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**CONTEMPORARY ISSUES
AND SUSTAINABLE PRACTICES
IN THE BUILT ENVIRONMENT**

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TABLE OF CONTENTS

Table of Contents	iv
Foreword	v
Acknowledgement	vi
Copyright Statement	viii
Declaration of peer review and scientific publishing policy	ix
Review Panel	x
Local Organising Committee	xv
Scientific Committee	xvi
Profile of Keynote Speakers	xviii
Programme for SETIC 2018	xix
List of papers in SETIC 2018 Conference Proceedings	xlii
Keynote Addresses	1
Conference Papers	1

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

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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.

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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).

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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).

NEIGHBOURHOOD CRIME VULNERABILITY MAPPING IN ILORIN, NIGERIA

Lekan Mohammed Sanni

Department of Urban and Regional Planning, Federal University of Technology, Minna, Nigeria

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° 30" and 08° 50" North of the Equator and between longitude 04° 20" and 04° 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 1 shows 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

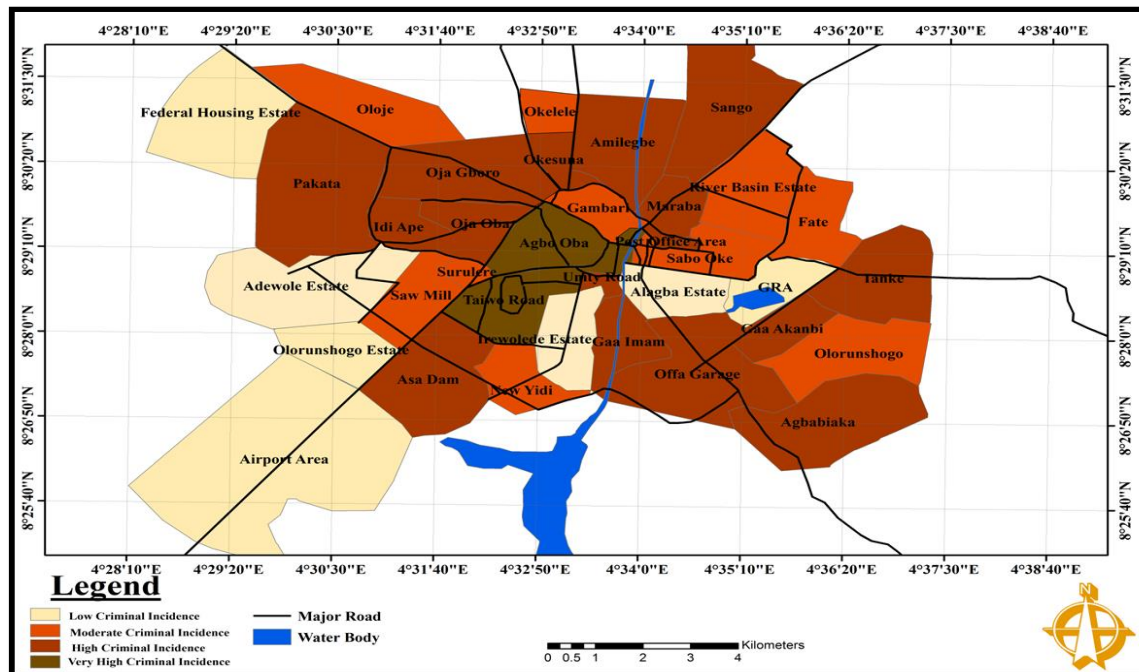


Figure 1: Crime Density Classification Map of Ilorin, Nigeria

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 -0.810 , 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.

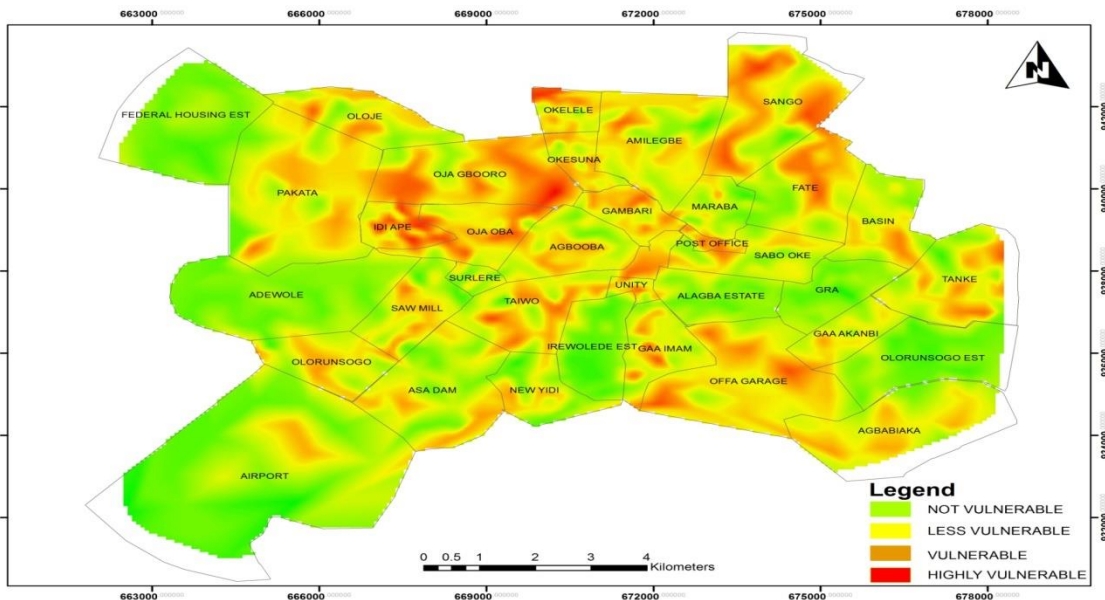


Figure 2: Neighbourhood crime vulnerability based on housing conditions
 Source: Author's Analysis, 2017

