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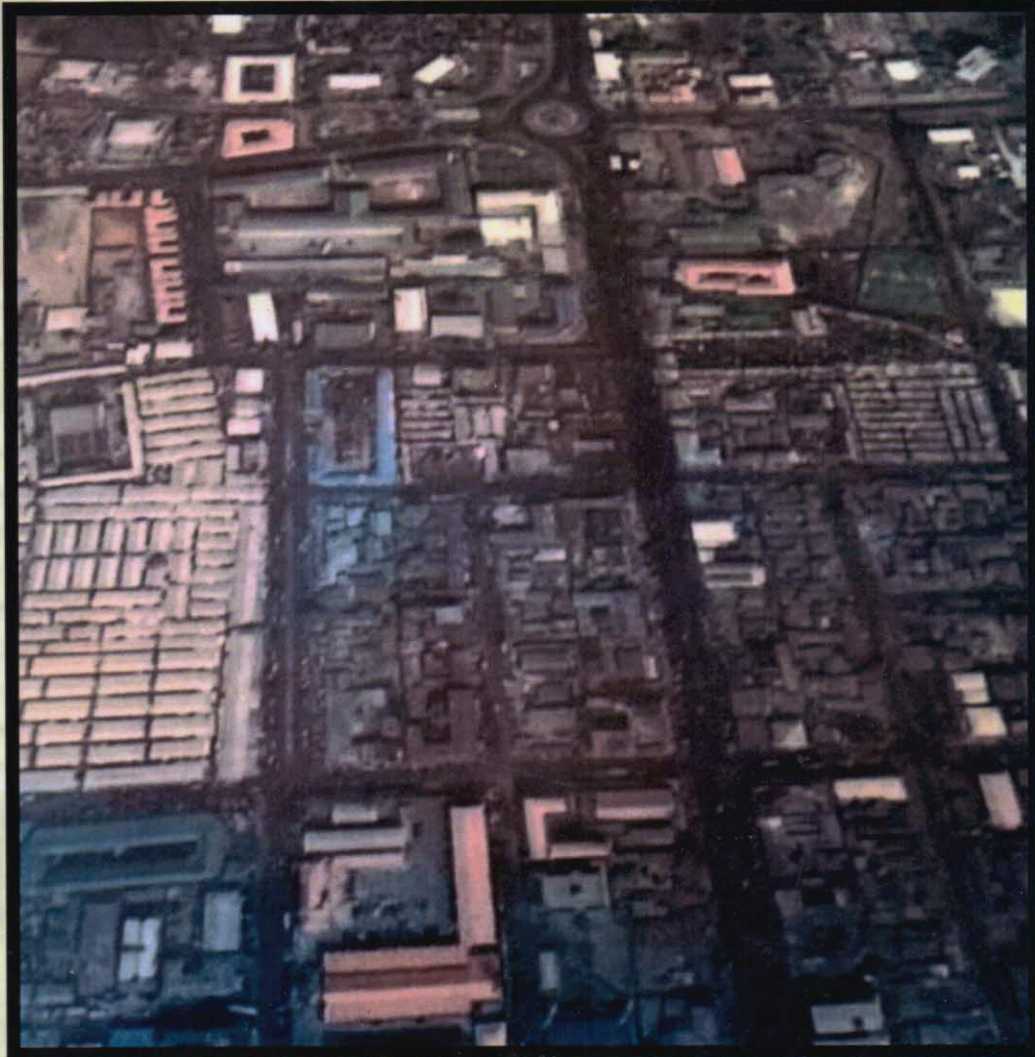
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ANALYSIS OF TEMPORAL LANDUSE CHANGE AND RESIDENT PERCEPTION OF PHYSICAL DEVELOPMENT EFFECT IN MINNA

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Abstract

Most populace in Niger state, Nigeria want to stay in Minna, the state capital because of the benefits derivable from it. The increase in the number of people coming into Minna has brought about an increase in the demand and the supply of the urban physical development in the study area. The persistence supply of this urban physical development without proper planning has brought about significant changes in the land use of the study area. This study is aimed at examining the temporal change in landuse and the perception of the people of the study area. The data used were sourced through primary and secondary sources, the primary data were gotten form the resident of the study area through the use of questionnaire. The data were analysed using a five point likert scale and the secondary data were analysed using image processing techniques. The results revealed that built up areas were evenly increasing in the study area with 1989 to 1999 experiencing the highest number of built- up, vegetation, marshed land, water bodies and rocky area experienced one reduction or the other. This implies that the increase in built- up and the reduction in vegetation has brought about a significant increase in the temperature of the area thereby affecting the water bodies. The study further revealed that the people of the study area are also engaged in quarrying. the questionnaire administered revealed that religious belief, sighting of educational facilities, presence of more white collar jobs and nearness of the study area to the F.C.T., investment incentives, advanced technology and better wages are responsible for the increase in urban physical development. The study further revealed that increasing urban physical development without control has brought about inadequate educational facilities, slum, poorly managed waste generated, hideout for criminals, traffic jam, inadequate social amenities and higher standard of living compared to its surroundings. The study thereby recommends that public awareness on the danger of uncontrolled physical development must be a recurring routine and proper punishment should be meted out to violators of physical development act so as to discourage those that do not want to comply.

