*International Journal of Academic Research in Business and Social Sciences*
*June 2015, Vol. 5, No. 6*
*ISSN: 2222-6990*

# Application of Remote Sensing and Geographic Information System in Monitoring the Dynamics of Landuse in Minna, Nigeria

**G. Morenikeji[1], E. T. Umaru[*2], S. H. Liman[3] and M. A. Ajagbe[4]**

[1]Centre for Disaster Risk Management and Development Studies.
[2]Urban and Regional Planning Department.
[3]Estate Management and Valuation Department
Federal University of Technology, Minna, Nigeria.

[4]Centre for Entrepreneurship Development Studies
Department of Business Management
Covenant University, Nigeria.

DOI: 10.6007/IJARBSS/v5-i6/1682 URL: http://dx.doi.org/10.6007/IJARBSS/v5-i6/1682

**ABSTRACT**
Urban expansion and increasing land use changes in Minna is a function of increase in population. There is increasing pressure on land, water and environment, particularly in the core area of Minna, therefore, this study set to monitor the Dynamics of Landuse in Minna using Remote Sensing and Geographic Information System application. The Landsat TM (Thematic Mapper) satellite images for year 1986, 1996, 2006, Landsat ETM+ (Enhanced Thematic Mapper Plus) images for years 2011 were used. The results were subjected to various statistical analyses and it shows that Agric Land increased from 54.75% in 1986 to 58.15% in 1996 and rose to 89.11% in 2011, natural vegetated area coverage decreased from 43.79% in 1986 to 0.20% in 1996 and extended to 24.32% in 2006, and later decreased to 5.77% in 2011.The rate of growth of Built-up area between 1986, 1996, 2006 and 2011 are 0.81%, 2.93% and 4.06% respectively. Loss of naturally vegetated area in Minna is mainly as a result of urban growth and expansion, farming and gully erosion. The study recommended that City wide infrastructure such as water supply, road and drainage should be provided and should be commensurate to the rate of the sprawl and population.

**KEYWORDS:** Urbanization, Sprawl, Land-use and Urban Growth.

## INTRODUCTION

Cities grow from inward to outward as a result of urbanization and gradually transform the original land use such as open space, vegetation zones, agricultural and residential into a desire purposes (Duncan et al. 2012; Eluwa et al. 2012). Minna has grown to such extent that most of

the aforementioned have been altered by quest for space for development by the developers. United Nation Population Fund, 1999 affirmed that 80% of the world population would live in the city by the year 2025, therefore one should expect more sprawl in urban centers including Minna. This urban sprawl would cause loss of natural vegetation, open spaces, productive agricultural land, urban development that were nucleated before are now occupying landscaped areas (Cunningham 2003; Mahmud and Achide 2012). The city of Minna therefore, requires immediate overhauling to provide harmonious city that provides major necessities, such as safety, water, community health care, education and other amenities.

**REVIEW OF LITERATURE**

Urbanization process bring about urban change. Sylvia (2000) attributed rising standards of living combined with economic and societal structural changes to a continuous increase in land used for residential, industrial, commercial, and infrastructure purposes which is one of the most noticeable trends in Minna urban form. Daramola and Ibem (2010) quoted that the world's population is put at about 6.572 billion people out of whom the United Nations data indicated that about 3 billion people (50 percent) live in urban areas (UNCHS 2007). World Bank, 2000 as quoted in IMF, 2006, stated that about 66 percent of the entire world's population were residing at the fringe in the early 1950s, in the same vain, recent statistics show that by 2030, about 61 percent of the total population in the world will be residing in the cities; and that all the world's increase in population in the next three decades will occur in low and middle income countries (Peters 2000:2; UNFPA 2007).

United Nations estimate shows that in all the twenty countries identified as possessing the lowest Human Development Index (HDI) in 2005, approximately 19 representing 95 percent are domicile in Africa. UN-HABITAT, 2005a claimed that over 166 million urban slum dwellers has been identified in the sub-Saharan Africa, which also represent about 71.9 percent of its total urban population, and thus there is increasing urban poverty and low life expectancy in the region. High rate of urbanization in Nigeria which stands at 5.3 percent which is also among the highest in the world has the tendency of spurring up environmental degradation (Goldstein 1990; Umaru et al. 2012; Ho et al. 2011). Similarly, urbanization has caused most urban areas in Nigeria to have grown beyond their environmental carrying capacities and existing infrastructure (National Population Commission 1998). Land use /cover bring about urban expansion that always cause major environmental problems like water pollution, loss of agricultural lands, soil erosion and some social and economic as highlighted by Soffianian et al. (2010). Similarly, Batisani et al. (2009) concurred that Sprawling urban development is a major driving force of landscape fragmentation and loss of agricultural land. Arshad Amin et al. (2012) opine that the eeconomic and social growth of a state depends also on level of urbanization. Urbanization affects environmental settings; it brings about changes in the land-scape, agriculture and forestland.