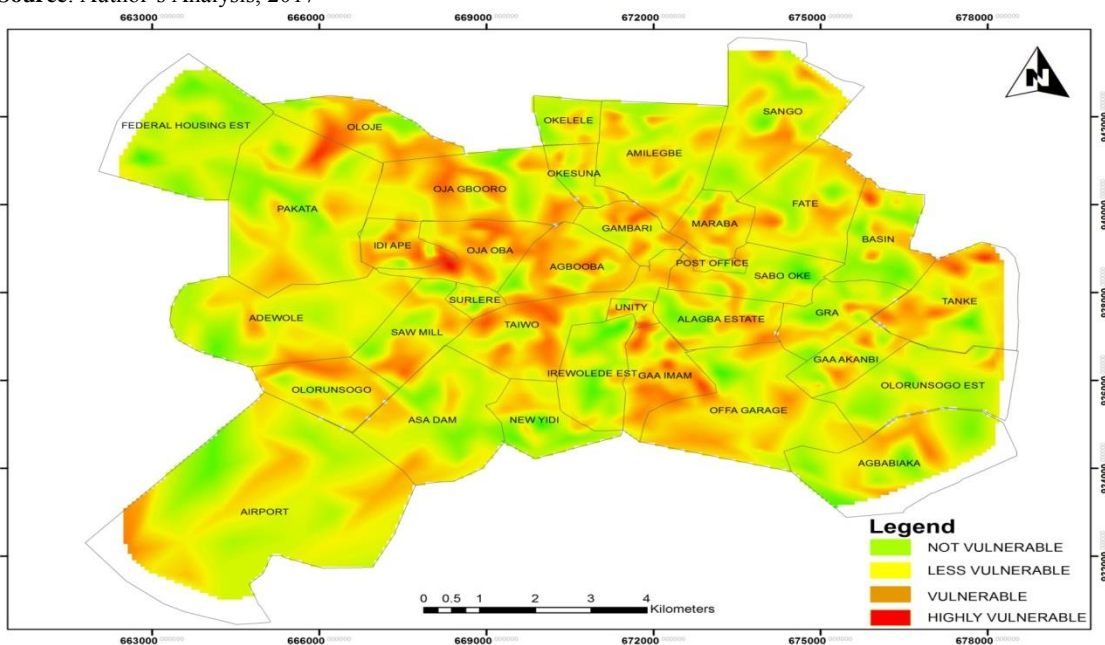


Figure 3: Neighbourhood crime vulnerability based on socioeconomic conditions
 Source: Author's Analysis, 2017

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.

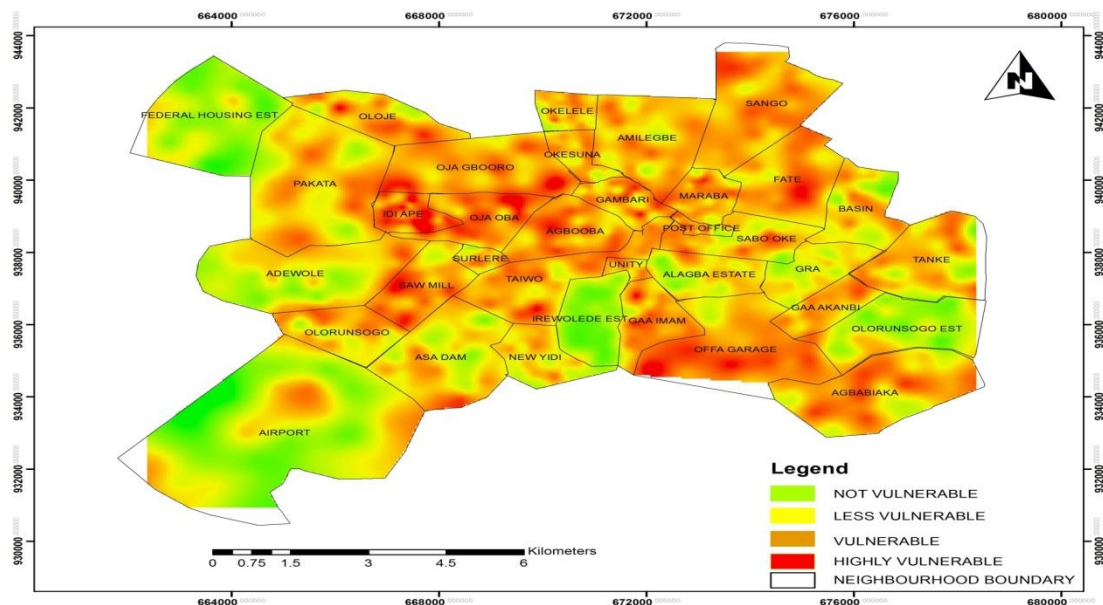


Figure 4: Crime vulnerability map of Ilorin based on socioeconomic, housing and environmental characteristics of neighbourhoods
Source: Author's Analysis, 2017

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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