Keywords: Landuse, Perception, Physical development, Urban growth, Slum

Introduction

According to World Bank (2009) and the United Nations (2010) who observed that more than half of the world's resident stay in urban areas.

This increases the demand for urban physical development thereby increasing the supply. The ever increasing supply of the urban physical development without proper

planning is a major cause of societal problems to the residents of Minna, Nigeria. Michael, (2014) observed that in the last two hundred years, world population has increased six times, stressing ecological and social systems. Urban sprawl is a global urban problem that has tremendous effects on our urban areas such as Minna, Nigeria which needs to be looked into so as to find a way to reduce this problem to the barest minimum. The benefits derived in urban areas such as Minna, Nigeria has opened new urban physical development in the study area. As a result, a huge land area of open spaces, marshland and vegetation has been changed to built-up area. In view of the on-going, this study seeks to know the changes that have occurred in the study area from 1989 to 2015, so as to know its implication on the environment in the area.

The only constant thing on earth is change. Change is a phenomenon that is inevitable in an urban setting. A hamlet transformed to a village, a village to a town, towns to a city and a city to mega city. All these changes, as both positive and negative effect on the environment. The increase in the provision of urban physical development has brought about gradual formation of slum, environmental blight, high crime rates, pressure on available facilities and infrastructures, traffic congestion and the presence of habitation for tout (Carmelo, 2012). All the above mentioned problems need to be reduced to the barest minimum so as to ensure comfortably and safety for the resident in the area and the generation unborn.

Jianlong (2008) disclosed the impact of urbanisation and advised that GIS should be used to curdle this problem. Ecological environment protection for the Desakota area should be paid enough attention and put into practice. Urbanisation leads to land use change and landscape pattern alteration, which responded obviously to the urbanisation phases. As the urban ecosystem is a complex ecosystem, it is important to consider both landscape metrics and social-economic factors in urban ecosystem studies. The sustainable problems of urban ecosystem can also be revealed using RS and GIS technology and CA model. Darvishzadeh (2000) change detection problems can be viewed as the consequence of an increase desire for up-to-date information about the development and changes in a GIS environment guide urban planners, urban decision makers and managers.

As Minna, grows rapidly, due to some factors, the growth has brought about so many problems for the populace in the study area. The present research seek to find solutions to all the identified problems and provide a good platform to the government and private investors to enable them look for a way of mitigating the effects brought about by the changes in urban physical development in Minna, Nigeria. Within the broad aim, the objectives of the study are to: examine the landuse pattern of the study area; determine the importance of the changes on the physical development of the study area and to examine the perception of the people to the observed impact.

The Study Area

Minna is located approximately between longitude 06°15'E and 06°35'E and latitude 09°25'N and 09°45'N (Figure 1) in the north central part of Nigeria. It is bounded by Kontagora in the south, Suleja in the northern part and Bida in the south-eastern part (Michael, 2014). Minna the State capital has twenty-one wards which comprises of Minna main, Minna South, Limawa A, Limawa B, Makera, Nassarawa A, Nassarawa B, Sabon Gari, Tundun wada to the south, Tundun wada North, and Nassarawa C, while the wards under Bosso Municipality includes; Beji, Bosso Central 1, Bosso Central 2, Chanchaga, Garatu, Kampala, Kado, Maikunkele, Maitumbi, and also

Shatta (Niger State Government, n.d). Minna has three major ethnic groups (Nupe, Gbagyi and Hausa). The town is comprised of both Muslim and Christian faith with a handful of traditional worshippers (Morenikeji, 2004). The population of the study area is 309,951 and it's as a population density and area mass of 2836 and 1679.5 squares.Kilometres. The study area experience distinct dry and wet season with rainfall varying from 1,100mm in the northern parts to 1,600mm in the southern parts. The Maximum temperature (usually not more than 30.5°C (87°F)) is recorded in March and June, while the Minimum is usually August at 25.1°C (77°F) (Morenikeji, 2004).