**URBANIZATION IN MINNA**

Niger State was created on 3rd February, 1976 from the defunct north-western state by the Late Head of State, General Murtala Ramat Mohammed. The State however, came into being on 1st April, the same year. At the inception of the State Administration in 1976, there were only eight local government areas. Right now they have grown up to twenty five local government areas. The population of Minna as compiled by Sanusi (2006), rose from 59 989 in 1963 to 76 480 in 1979, to 190 750 in 1991 and to 440 251 in 2002. Minna the capital of Niger State has grown from a compact settlement that it used to be. The settlements only grow around the railway station as far as 10 to 15 km from the center of the town. Since then, the land area of Minna has expanded from about 800 hectares in 2000 to over 10 000 hectares in 2005 (Sanusi 2006; Eluwa et al. 2012; Umaru et al. 2012). Since 1999, the city has experienced change in both pace of growth and types of space occupied for development (Sanusi 2011). It has a total area of 74,344 $km^2$ wide. Max Lock (1979) posit that it is approximately 8% of the land area of the country (See figure 1.1 and 1.2 below). Minna of today started as a scattered settlement on hill top around nineteenth Century? Minna town got its name from the word, Myina. Myina itself is derived from a cottage on the hills outside the outskirt of the town; the famous 'zaure' or mud huts on top of Paida hill and the burning of fire. This is an annual ceremony practiced by the Gwaris (Fabiyi 1984).

Minna was already in existence during the reign of Umar Nagwamatse, a descendant of Dan Fodio. Nagwamatse was said to have raided Minna on many occasions (Fabiyi 1984). Constant attacks of Minna settlement by Nagwamatse and the need for protection from external invasions made the choice of settlement on hilltop attractive to the earlier settlers. Railway system constructed by the Colonial masters started the conglomeration of Minna. The town was linked with rail lines in 1905, Minna harbor two major railway crossing, Kano-to-Baro railway (1911) and the extension of the Lagos-to-Jebba line (1915) which gave Minna comparative advantage over other towns in Nigeria as a major collecting point for many farm produce (groundnuts, cotton, yams, and Shea nuts. The larger part of residential development was concentrated around the railway station. Around 1950, a traditional ruler was appointed as first chief of Minna (Alhaji Ahmadu Bahago Kuta) who was also serving as Sarkin Minna and Sarkin Kuta-in-Council (Ibid). Around 1924 Colonial administration moved from Bida to Minna, the exodus gave birth to basic administrative departments and functions that made Minna to be a center of attraction to migrants. The transition led to the construction of Zungeru-Paiko road in 1928, in the same year, Minna remained scattered developments emerging urban centre with isolated villages.

Available figures from Fabiyi, 1984 show that in 1934, Minna population was approximately 5000. In 1954, there were 3005 male tax payers in Minna. Given a similar number of females and children population of about 40 percent, the population of Minna might have stood at 20 200 in 1954. With the approach of National Independence in late 1950s, Minna became attractive to both the people and governments. The political activities that preceded and followed independence and their spill-over effects in economic activities attracted people into Minna. In

