the sample population are located on a land area below minimum requirement. Only 14 Filling stations representing 28% of the sample size met the minimum requirement of 30x30m while 12 Filling Stations with total of 24% possess land area above minimum requirement.

According to the State Urban Development Board, area for Filling Station should not be less that 30x30m which corresponds to 2 plots of land. Majority of Filling Stations in Minna engage in other businesses aside from their primary function of selling Fuel. But there must be adequate land provision in order to conveniently provide for other supporting facilities in the Filling Stations and also make room available to include sustainability features such as soft landscaping. Furthermore, findings revealed that all the Filling Stations visited are located along major roads in Minna metropolis. There is a seeming competition among oil marketers, and that account for why all want their Filling Stations to be located along major roads and Central Business Districts (CBD) of the town. But due to the existing law by the State Government to build only high-rise buildings along major roads in Minna, there is pressure on land availability within these locations. Therefore, existing Filling Station owners do not want to relocate for fear of low market while new Filling station owners still prefer to source and access the small lands available along major roads and business activity areas than to locate their Filling Station in other parts of town where there are available lands that can accommodate more facilities and enhance assessment of sustainable design considerations to achieve eco-friendliness. A result of this study agrees with the work of Abdullahi and Adedayo (2017), which shows that despite most Filling Stations having

minimum land sizes of 30x30m and 15x15m, they still squeeze in several functional spaces all in the bid to make more profit which is an unsustainable practice. Though this would not have been the case if the DPR ensured that its EIA requirement is strictly enforced.

Furthermore, the location of these Filling Stations violate the DPR guideline for location of Filling stations which specifies that minimum distance of Filling stations to schools, market and other public buildings to maintain 50m in all directions (DPR, 2007). As shown in plate I, First El-Shaddai Filling Station shares boundary with another Filling Station and a market. The land size is inadequate with no form of sustainable feature present. According to Mohammed, Musa and Jeb (2014), guiding rules and regulations should be followed rather than client discretion in the location of Filling stations. However, that is not the case as all Filling Stations observed in the study area are either located close to schools, mosque and other public facilities or sharing border with residential areas. The consequences of oil spills and leakage from Filling Station can lead to fire outbreak, water and land pollution which can cause serious harm to human and aquatic life in the metropolis.

Table 1: Availability of Land for Filling Stations in Minna Niger State

Plot Size	No. of Filling Station	Percentage %
15x15m	5	10
15x30m	19	38
30x30m	14	28
40x60m	4	8
50x100m	2	4
above 60x100	6	12
Total	**50**	**100**

Source: Researcher's Field work (2016)

Plate I: A. A Erena Filling Station
Has large land size but has converted some part

Plate II; First El-Shaddai Nig. Ltd shares boundary with another Filling Station and market For farming

Choice of Building Materials in Filling Stations

The Architect is responsible for the choice of building materials as specifications which is included in the working drawings. Results in figure 1 indicated that the most preferred building material is concrete amounting to 33% of Filling Stations, 33% accounted for concrete and steel frames, strictly used in Fuel dispensing area. Only 3% of the Filling Stations in the study area used bricks but only for aesthetic purpose, while 12% made use of plastic for roof covering in the entrance porches. The most preferred construction material in Filling stations observed is concrete amounting to a total of 66%. This is because it is relatively cheaper and easier to handle though it is not classified as a green building material. The processes of concrete manufacture and use emits CO_2 into the atmosphere which contributes to climate change. Also, concrete is heavy and not flexible to mould into different shapes, and contributes to general heat gain in the building. Sustainable designs are mostly easy to construct and flexible to maximize space and also ease maintenance. This is the reason why modern technological buildings are using canopy structures, tent structures, and frame work construction method of building to maximize the advantage of flexible installation including other mechanical fixtures and for easy dismantling when the need arises. Steel is highly sustainable and flexible to work with. But due to challenges of easy

accessibility, technical support and high cost of acquiring high quality steel material, many Filling Stations have limited its use to areas of importance such as roofing, columns and beams that carry the weight of the structure especially in the fuel dispensing area which is deemed to be most important and busy place in the Filling Station. The use of bricks and plastic which are the most used sustainable building material today is very rare, and also restricted to less important areas in the station. Bricks and plastic are highly resistance to fire, easy to handle, reusable and aesthetically pleasing because it requires no any other finishing. They are also expensive, and scarcely available for large scale projects.

In figure 2, 70% of total Filling Stations observed made use of Aluminium as roofing sheet, 22% made use of Zinc roofing sheet and 8% step tiles roofing sheet. The fuel dispensing areas in Filling Stations are busy business areas that are prone to Fire, hence roofing material in Filling Stations should be highly fire resistant and should span long distances. There is no Filling Station that adopted the use of green roof. Green roofs are used to reduce rain water runoffs and to serve as means of natural cooling in buildings. They also beautify spaces and reduce water pollution, as water that is supposed to pour on the floor will be use to water green. But the roofing materials that are highly fire resistant such as steel, flat roof (covered with green) and canopy structures are expensive to install especially for large scale products including regular maintenance cost. Many clients will decline to use such roofing materials and techniques that would cost a lot and will prefer to access the readily available ones that are also cheaper to install and requires little to no maintenance. Geoff B. (n.d), suggested that the initial cost of the building may only make up 20%-30% of the total building cost over its useful life span. He went further to explain that the concept of entire lifecycle cost of a building is yet to be fully understood, but initially expensive buildings often times eliminate the need for frequent short time modifications that may cost the client more. Tent and canopy structures are recommended for use in Filling Stations because it can span long distances, admit ample amount of light into space which could also be maximized for solar panels, they come in different shapes and sizes, and also highly resistance to Fire. The challenges of accessibility, cost of sustainable building materials, high cost of installation and maintenance cost is responsible for less frequent use of sustainable roofing materials in Filling Stations.