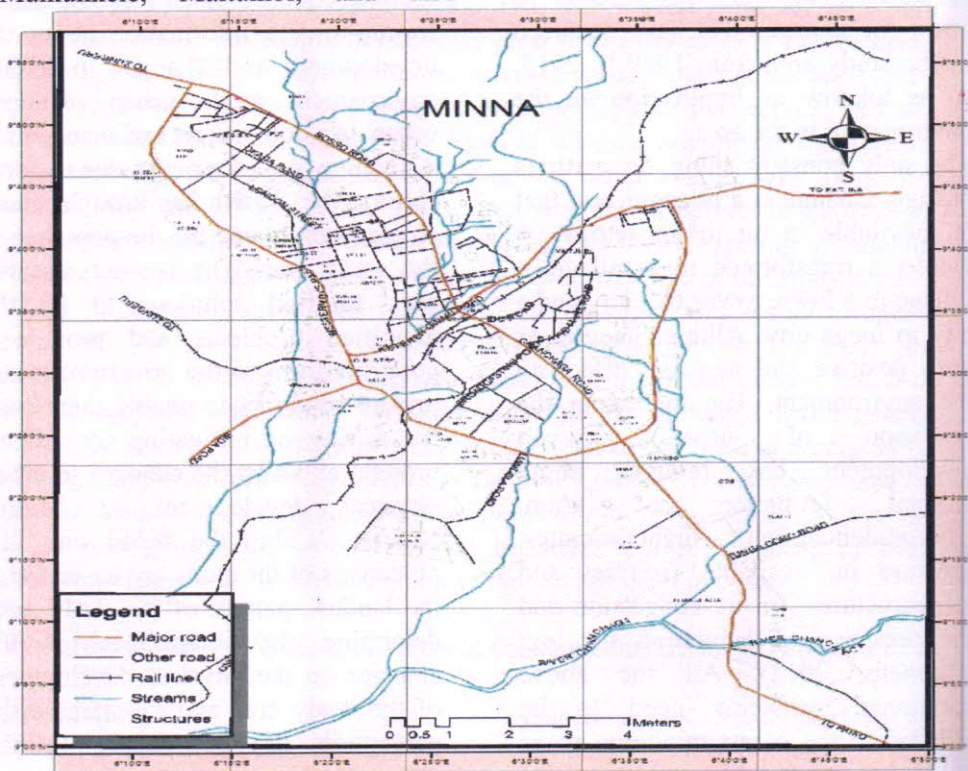


Figure 1. Minna, Nigeria.
Source: NASDRA, 2013.

Materials and Methods

In conducting this research, Four different satellite images were classified with emphasis on Minna from 1989-2015. Integrated Land Water information was used to compose the images classified; Erdas imagery was used for image classification re-sampling and subset of images. The entire study area was considered to generate the land use rate and the absorption rate laying emphasis on built- up area from 1989-2015. The entire study area was also divided into wards The wards chosen for the study includes; Minna Central, Minna South, Bosso Central, Bosso Central 2, Chanchaga, Mekera, Maikunkele. A total of 370 copies of questionnaires were randomly administered to the resident in the six wards selected. The causes of the increase in urban physical development and its effect on the

environment were analysed using parametric analysis of ordinary average likert scales. Results were presented using descriptive statistic.

Results and Discussions
 Minna Land Use in 1989

Figure 2 is the spread of Minna in 1989; the Red colour represents Built-up Areas which covered 12.47 km² (1.1%). Bare surface areas are represented in yellow colour was 17.38 km² (1.55%). Marshland is represented in gold colour and has a total area of 551.13 km² (49.26%). Light vegetation is represented in Olive green Colour with a total area of 400.32 km² (35.78%), Dense Vegetation is represented in Olive green colour and with a total area of 66.05 km² (5.94%), Rocks is represented in black colour with a total area of 67.65km² (6.05%) while blue represent water body which covered 3.41 km² (0.30%) see also Figure 1.0