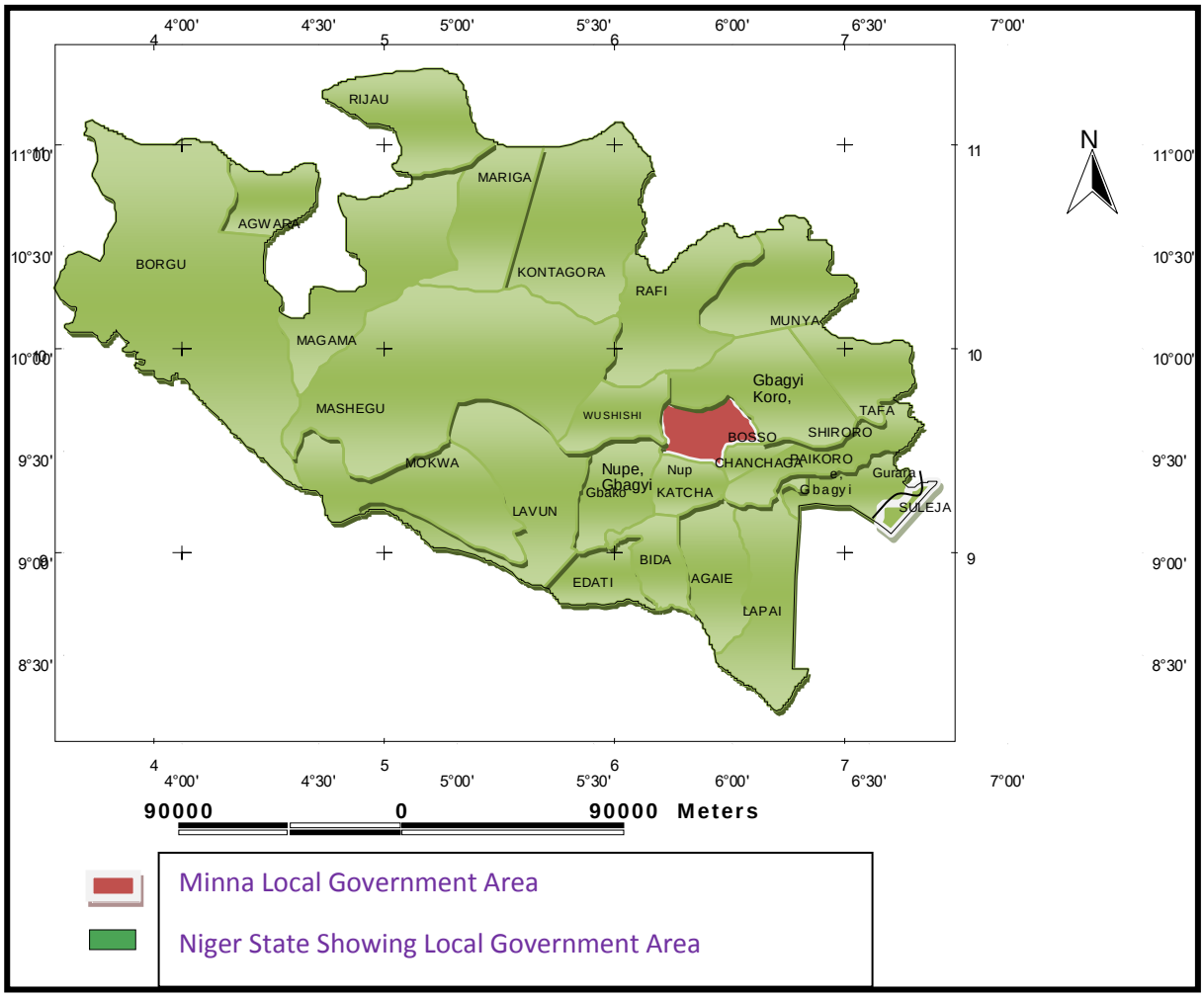
1956, Minna was connected with electricity supply. Already, from 1949, it had been enjoying water supply from a dam on River Suka in Bosso.

The effect is a large population recorded in 1963 National Population Census. So, the town had a population of 59, 988 people. That was between 1934 and 1963, Minna population increased at an average annual growth rate of 9% this is about ten times growth rate. In 1979, the population of Minna was estimated at 76,480 (NPC, 1963). The population census of 1991 gave the population of Minna metropolis as 190,750 with an annual growth rate of 7.9%, the population of Minna between 1979 and 1991 increased by about two and a half times the 7.9% growth rate within this period is well above the national population growth rate of 2.83% given by the National Population Census of 1991. Changes in political status of Minna, having become a state capital in 1976; the establishments of the State's College of Education (1976), the Federal University of Technology (1981) and other tertiary institutions and federal institutions could account for the higher growth rate between 1979 and 1991. All these led to influx of people from within and outside Niger state into Minna. It should be emphasized that the practical influence of Abuja on Minna makes the adoption of the higher population estimates for the town more acceptable.