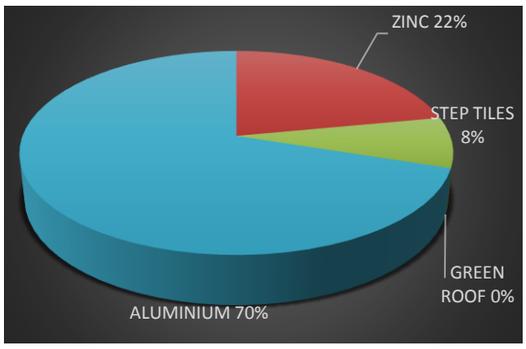

Figure 1: Type of roofing material in Filling Stations Minna

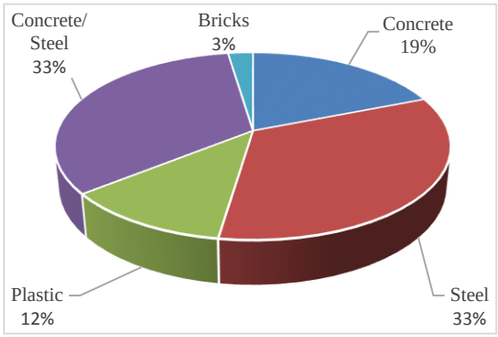

Figure 2: Preferred building material in Filling Stations Minna

Efficient Water Supply and Management in Filling Stations Minna

Filling Stations just like every other facility require water for domestic use in the retail facilities and for maintaining green vegetation. There is an inconsistent to no supply of pipe bone water in many areas in Minna, the reason why few have resulted to alternative sources such as well water and boreholes. Sustainable water use in building construction collects rain water which is used to water plantings and may be treated for other hygienic use. Result in Figure 4 reveals collection and use of rain water in Filling Stations, which is through the manual process of collecting water in a tank through the edges of the roof and fetching with a bucket. About 14% of the Filling Stations observed use rain water for toilet Flushing, only 4% use rain water for green areas and farmlands which of course is an unsustainable practise in a Filling Station. But this process is tedious because it is manually operated and it is not serving the intended purpose.

In addition, assessing Grey water harvest and recycle system requires the expertise of a professional that has a sound understanding of the Grey water recycle machine that may be suitable and efficient for the Filling Station, the number of tanks required to collect, store and recycle water sufficient to run the Filling Stations and the best place of location. Most importantly, rain water do not last throughout the year, therefore water from car wash area

and other places of high water use in the Filling Station have to be collected and recycled continuously to ensure steady supply throughout the year. But this system, design and fitting is expensive to install. Some clients will feel reluctant to provide for this system because they may feel the occupants may not be able to pay better rent despite this extra efficient water feature provided. According to Geoff B.(n.d), a building developer may not be encouraged to pay for additional green features included in a building because the buyers or tenants may be ignorant of the benefits that are associated with and may decline to pay higher amounts.

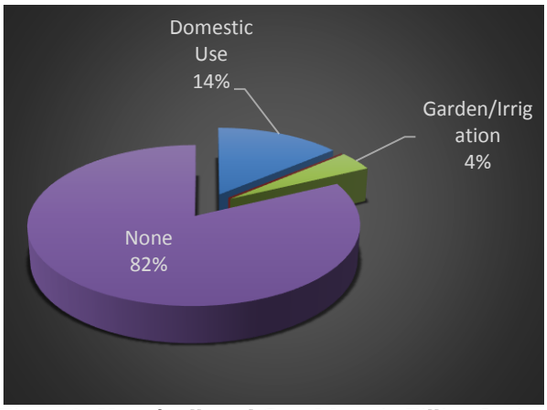

Figure 3: Use of collected Grey Water in Filling Stations Minna

Alternative Energy Source in Filling Stations Minna, Niger State

Electricity is an important requirement in Filling Stations to run its services, but Nigeria is still struggling to supply efficient power supply to its citizens. Virtually all Filling Stations observed have generator as alternative to electricity supply. In figure 3, the main source of power supply is electricity and only 1 Filling Station had photovoltaic system to power a small retail area which was installed without the solar panels reducing its efficiency. Nigeria is blessed with ample amount of sunlight that can be maximized to power as much power as required. But some of the challenges that impede the use of photovoltaic system is the cost of Installation. They have become quite popular in many Nigerian homes and it costs fairly high to install a good and long-lasting photovoltaic system. As opined by Geoff B. (n.d), a building developer may not want to pay for cost of additional green features such as solar panels when the benefits will be enjoyed by the tenant or new buyer whom will not necessarily want to reimburse for additional benefits. Filling Station is a busy facility with activity areas which include the fuel dispensing area, retail areas, in some cases plaza, service and car wash areas. To install a photovoltaic system to power the fuel pumps and other electrical appliances efficiently will cost a lot for initial capital and subsequent maintenance cost.