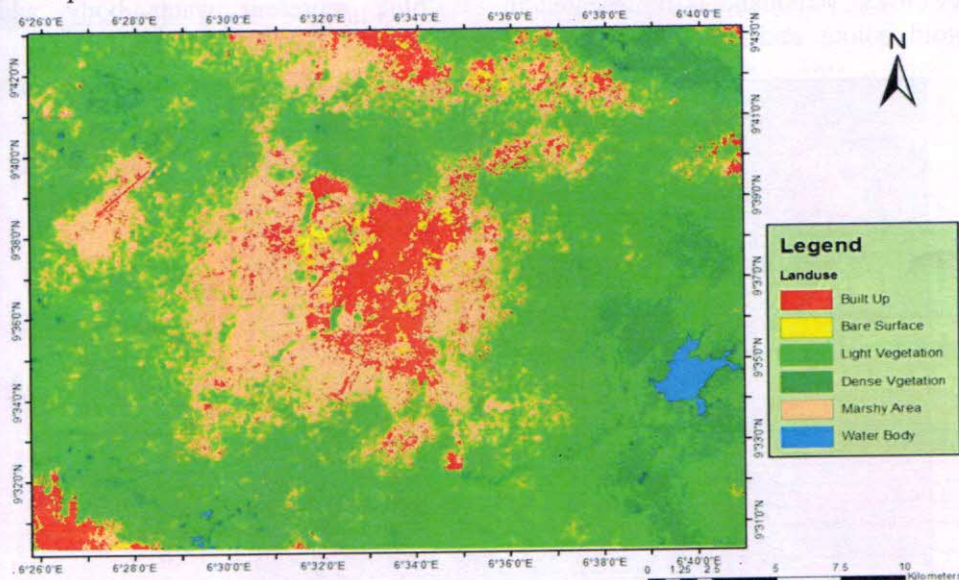


Figure 2: Minna Landuse Classification, 1989
Source: Author’s Data Analysis, 2016

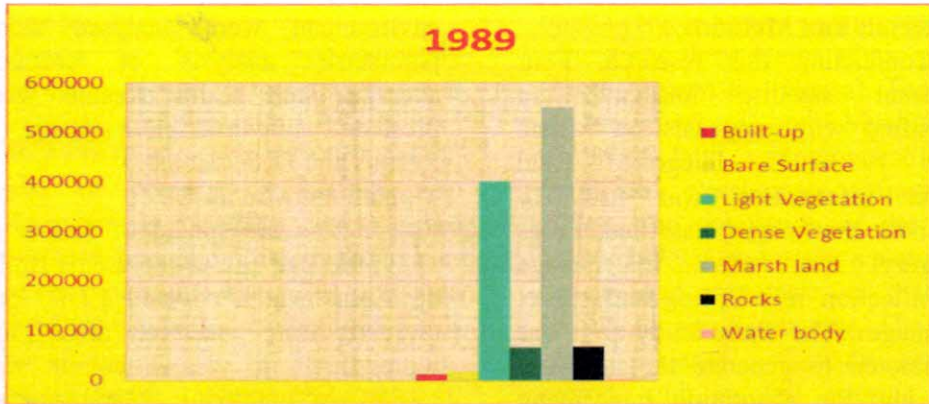


Figure 3: Landuse distribution of Minna (1989)

Source: Author’s Data Analysis, 2016

Minna Land Use in 1999

Figure 3 shows the statistics of Minna land use in 1999. The colours used represent the different classes of identification. The Red colour represents Built- up Areas which covered 30.62 km² (2.78%). Bare surface areas are represented in yellow colour, the use occupied 11.65 km² (1.06%). Marshland is represented in gold colour and has a total area of

518.564 km² (47.04%). Light vegetation is represented in Olive green Colour with a total area of 236.27km² (21.43%), Dense Vegetation is represented in Olive green colour and with a total area of 180.02 km² (16.33%), the rocky area is represented in black and has a total area of 121.75km² (11.04%) while blue represent water body which covered 3.45 km² (0.31%)

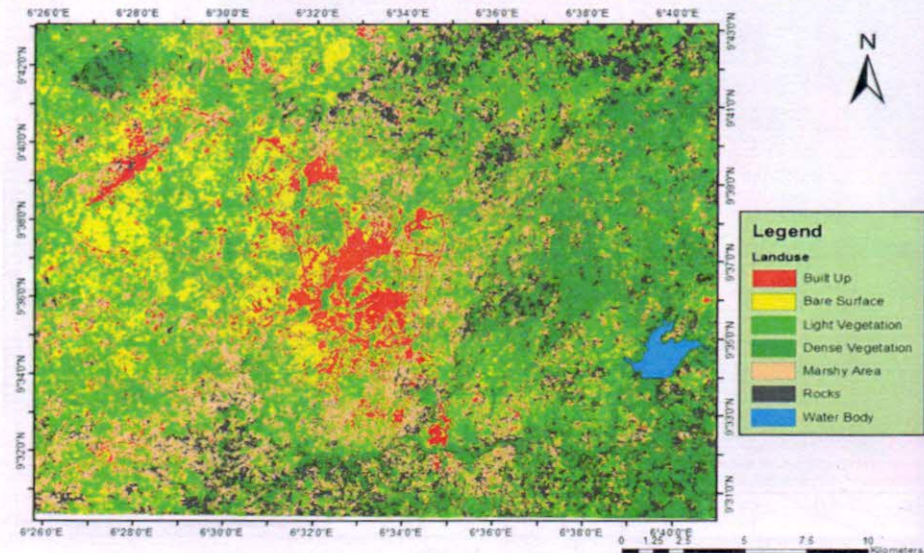


Figure 4: Minna Landuse Classification, 1999

Source: Author’s Data Analysis, 2016

The histogram below shows visually the quantities of Built up and Non- built up land class changes in 1999.