In term of built-up area, Minna area extent increased from 884 hectares in 1979 to 5336 hectares in 1983 and to 7070 hectares in 1993 (Bashir 2001). The phenomenal growth of Minna after its choice as a state capital can be seen in the difference between its built-up area in 1979 (three years after its choice as a capital) and 1983 (seven years after). With additional land area of 4452 hectares, the town witnessed an annual growth rate of 30% in its area coverage within 1973-1983 periods while between 1983 and 1993 Minna land area grew at the rate of 2.9%.

The urbanization of Minna is also observable in the increase in the number of its administrative wards from six in 1950 to 11 by the end of 1990s. The eleven wards are RafinYashin, Limawa A, Limawa Ward, Minna Central, Sabon Gari, Tudun Wada North, Tudun Wada South, Maitumbi, Nassarawa A, Nassarawa B, Minna South, Chanchaga. These are broad divisions for urban administration. Figure 1 below shows the location of Minna in Niger State, while figure 2 shows the location of Niger State in Nigeria.

Figure 1: **Location of Minna in Niger state**
Source: Ministry of Land and Housing, Minna (2013)



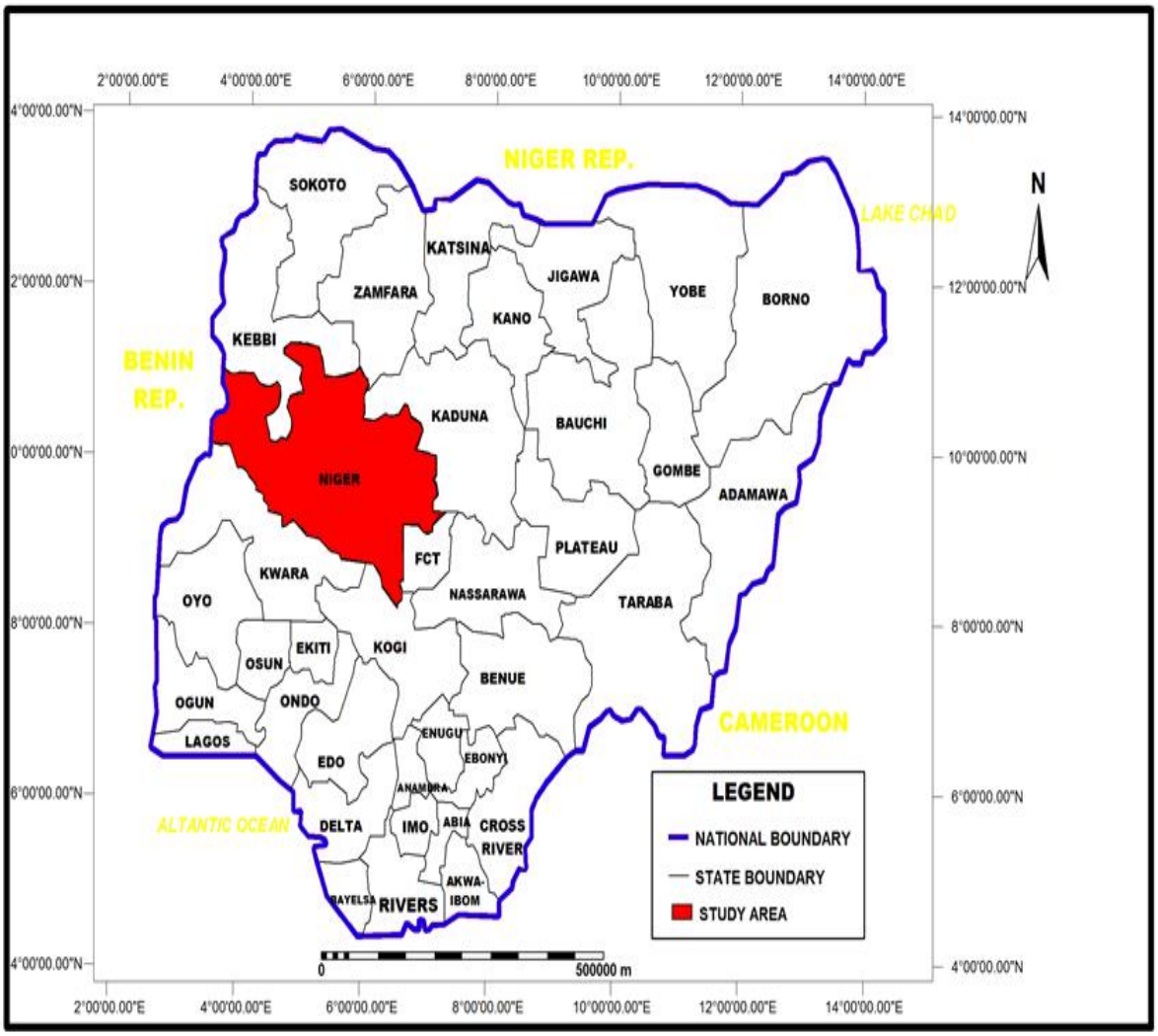



Figure 2: Location of Niger State in Nigeria
Source: Ministry of Land and Housing, Minna (2013)