Furthermore, the design and roof span of most Filling Stations observed is not adequate to accommodate as much solar panels as may be required to power the facility. This is where the type of building plan and choice of roofing materials play important role as many Architects design without consideration for such provisions in the present or future. Instead, they simply make provision for generator houses to run generator sets which emits harmful toxics that are major causes of air pollution. Building developers must begin to see the importance of sustainable means of power generation in Filling Stations by breaking barriers to ensure there availability for efficient running of business activities and also to save overall running cost while being environmental conscious (Abdullahi and Adedayo 2017).

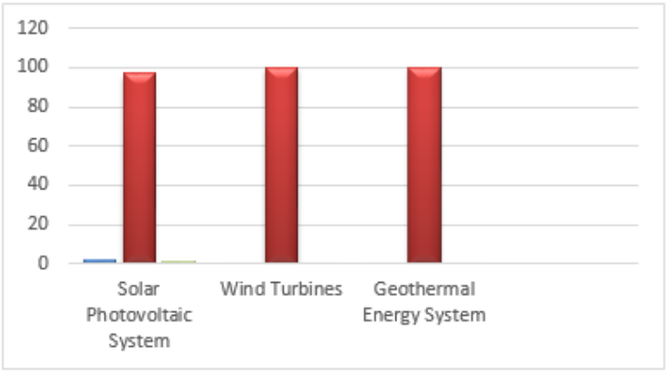

Figure 4: Alternative Source of Energy

CONCLUSION AND RECOMMENDATIONS

Sustainability requirements that can be included in Filling Stations include: sustainable planning (zoning of activity area), use of fire resistant materials such as Polytetrafluoroethylene (PTFE), tent and canopy structures, plastic, bricks and landscape feature. Generally, it can be concluded that barriers to sustainable Filling Stations planning and development in Minna is due to social, economic and environmental factors. Increase urbanization and rapid infrastructural development in countries such as Nigeria has made it necessary to adopt sustainable construction principles in order to achieve sustainable development (Du Plessis, 2007). Client's decision may differ on sustainability provisions, where a client with a vast knowledge and experience on sustainability will be willing to include such features despite the cost whereas another client may see it as unnecessary. The findings from this study concludes that the barriers to sustainability in Filling Stations include; lack of knowledge on sustainability, lack of integration of sustainability features in the design stage by Architects, influence of design by clients, high cost of sustainable building materials, lack of technical manpower, and absence of subsequent maintenance plan. There is need for the stakeholders in the construction industry to create awareness on the importance of sustainability. As pointed out by (Hartshorn et al., 2005; Graedel & Klee; 2002) on the barriers to sustainability, the term has not been fully embraced by stakeholders in the construction industry. It is very important for architects' and other building professionals to gain adequate knowledge on theories as well as practical implementation of sustainability in the built environment. Also, Federal Government and policy makers should show positive attitude towards environmental sustainability, review the existing legislation in the construction industry and implement new laws which will encourage sustainability practice in Nigeria.

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DESIGN CONSIDERATIONS FOR CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN IN MINNA SHOPPING CENTRES

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In recent time, architecture designs have emerged worldwide as one of the most promising and currently effective approaches to reducing opportunities for crime. The basic tenet of crime prevention through design in building is that proper design and effective use of the built environment can be used to reduce the fear and incidence of crime and thereby improve the overall quality of life. Studies have shown that in communities where these principles have been implemented, criminal activity has decreased by as much as 40 percent. Environmental crime prevention has many positive aspects which deter crime instead of addressing criminal activity after it occurs. This paper is aimed to assess the design considerations for crime prevention through environmental design in minna shopping centres. Five shopping centres within Minna metropolis are purposively selected for this study. The study have employed case study and a descriptive survey method. Data were collected by means of structured survey observations and interview. The outcome of the study shows that designers and developers play important role and influence in enhancing the safety and security of the community. The study suggested that for effective crime control, the government should involve architects and other building professionals through integration of crime prevention through environmental design (**CPTED**) principles and concept at the inception of design.

Keywords: Built environment, crime, safety, security, shopping centre.

INTRODUCTION

Crime is a social problem in our society that affects thousands of people's lives each year. Serious crimes against persons and properties generate considerable fear within the community. Crimes like theft, break-in, rape and murder are serious threats to the safety of the community. The resulting fear of crime in itself can restrict people's freedom of movement and prevent them from fully participating in the community, particularly some groups of people like older people, women, parents, teenagers who are more vulnerable to crime and fear of crime (**CPTED** Hand Book, 2002)

Many different strategies are needed to combat the complex issues of crime and fear of crime. A whole range of responses involving strategies in design, community action and law enforcement would be required to achieve successfully the objective of crime prevention. In this connection, there is widespread acknowledgement that planners, architects and developers can play an important role in enhancing the safety of our communities as they have a major influence in the design of the built environment. Traditionally, the community has turned to the police and the judicial system to protect them by deterring criminals and punishing offenders. The general public's indifference towards self-protection arises mainly from the lack of knowledge of the means of protection, and perhaps a perception that somebody else - the government or insurance companies - bears most of the cost of theft and vandalism.