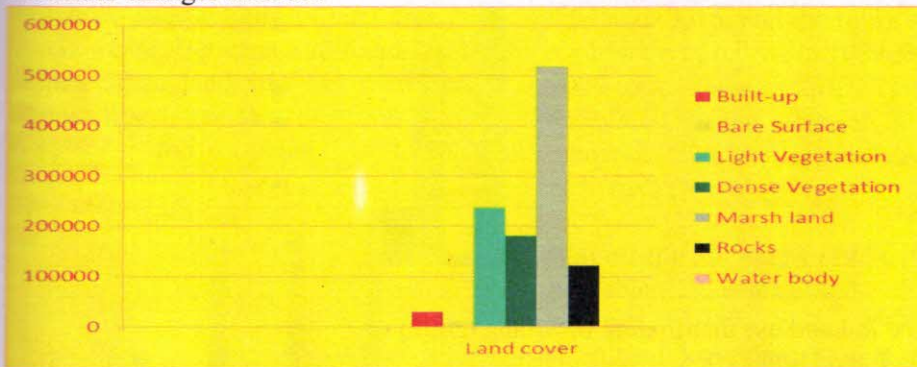


Figure 5: Land use distribution of Minna (1999)
 Minna Land Use in 2009

Figure 6 shows the landuse characteristic of Minna in 2009. Red colour represents Built- up Areas which covered 32.71 km² (2.97%). Bare surface areas are represented in yellow colour was 15.79 km² (1.43%). Marshland is represented in gold colour and has a total area of 414.75 km² (37.62%). Light vegetation is

represented in Olive green Colour with a total area of 507.37km² (46.03%), Dense Vegetation is represented in Olive green colour and with a total area of 20.48 km² (1.86%), the rocky area is represented by black colour with a total of 107.35 km² (9.74%) while blue represent water body which covered 3.89 km² (0.35%)