## METHODOLOGY

Since this study involves city growth monitoring, it requires the use of imageries taken at different times. Three sets of satellite raw imagery for Minna for 1986, 1996, 2006 and 2011. The imageries of 1986 ,1996, 2006 and 2011 are the American Land-sat series Thematic Mapper (TM) and Enhance Thematic Mapper (ETM) All the satellite imageries were obtained from the National Centre for Remote Sensing, Jos Plateau state and Global Land Cover Facility (Maryland). The software used for this project include, Integrated Land Water Information

Table 1: **Land-use and land-cover classification scheme:**

| S/N | Classification | Description |
|---|---|---|
| 1 | Built-up area | All residential, commercial and industrial areas, village settlement and transportation infrastructure. |
| 2 | Agric land | Cropland and pasture, Orchards, groves, vineyards, nurseries, and ornamental, horticultural areas, Confined feeding operations. |
| 3 | Wetland | Swamp, waterlogged. |
| 4 | Vegetation | Trees, shrub land and semi nature vegetation, deciduous, coniferous and mixed forests, palms, orchids, herbs, gardens and grasslands. |
| 5 | Water body | River, permanent open water, lakes, ponds, canals and reservoirs. |

**Author, 2013**

## METHOD OF DATA ANALYSIS

### Image processing techniques (classification)

The raw images got from National Center for Remote Sensing, Jos, Plateau were subjected to various classifications. Vegetation appears as red and rocks appear dark grey. Water surfaces appear blue. Topographic map of the area was also overlain on the colour composite image to enhance topographic features .The image was also passed through the edges enhancement filter which made the image sharper. A supervised classification was then performed which was based on the researchers acquired knowledge of the study area and the surface cover types present on the image. A sample set was created before sampling (classification) started. During sampling, class names were assigned to groups of pixel with similar spectral values that are supposed to represent a known feature on the ground (structured classification). A sample set thus stores locations of sampled pixels and the assigned class names. In classifying the satellite image of Minna, sample set were created: First step is to go to the file menu of the main window, choose the create command or double click the sample set item in the operation list and a dialog box will appear. Second step is giving the sample set a name and select an existing

class domain which contains the class names that will be used during sampling (open the list box by clicking it), or create a new class domain by clicking the create button. (Note five classes were created during sampling of the three set of satellite images, the classes are: built-up area, marsh land, water body, agriculture land and vegetation) Third step: Un-supervised classification is then carried out. Fourth step is double clicking on maximum likelihood classifier on the dialog box displayed and give the sample set a desired output name e.g. minna_10classify. To get the statistics of the work done (classification) right click on the raster mp of the classified image, an array of options are displayed, click on statistics and select the option histogram.

**RESULTS AND DISCUSSION**

Figure 3 below is the 1979 Minna existing land use; about 884.0 hectares of the land were developed, Low Density Urban takes 129.2 hectares (14.3%), Medium Density Urban occupied 182.2 hectares (20.6%), High Density occupied 174.5 hectares (19.7%) and Institutional occupied 398.1 hectares (45.0%), meanwhile over half of the developments were non-residential. Low Density zone comprised of G.R.A and newly developed sites. The Medium Density includes intermediate staff quarters and uncompleted layout and other town expansions, while the High Density includes other traditional town areas such as shops, primary schools, streets, offices, markets and other non-residential areas.