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A great deal can be done architecturally to mitigate security risks in a facility or site. These measures often cost nothing or very little if implemented early in the design process. All considerations which include careful design of building layout, configuration of space and the use of built environment are termed architectural. All these architecture mechanism for crime prevention through principles of design are also known as Crime Prevention Through Environmental Design (**CPTED**).

Katyal (2002) argued that architecture at the beginning of the twenty first century has been given the least importance and underexplored in the form of crime control. He also states the needs and importance to understand the relationship between crime and architecture so as to enhance its effectiveness in the fight against crime

CPTED, also known as 'Design Out Crime', is an acronym for crime prevention through environmental design which states that "the proper design and effective use of the built environment can lead to a reduction in the fear and incidence of crime, and improvement in the quality of life" (Crowe, 2000). **CPTED** is a multi- disciplinary approach, drawing on criminology, planning and environmental psychology, and is specifically located with the field of environmental criminology. **CPTED** is concern with the identifying conditions of the physical and social environment that provide opportunities for criminality and the modification of those conditions in order to reduce such opportunities. Its objective is to proactively prevent crimes as compared to the reactive strategies of most criminal justice systems (police, court, and correctional facilities (Wallis, 1980). The term **CPTED** was originally coined by Jeffery (1971) and most of the theoretical and practical development where based upon Newman's Defensible space (1973)

Research in architectural theory and environmental psychology reveals that architects influence, in subtle ways, the paths by which we live and think, for example fast-food restaurants use hard chairs that quickly grow uncomfortable so that customers rapidly turn over; elevator designers place the numerals and floor indicator lights over people's heads so that they avoid eye contact and feel less crowded; supermarkets have narrow aisles so that customers cannot easily talk to each other and must focus on the products instead. With strategies like these, private architects are currently engaging in social control. Law occasionally harnesses the power of physical space to shape social norms and uses architecture as an expressive tool to embody certain commitments (Katyal, 2002).

This paper is focused on how architectural solutions can be explored to crime and then suggests ways for the government to take more active role in architectural design. First the paper suggest six architectural concepts which are also the principles of **CPTED** ; increasing area for natural surveillance (its visibility and susceptibility to monitoring by private citizens), introduction of territoriality **(**by demarcating private and semiprivate spaces), reducing social isolation, access control, maintenance management of pace and protecting potential targets. The study is to be carried out in Minna, Niger State of Nigeria. Minna being the capital city of Niger state consist of two local government area which is Bosso and Chanchaga

REVIEW OF RELATED LITERATURE

Some architects have outlined mechanisms for crime prevention through principles of design." This emerging field is known as "Crime Prevention Through Environmental Design" **(CPTED). CPTED** is an acronym for Crime Prevention Through Environmental Design which asserts that "the proper design and effective use of the built environment can lead to a reduction in the fear and incidence of crime, and an improvement in the quality of life" (Crowe, 2000). By optimising opportunities for surveillance, clearly defining boundaries (and defining preferred use within such spaces) and creating and maintaining a positive 'image', urban design and management can discourage offending. This is explained by the fact that offenders are potentially more visible to 'law-abiding' others, and therefore, perceive themselves to be more at risk of observation and subsequent apprehension. Additionally, a well-maintained and appropriately used environment can signify that a sense of 'ownership' and proprietary concern exists within the community. The federal government of Nigeria, however lack regulations for crime prevention in building designs. Nevertheless, an extensive review of the architectural literature reveals six basic concepts.

Six Principles of CPTED

- Natural surveillance
- Territorial reinforcement
- Natural Access control
- Activity support
- Target management
- Maintenance Management

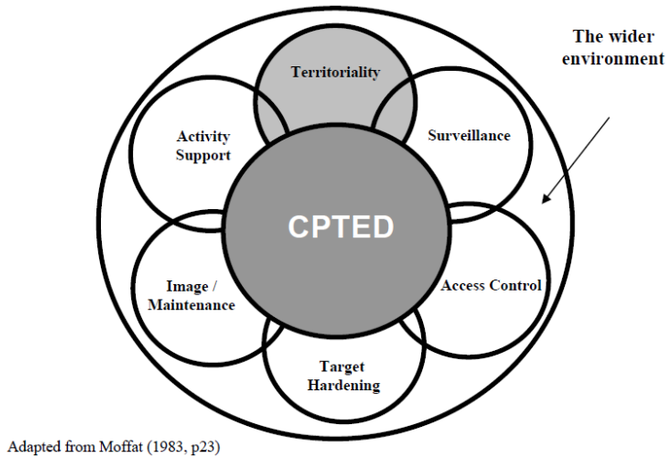

Fig. 1.1 showing the 6 principles of CPTED Source: adopted from Moffat (1983)