Minna landuse image of 2009

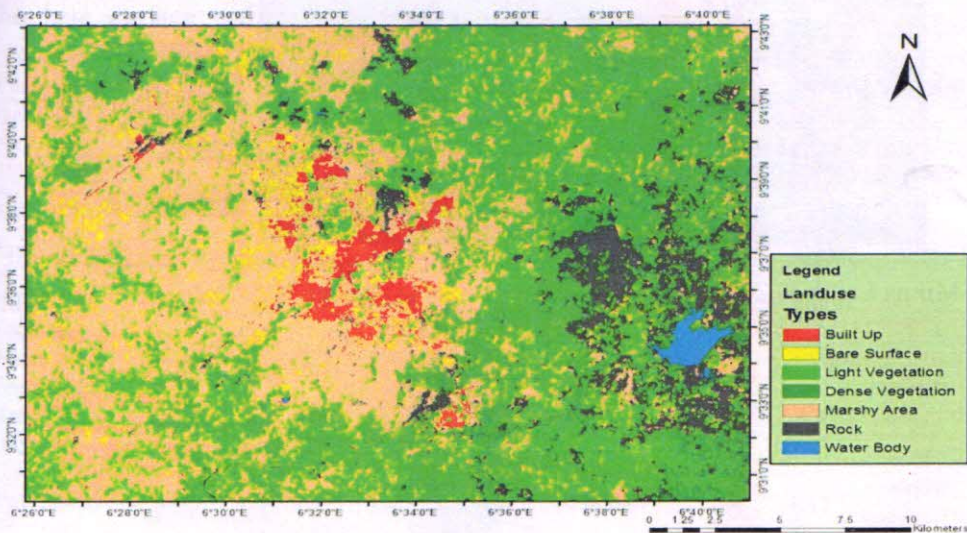


Figure 6: Minna satellite image of 2009

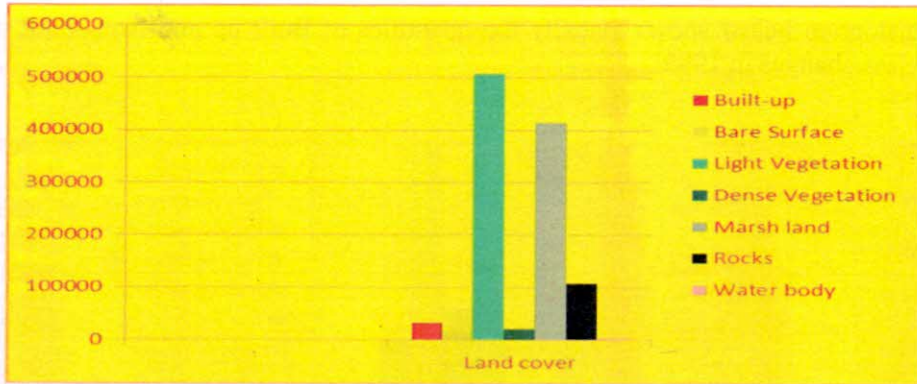
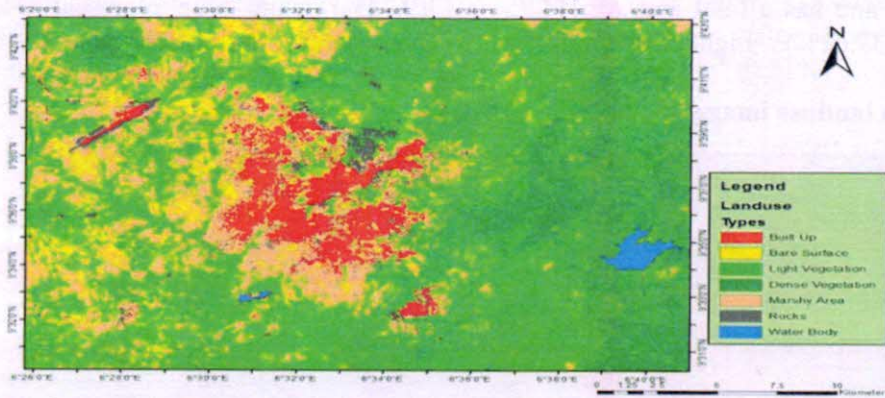


Figure 7: Land use distribution of Minna (2009)
Minna Land Use in 2015

Figures 5 and 6 shows the image characteristic of Minna in 2015. The Red colour represents Built- up Areas which covered 35.84 km² (3.25%). Bare surface areas are represented in yellow colour was 44.90 km² (4.07%). Marshland is represented in gold colour and has a total area of 227.70 km² (20.66%). Light vegetation is

represented in Olive green Colour with a total area of 623.32 km² (56.54%), Dense Vegetation is represented in Olive green colour and with a total area of 144.96 km² (13.15%), the rocks is represented in black colour with a total of 20.92 km² (1.90%) while blue represent water body which covered 4.74 km² (0.43%)



Minna Landuse 2015

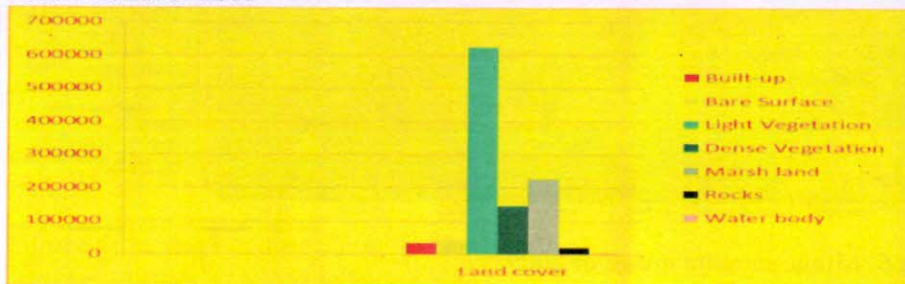


Figure 8: Land use distribution of Minna (2015)

Virtually every area in Minna has expanded substantially in land area in recent years. Between 1989 and 2011 Minna urban land area has increased almost five times that of 1989, from 0.81% to about 4.06%.

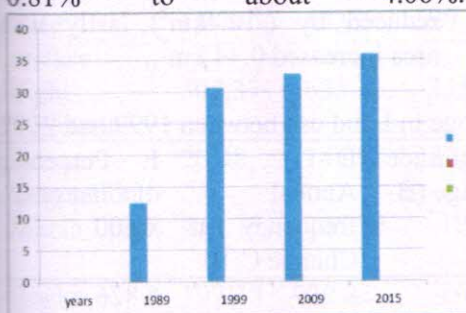


Figure 9: Growth percentage in Built up Area in Minna (1989-2015)

Light Vegetation increased from 35.78% in 1989 to 56.54% in 2015, Built-up area rose from 1.1% in 1989 to 3.25% in 2015, Dense Vegetation cover shows variation between the study period, it was 5.94% in 1989, 1.86% in 2009 and 13.15% in 2015. Marshland was 49.26% in 1989, 37.62% in 2009 and 20.66% in 2015, the bare surface had a variation of

1.55% in 1989, 1.43% in 2009 and 4.07% in 2015, and the rocks also had a variation of 6.05% in 1989, 9.74% in 2009 and 1.09% in 2015. The reason accounted for the variation is that the image of 2009 was captured during the wet season.

Magnitude of change (1989-1999)

In Table 1, the magnitude of change between 1989 and 1999 was calculated by subtracting B from A (Land use in 1989 from 1999). The percentage of change (E) was calculated by dividing the magnitude of change C of each of Land use by ten years (reference year and multiply by 100 ($C/10 \times 100$)). Built-up area increased by 18.15km^2 , bare surface reduced by 5.73km^2 , light vegetation experienced reduction by (-164.05km^2), Dense vegetation increased by 113.52km^2 , Marshy area reduced by (-32.57km^2) while rocky area and water area increased by 54.1km^2 and 0.04km^2 respectively.