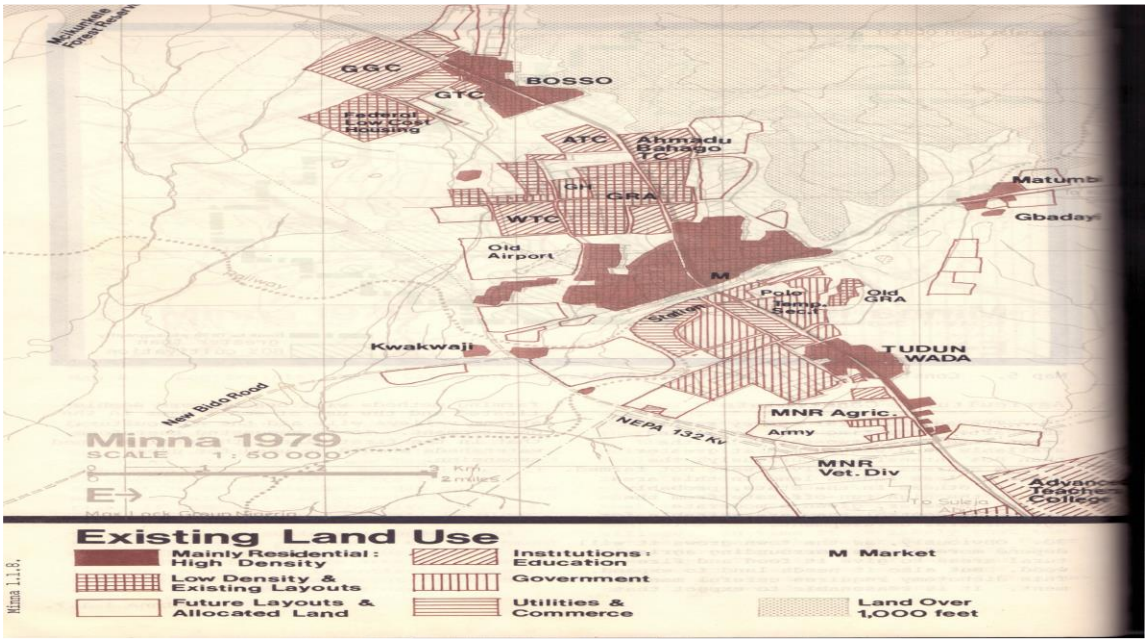



**Figure 3: Existing Land use of Minna in 1979**
**Source: Max Lock, 1980**

**Minna Land Use in 1986**

Figure 4 is the spread of Minna in 1986; the Green colour represents Agricultural Land which covered 404.05 km$^2$ (54.75%). The built –up areas is represented in Red colour was 5.99 km$^2$

(0.81%). Marshland is represented in gold colour and has a total area of 2.26 km$^2$ (0.31%). The Vegetation is represented in Yellow colour and with a total area of 323.15 km$^2$ (43.79%), while blue represent water body which covered 2.58 km$^2$ (0.35%) see also figure 5.