Natural Surveillance

Natural surveillance refers to the use of architecture to create spaces that are easily viewed by residents, neighbours, and bystanders. It supports good visibility in and around the buildings to limit concealment of criminal activities .If offenders perceive that they can be observed (even if they are not), they may be less likely to offend, given the increased potential for intervention, apprehension and prosecution. The most famous exponent of this approach was Jacob (1961) who reasoned that "eyes on the street" would deter crime. Jacobs's goal was to investigate why crime rates differed among cities. Jacob discarded the conventional theories of architecture and crime, such as those contending that building more public housing would prevent crime. Instead, she emphasized the density and diversity of city life. The primary aim of surveillance is not to keep intruders out (although it may have that effect) but rather, to keep intruders under observation. Natural surveillance can be achieved by a number of techniques. This can be done by putting more people (observers) near a potential crime area, the placement of windows and lighting and the removal of obstructions can be placed to improve sight lines from within buildings. Other forms of surveillance include formal or organised (e.g. police and security patrols) and mechanical surveillance strategies (e.g. street lighting and CCTV) .Design teams shall incorporate the following design strategies and techniques when designing or renovating a facility

- Orientate travel ways perpendicular to buildings.
- Develop pedestrian pathways and corridors with clear lines of sight.
- Parking lots rows should be perpendicular to buildings to maximize visibility.
- Landscape architecture that supports security requires a design that integrates natural surveillance, video surveillance, and natural access control.
- Avoid constructing large blank walls that limit visibility and can become targets for graffiti; instead encourage the use of walls with windows, architectural details, or foliage.
- Place facility personnel where they have clear lines of sight of walkways and parking lots through windows and doors.
- Use baffle type restroom entrances to support visual and audible surveillance and position restroom entrances to be visible from main pedestrian areas but away from outside exits and pay telephones.
- Avoid dead-end corridors, isolated stairwells, and open areas under stairs.
- Design open floor plans for offices, classrooms, and laboratories.
- Include intended gathering areas where practical to increase legitimate use of corridors and lobbies therefore increasing natural surveillance (ECU, 2011).

Empirical studies of burglary confirm that the surveillability of an area is a major predictor of its crime rate.

Territorial Reinforcement

Territoriality is a concept that clearly delineates private space from semi-public and public spaces and provides cues that help to create a sense of ownership. People usually protect territory that they feel is their own and have a certain respect for the territory of others. Identifying intruders is much easier in a well-defined space. An area that looks protected gives the impression that greater effort is required to commit a crime. CPTED Guideline (2005). Territoriality clearly defines an area by utilizing physical or psychological element to create an environment with a sense of ownership where abnormal behaviour, such as unusual loitering or other unauthorized activities, is easily recognized. This can be achieved by using physical elements such as fences or real barriers, pavement treatment, art, symbolic barriers (e.g. signage), good maintenance and landscaping to express ownership. Architects can work to create territoriality by manipulating both the internal and external features of buildings by

- Providing a defined boundary around the building.`
- Selecting pavement patterns, vegetation, low walls, or site features to form physical or psychological separation of areas.
- The Use signage to reinforce or establish territoriality and to support way finding,
- Providing trash receptacles in areas of intended pedestrian use to encourage a clean and kept environment.
- Appling polyurethane paints that reflect light and resistant to graffiti.
- The Use symbolic barriers to inform an individual that he/she is passing from a public to private space, this may include open gateways, light standards, low walls, and plantings. Research on territoriality has shown it to be most effective at the local level (Brown and Altman, 1981; Taylor, 1988; Ratcliffe, 2003)

Natural Access Control

Natural access control is a **CPTED** concept focused on reducing opportunities for crime using spatial definition to deny access to potential targets and creating a heightened perception of risk in offenders. . Natural Access Control is about using layout and design elements to easily direct site users in an orderly fashion from one location to another while reinforcing territoriality and aiding natural surveillance. By denying access to targets and creating a perception of risk for offenders this concept decreases the opportunity for criminal activity. The mainstay of natural access control is limiting the number of intended access points to the greatest extent possible without negatively affecting operations as well as to guide people through a space by strategic design. This aids natural surveillance by increasing traffic flow at each of those locations therefore increasing the opportunities for surveillance. Formal or organised access control (e.g. security personnel) and mechanical access control (e.g. locks and bolts). Natural access control relies on doors, fences, shrubs, and other physical elements to keep unauthorised persons out of a particular place if they do not have a legitimate reason for being there. In its most elementary form, access control can be achieved in individual dwellings or commercial establishments by the use of adequate locks, doors and window barriers. The strategies were not generally considered as part of the early definitions of **CPTED**.

- Limit the number of pedestrian and vehicle entrances to building facilities.
- Develop pedestrian traffic corridors between high use areas, such as between parking lots and main building entrances.
- Use site features, building design, and pathways to channel pedestrians and vehicles into intended corridors.
- Limit the number of entrances into a building without inhibiting its functionality or operations.