Table 1: Magnitude and percentage of change in Land use between 1989 and 1999

Classes	A (1989)	B (1999)	C Magnitude of Change (B-A)	D Annual frequency of Change C/10	E Percentage of Change $C/A \times 100$
Built-up	12.47	30.62	18.15	1.815	145.55
Bare Surface	17.38	11.65	-5.73	-0.573	-32.97
Light Vegetation	400.32	236.27	-164.05	-16.405	-40.98
Dense Vegetation	66.50	180.02	113.52	11.352	17.07
Marsh land	551.13	518.56	-32.57	-3.257	-5.91
Rocks	67.65	121.75	54.1	5.41	79.97
Water body	3.41	3.45	0.04	0.004	1.17
Total	1118.86	1102.32	-16.54	-1.654	163.90

Source: Authors' analysis, 2015

Magnitude of change (1999-2009)

In the Table 2 the magnitude of change between 1999 and 2009 was calculated by subtracting B from A (Land use in 1999 from 2009). The percentage of change (E) was calculated by dividing the magnitude of change C of each of Land use by ten years (reference year and multiply

by 100 (C/10*100). Built- up area increased by 2.09 km², bare surface increased by 4.14 km², light Vegetation increased by 271.1 km², Dense vegetation reduced by (-159.54km²), Marshy area reduced by (-103.81 km²) while rocky area reduced by (-14.4km²) lastly water area increased 0.44 km².

Table 2: Magnitude and percentage of change in Land use between 1999 and 2009

Classes	A (1999)	B (2009)	C Magnitude of Change (B-A)	D Annual frequency of Change C/10	E Percentage of Change C/A x 100
Built- up	30.62	32.71	2.09	0.209	6.826
Bare surface	11.65	15.79	4.14	0.414	35.536
Light Vegetation	236.27	507.37	271.1	27.11	114.742
Dense Vegetation	180.02	20.48	-159.54	-15.954	-88.62
Marsh land	518.56	414.75	-103.81	-10.381	-20.019
Rocks	121.75	107.35	-14.4	-1.44	-11.828
Water body	3.45	3.89	0.44	0.044	12.75
Total	1102.32	1102.34	0.02	0.002	49.387

Source: Authors analysis, 2015

Magnitude of change (2009-2015)

In Table 3, the magnitude of change between 2009 and 2015 was calculated by subtracting B from A (Land use in 2009 from 2015). The percentage of change (E) was calculated by dividing the magnitude of change C of each of Land use by six years (reference year and multiply

by 100 (C/5*100). Built- up area increased by 3.13 km², bare surface increased by 29.11 km², light Vegetation increased by 115.95 km², Dense vegetation increased by 124.48km², Marshy area reduced by (-187.05 km²) while rocky area reduced by (-86.43 km²) lastly water area increased 0.85 km².

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 Physical Development Effect in Minna

Table 3: Magnitude and percentage of change in Land use between 2009 and 2015

Classes	A (2009)	B 2015	C Magnitude of Change (B- A)	D Annual frequency of Change C/10	E Percentage of Change C/A x 100
Built-up	32.71	35.84	3.13	0.523	9.569
Bare surface	15.79	44.90	29.11	4.852	184.357
Light Vegetation	507.37	623.32	115.95	11.595	22.853
Dense Vegetation	20.48	144.95	124.48	20.745	607.813
Marsh Land	414.75	227.70	-187.05	-31.175	-45.099
Rocks	107.35	20.92	-86.43	-14.405	-80.512
Water body	3.89	4.74	0.85	0.142	21.851
Total	1102.34	1102.25	0.04	-7.721	720.832

Source: Authors analysis, 2015

Table 4: Consensus opinion of the residence of Minna, Niger state on the causes of urban physical development in Minna, Niger state.

Opinion	Mean	Consensus Opinion
Religious belief (not using contraceptives) has contributed to the increase of the population and urban physical development in Minna, Niger state.	4.0	Agree
The sighting of Educational facilities such as Federal University of Technology, College of Education, and School of Health has led to the increase in the demand for urban physical development thereby increasing the supply of these urban physical developments in Minna, Niger state.	3.5	Agree
Minna, Niger state has more white collar jobs opportunity compared to the surrounding rural areas of the state.	3.7	Agree
So many workers in the federal capital territory settle in Minna, Niger state because of the affordability of housing, cheaper and lower standard of living in the study area compared to the federal capital territory.	3.7	Agree
Investment incentive given to investors has increased the urban physical development in the study area.	3.5	Agree
Advance technology, acceptance of single parenthood and deterioration of morality as increased the population of the people in Minna, Niger state thereby increasing the urban physical development in the study area.	3.0	Undecided
Better wages for services done is paid in Minna, Niger state than the surrounding rural areas.	3.5	Agree

Table 4. Consensus opinion of residence of Minna, Niger state on the effects of urban physical development on the environment in Minna, Niger state.