Activity Support

Activity support involves the use of design and signage to encourage intended patterns of usage of public space. Crowe (2000) notes how activity generation and support seeks to place inherently “unsafe” activities (such as those involving money transactions) in “safe” locations (those with high levels of activity and with surveillance opportunities). Similarly, “safe” activities serve as magnets for ordinary citizens who may then act to discourage the presence of criminals. This approach clearly contains elements of territoriality, access control and surveillance. Although increased numbers of pedestrians may provide additional

"eyes on the street" and potentially discourage some offences, this may also actually encourage and provide potential targets for crime (e.g. pick-pocketing). This concept can decrease criminal or abnormal behaviour by providing gathering areas and other architectural features that encourage the appropriate use of a space by intended users. This can deter crime because criminals do not typically intermix with intended users. These are interior and exterior features around the campuses that include features for students, faculty, and staff and may include barbeque grills, picnic tables, benches, outside eating areas, or basketball courts. Interior features could be student, staff, and faculty lounges, billiard or Ping-Pong tables, and TV or game rooms

Target Hardening

One of the more obvious ways in which architecture can prevent crime is by strengthening targets against attack. . Target hardening increases the efforts that offenders must expend in the commission of a crime and is the most long-established and traditional approach to crime prevention. Some of these techniques are easy to employ, such as placing deadbolts lower on door frames, having doors in vulnerable locations swing outward, raising fire escapes to put them out of easy reach, and reducing the size of letter-box openings. Modem technology permits targets to be hardened in ways that are not obvious to the public. Strong plastics, graffiti-resistant paint, and doors with steel cores are a few examples. These advances allow architects to disguise their efforts at strengthening targets and thus avoid sending a message that crime is rampant. This describe an important feature that distinguishes various architectures of crime control. However, there is much disagreement concerning whether or not target hardening should be considered as a component of **CPTED**. It is directed at denying or limiting access to a crime target through the use of physical barriers such as fences, gates, locks, electronic alarms and security patrols. Substantial evidence reveals that such security measures decrease crime in post offices, banks, and convenience stores.

Maintenance Management

Promoting a positive image and routinely maintaining the built environment ensures that the physical environment continues to function effectively and transmits positive signals to all users. The significance of the physical condition and "image" of the built environment and the effect this may have on crime and the fear of crime has long been acknowledged (Lynch, 1960; Newman, 1973; Wilson and Kelling, 1982; Perglut, 1983) and an extensive body of research now exists (Eck, 2002; Kraut, 1999; Ross and Mirowsky, 1999; Ross and Jang, 2000). Indeed, vacant premises have been found to represent crime "magnets" (Spelman, 1993). Maintenance and management need to be considered at the design stage, as the selection of materials and finishes will impact on the types of maintenance regimes that can be sustained over time. For example, plant material should be selected for its size at maturity to avoid blocking of sight lines. Crucially, much research suggests that the routine maintenance of the urban environment will significantly assist in reducing crime (Wilson and Kelling, 1982; Kraut, 1999; Ross and Mirowsky, 1999; Ross and Jang, 2000; Cozens *et al.*, 2001b)

The "Three D" Approach

CPTED involves the design of the physical space in the context of the normal and expected use of that space by the users as well as the predictable behaviour of people around the space. **CPTED** emphasises the connection between the functional objectives of space utilisation and behaviour management. Conceptually, the six **CPTED** principles are applied through the 3-D approach, i.e. **Designation**, **Definition** and **Design**. The 3-D approach is a simple space assessment guide that helps the user in determining the appropriateness of how a space is designed and used. The 3-D concept is based on the three functions or dimensions of human space:

- All human space has some designated purpose.
- All human space has social, cultural, legal or physical definitions that prescribe desired and acceptable behaviours.
- All human space is designed to support and control the desired behaviours.

By using the "Three D's" as a guide, space may be evaluated by asking the following questions:

1. Designation

- What is the designated purpose of this space?

- What was it originally intended for?

2. Definition

- How is the space defined?
- Where are its borders?
- Are there social or cultural definitions that affect how that space is used?
- Are legal or administrative rules clearly set-out and reinforced in policy?
- Are there signs?

3. Design

- What physical design will best support the intended use of the space?
- What physical design will best provide the means to influence human behaviour?

Consideration of these questions may reveal areas that requires changes or improvements. Once these questions have been considered, the information received may be used as a means of guiding decisions about the design or modification of the space so that the objectives of space utilization as well as natural surveillance, natural access control, territorial reinforcement and maintenance and management can be better achieved. CPTED Guidebook (2003)

CPTED Strategies for Designing A Shopping Center

The four CPTED principles can be translated into various planning and design strategies that would enhance security in shopping centre. These strategies can be categorised as follows:

1. Allow for clear sight lines,
2. Provide adequate lighting,
3. Minimise concealed and isolated routes,
4. Avoid entrapment,
5. Reduce isolation,
6. Promote land use mix,
7. Use of activity generators,
8. Create a sense of ownership through maintenance and management,
9. Provide signs and information and
10. Improve overall design of the built environment.

Sight Lines

Sight line is defined as the desired line of vision in terms of both breadth and depth. The inability to see what is ahead along a route due to sharp corners, walls, earth berms, fences, bushes or pillars can be serious impediments to the feeling of being safe. Large columns, tall fences, over grown shrubbery and other barriers blocking sight lines adjacent to pedestrian paths could shield an attacker. Alternatively, low hedges or planters, small trees, wrought iron or chain-link fences, transparent reinforced glass, lawn or flower beds, benches allow users to see and be seen and usually discourage crime and vandalism. Built environment should be design to allowing for clear sight lines and avoiding isolated or hidden spaces especially where risk to personal safety is perceived to be high such as recessed doorways, Sharp “blind spots” corners in stairs or corridors where there may be no alternative routes of escape and sudden changes of grade on walkways. Landscape can be a major impediment as they mature over time resulting to unintended screens, barriers or hiding places. Therefore, planting in a landscape must take into consideration the growth, final height and habit of the plants and proper maintenance should be ensured not to obscured sight lines. CPTED Guidebook (2003).

Lighting

Sufficient lighting is necessary for people to see and be seen. From a security point of view, lighting that is strategically placed can have a substantial impact on reducing the fear of crime. A basic level of lighting should allow the identification of a face from a distance of about 10 metres for a person with normal vision.

1. **Minimum Standards**
   If the area is intended for night time use, lighting should provide adequate visibility. Pedestrian walkways, back lanes and access routes open to public spaces should be lit so that a person with normal vision is able to identify a face from a distance of about 10 metres. Inset spaces, signs, entrances and exits should be adequately lit.

2. **Paths not Intended for Night Time Use**
   Lighting is not desirable in an isolated area or for a path leading to some obscure places. Lighting such areas may provide a false sense of confidence for people during night time use. The paths or spaces not intended for night time use could be fenced off and remained unlit to avoid giving a false sense of security or impression of being used.
3. **consistency of lighting**
   Lighting should be uniformly spread to reduce contrast between shadows and illuminated areas. More fixtures with lower wattage rather than fewer fixtures with higher wattage help reduce deep shadows and avoid excessive glare.
4. **protection of lighting**
   Light fixtures should be protected against casual vandalism by means of vandal resistant materials and design.
5. **Maintenance**
   Lighting requires maintenance to preserve visibility. Bushes and trees that block off light should be trimmed. Lighting fixtures should be located at suitable heights for easy maintenance and replacement. Light fixtures should be maintained in a clean condition and promptly replaced if burnt or broken. Posting information indicating who to call in case of burnout or vandalised lights is desirable. CPTED Guidebook (2003).

Concealed or Isolated Routes

Concealed or isolated routes are often predictable routes that do not offer alternative for pedestrians. An attacker can predict where pedestrians will end up once they are on the path. Examples are underpasses, pedestrian overhead bridges, escalators and staircases. Predictable routes are of particular concern when they are isolated or when they terminate in entrapment areas.

1. **Visibility of Concealed or Isolated Routes**
   If there is a need for the concealed or isolated route, it should be designed to incorporate visibility. If there is an existing concealed or isolated route and security is in question, it should be modified or eliminated. Concealed or isolated routes can be made safer by bringing in more activities, ensuring clear sight lines, improving lighting, installing emergency telephones and electronic surveillance devices.
2. **Surveillance Through Hardware**
   If a concealed or isolated route is enclosed and prone to crime e.g. passageway or stairwell, surveillance through security hardware should be considered and these hardware should be properly monitored..

Entrapment Areas

Entrapment areas are small, confined areas near or adjacent to well-travelled routes that are shielded on three sides by some barriers, such as walls or bushes. Examples are lifts, tunnels or bridges, enclosed and isolated stairwells, dark recessed entrances that may be locked at night, gaps in tall vegetation, a vacant site closed from three side by barriers, narrow deep recessed area for fire escape, grade-separated driveways or loading/ unloading areas off a pedestrian route. Parking lots, petrol kiosks and school buildings isolated by school yards can also become entrapment areas, especially when there is less activity after operating hours. It is preferable to have natural surveillance if an entrapment area is unavoidable, the area should be well lit with some form of formal surveillance. In the case of lifts, incorporation of glass windows in the design of lift doors would be helpful. CPTED Guidebook (2003).

Isolation

Most people feel insecure in isolated areas especially if people judge that signs of distress or yelling will not be seen or heard. People may shy away from isolated areas and in turn such places could be perceived to be even more unsafe. Natural surveillance from adjoining commercial and residential buildings helps mitigate the sense of isolation, as does planning or programming activities for a greater intensity and variety of use. Some dangerous or isolated areas may need formal surveillance in the form of security hardware, i.e. audio and monitoring systems. Compatible land use and activity generators can also be created, thereby allowing visibility by users.

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Land Use Mix

A balanced land use mix is important for environmental, economic, aesthetic and safety reasons. Mixed uses must be compatible with one another and with what the community needs.. The social value of frequenting local businesses provides a sense of security and safety as the local business people "watch" the street. Generally, any design concept that encourages a land use mix will provide more interaction and a safer place. Examples include convenience retail shops, personal service shops and offices in primarily residential areas, especially if they provide local employment opportunities. Childcare centres, health and fitness clubs and grocery stores in office areas are other examples of compatible mixed uses.

Activity Generators

Activity generators are uses or facilities that attract people, create activities and add life to the street or space and thus help reduce the opportunities for crime. Activity generators include everything from increasing recreational facilities in a park, to adding a restaurant to an office building. They can be provided on a small scale or be added as supporting land use, or intensifying a particular use and provide surveillance to potentially isolated areas, e.g. by locating administration office, lounge, TV room facing back lanes or side entrances and placement of licensed vendors in sensitive areas in the parks

Ownership, Maintenance and Management

Sense of ownership, or territoriality, is often considered a vital factor in making a place safer.