Opinion	Mean	Consensus Opinion
The Educational facilities in Minna, Niger state are adequate for its population.	2.3	Disagree
The waste generated in Minna, Niger state is little and well managed.	2.4	Disagree
Due to the improper provision of urban physical development the study area has the presence of slum.	3.6	Agree
The cluster and improper provision of urban physical development has created hide out for criminals and tugs that terrorises the area.	3.3	Undecided
Traffic jam is always experienced when going to work in the morning and when coming back from work in the evening.	3.5	Agree
There are many unemployed legible workers in the town.	3.7	Strongly Agree
The social amenities and public facilities are not adequate.	3.5	Agree
The rate at which people come in to Minna, Niger state far exceeds the speed at which urban managers and town planners respond to its dynamicity due to inadequacy of the facilities to carry them out	3.5	Agree
The affordability of decent houses in rural area and surroundings is far better than the houses in Minna, Niger state.	3.3	Undecided
Food is cheaper in the rural part of the state than in Minna, Niger state.	3.5	Agree

Discussion of Results

Consensus opinion of the residence of Minna, Niger state on the causes of urban physical development in Minna, Niger state.

Table 4 showed that the majority of the respondents agreed that religious belief (not using of contraceptive) has contributed to the increase of the population and urban physical development in the study area, most of the residents also agreed that the sighting of educational facilities such as Federal University of Technology, College of Education and School of Health Technology has led to the

increase in the demand for urban physical development thereby increasing the supply of these in the State. Furthermore, the majority of the residents in the study area agreed that Minna, has more white collar jobs opportunities compared to the surrounding rural areas of the state, they agreed that so many workers in the Federal Capital Territory settled in Minna because of the affordability of housing, cheaper and lower standard of living compared to the Federal Capital Territory. Most of the residents in the study area agreed that the incentives given to investors in the state has caused increase in urban

physical development in the area, it was also undecided by the residents of the study area whether advanced technology, acceptance of single parenthood and deterioration in mortality rate has increased the population of the people of the study area thereby increasing the urban physical development of the area. Finally, the majority of residents agreed that better wages paid for services done in the study area than its surrounding rural areas has also caused an increase in urban physical development.

Consensus opinion of residence of Minna, Niger state on the effects of urban physical development on the environment in Minna, Niger state.

From the data gathered and analysed in Table 5, it is seen that most of the residents in the study area disagreed that the educational facilities in the study area are adequate for its population. The majority of the residents in the study area agreed that due to the improper provision of urban physical development in the study area, has contributed to the generation and presence of slum, they were also undecided about the opinion that the cluster and improper provision of urban physical development has created hideout for criminals and thugs that terrorises the study area. It was agreed that traffic jam is always experienced when going to work in the morning and when coming back in the evening, it was also agreed that there are many unemployed people in the study area. The social amenities and public facilities in the study area is agreed not to be adequate. Furthermore, it was agreed that the rate at which people come into Minna,

far exceeds the speed at which urban managers and town planners respond to its dynamism due to inadequacy of the facilities to carry them out, the majority of the respondents were undecided about the opinion that the affordability of decent houses in rural area and surroundings is far better than the houses in Minna, Niger state. Finally, it was agreed that food is cheaper in the rural part of the state than in Minna, Niger state.

Conclusion

Minna, an ever increasing urban area in population has brought about changes from other class of urban physical development to increase in the supply of the built-up class of the urban physical development. The increase in the built-up areas and the decrease in vegetation and the water body will no doubt have effects on the residents in the study area. Unplanned urbanisation is one of the major factors that have brought about these effects. The several benefit derived in Minna, has been proven to be one of the main reason that causes the changes in the classes of urban physical development thereby causing so many negative effect on the environment in the urban setting. The built-up provided cannot be destroyed to do away with this long accumulating problem but ways to mitigate and adapt to this problem can be provided.

Recommendations

- i. Efforts should be made to evenly distribute the use of each class of urban physical development available in the study area.
- ii. Preference shouldn't be given to urban areas alone to reduce the massive movement of people into

it. The rural areas too must be developed equally and must have many benefit attached to staying in rural areas.

iii. Environmentalist should organise public awareness programmes that would enlighten the resident in the study area about the danger of not strictly following the laid down plans that would benefit everyone.

iv. The use of environmental friendly urban physical developmental processes should be encouraged so as to safe guard our environment.

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