Taking responsibility and caring for an environment helps make it safer. The visual or real barriers separating many new housing developments from surrounding neighbourhoods may isolate residents from the wider community.one of the ways to achieve this is to define properties by the presence of design features with the use of small fence, use of durable vandal resistance materials, proper maintenance of building and placement of telephone numbers or wed site to call for repair or vandalism of properties

Signs and Information

Well designed, strategically located signs and maps contribute to a feeling of security. Signs should be standardised to give clear, consistent, concise and readable messages from the street. It should be well lit up and visible at night. Where it is difficult to find one's way around; signs with maps should help. Signs must be visible, easily understood, well maintained and strategically located at entrances and near activity nodes. It should be placed for visibility at an appropriate height, maintained on regular basis and should indicate where and when entrance and exit are closed

RESEARCH METHOD

The research method adopted was the descriptive survey method. Data were collected by means of well-structured questionnaires and observations schedule to evaluate the physical outdoor space of each shopping centre. The assessment was conducted in Minna Niger state, Nigeria. Minna consist of two local government area which are Bosso and Chanchaga. Chanchaga local government occupies an area of about 72km^2 and population of 201,429 and Bosso occupies an area of about 1,592km^2 and a population of 147,359. Five (5) shopping centres were purposefully selected based on their large numbers of shops in the shopping centre, large numbers of patronage and their locations which makes them a target area for crime. The sampling method employed was random sampling method. 125 questionnaires were distributed to shop owners at the centres only 100 were returned. Data collected were analysed using frequency distribution tables.

FINDINGS AND DISCUSSION OF RESULTS

The shopping centres that were sellected are

1. Blue mart Tunga, Chanchaga
2. Kpakungu shopping plaza, Kpakungu, Chanchaga
3. Obasanjor shopping complex, Chanchaga
4. Peniel Albarka plaza, Chanchaga
5. Shamras plaza, Bosso

Table 1. Height of wall fencing

Height of wall fence	Frequency	Percentage (%)
None	1	20%
Less than 1m	3	60%
1-2 m	1	20%
Above 2m	0	0%
TOTAL	5	100%

Source: Author

In Table 1. 20% of the shopping centre has no perimeter fencing, 60% has its perimeter fencing less than 1meters, 20% between 1-2meters while none record above 2meters of fencing.

Table 3. Standoff distance

Standoff distance	Frequency	Percentage (%)
Less than 4m	1	20%
4m- 8m	1	20%
8m- 12m	3	60%
Above 12m	0	0%
TOTAL	5	100%

Source: Author

In table3, 20% of the shopping centres have a standoff distance less than 4meters, 20% between 4meters to 8meters, 60% between 8meters – 12meters and none recorded a standoff distance above 12meters

Table 4. Number of entrance/ exit

Number of entrance/ exit	Frequency	Percentage (%)
Less than 3	1	20%
3-5	3	60%
1-2 m	1	20%
Above 2m	0	0%
TOTAL	5	100%

Source: Author

Table 4. CPTED measures applied on the shopping centres

CPTED Strategies	Yes	No	I don't know
Isolated area	46%	35%	15%
Entrapment area	55%	25%	20%
Feature impediment	20%	70%	10%
Formal surveillance	10%	80%	10%
Compactible land use mix	50%	20%	30%
Activity generator	40%	50%	10%
Well define boundaries	70%	20%	10%

Source: Author

From table 4. The shop owners were asked questions on the availability of the following CPTED measures applied on the centres, these were their responses.

Table 5. User's general perception on the use of CPTED strategies

CPTED strategies	Satisfactory	Unsatisfactory
site visibility	32%	68%
Location of car pack	23%	77%
Site maintenance	30%	70%
Display of signs and maps	34%	66%
Quality of lighting both day and night	25%	75%
Numbers of Escape and alternative routes	35%	65%
Safety impression about the place	39%	61%

In table 5 above, the shop owners were asked their general perception of the shopping centres. 32% of them were satisfied with the site visibility while 68% were unsatisfied 23% were satisfied with the location of the car park while 77% were unsatisfied. For display of signs and maps, 30% were satisfied while 70% of them were unsatisfied. For quality of lightning both day and night, 25% of them were satisfied while 75% were unsatisfied. For number of alternative routes and escape routes, 35% unsatisfied while 65% satisfied. They were also asked their general impression of the safety of the site, 39% satisfied while 61% unsatified

CONCLUSION AND RECOMENDATIONS

It is quite clear and obvious from the results and data analysed that most of the shopping centres in Minna are design with little or no consideration for crime prevention and safety of the users. This result has reveal the tendency of high crime rate in Minna shopping centres. People's safety and crime prevention should be given utmost priority in shopping centres. There is clear evidence that well-planned crime prevention strategies not only prevent crime and victimization, but also promote community safety and contribute to the sustainable development of countries. Conventional law would be at its best in crime prevention if architectural considerations should be integrated into law, not banished into a separate and isolated discipline.

It is the government responsibility to create, maintain and promote a context within which relevant governmental institutions and all segments of civil society, including the corporate sector, can better play their part in preventing crime. Firstly government should involve architects and other building professionals through integration of crime prevention through environmental design (**CPTED**) principles and concept at the inception of design. Secondly, it will be recommended that the government should design, implement and enforce policies regarding crime prevention and safety on building designs before being built. There are also needs to involve the people's perception of safety in building design.

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