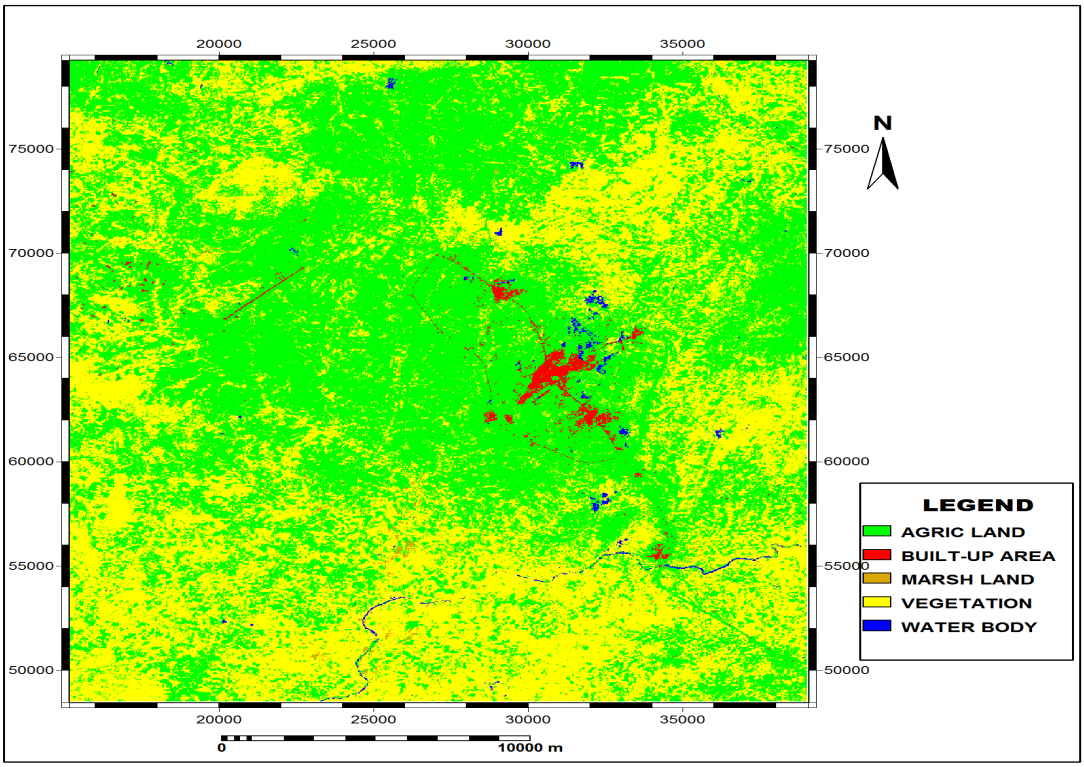
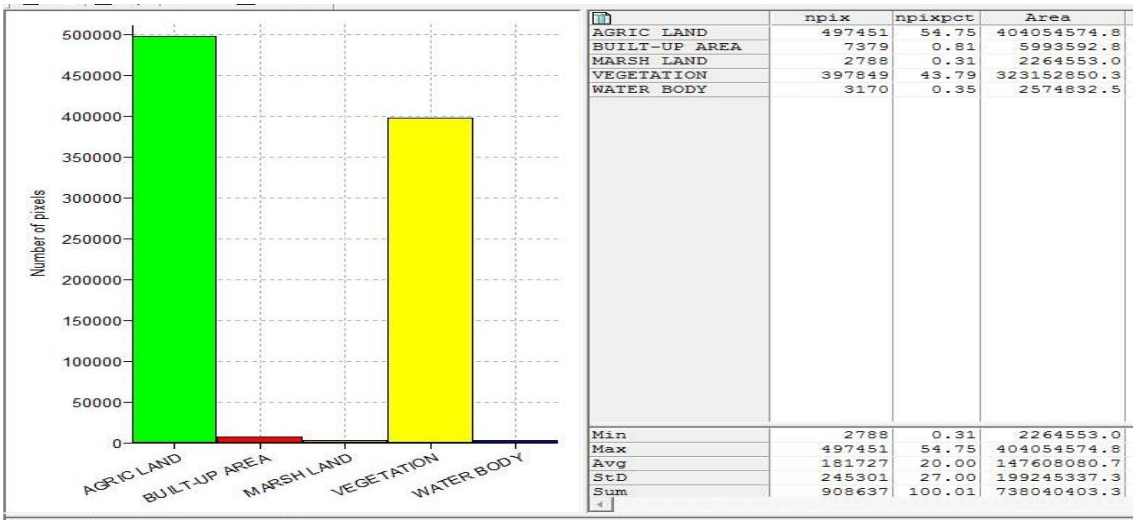



Figure 4: Minna satellite image of 1986




| | npix | npixpct | Area |
|---|---|---|---|
| AGRIC LAND | 497451 | 54.75 | 404054574.8 |
| BUILT-UP AREA | 7379 | 0.81 | 5993592.8 |
| MARSH LAND | 2788 | 0.31 | 2264553.0 |
| VEGETATION | 397849 | 43.79 | 323152850.3 |
| WATER BODY | 3170 | 0.35 | 2574832.5 |
| Min | 2788 | 0.31 | 2264553.0 |
| Max | 497451 | 54.75 | 404054574.8 |
| Avg | 181727 | 20.00 | 147608080.7 |
| StD | 245301 | 27.00 | 199245337.3 |
| Sum | 908637 | 100.01 | 738040403.3 |

Figure 5: Histogram of Minna Land use (1986)

**Minna Land Use in 1996**

Figure 6 shows the statistics of Minna land use in 1996. The colours used represent the different classes of indentification. Agricultural land is represented in Green colour with an area of 429.14 km$^2$ which also increased to 58.15%. The built-up area is seen to have expanded compared to how it was in 1986. The total area of built-up area has increased from 5.99km$^2$ to 17.77 km$^2$ (2.41%) in 2006. Marsh land is represented in Gold colour show an area of 162.54 km$^2$ (22.02%), this might be as a result of the season the image was taken (rainy season). The Vegetation represented in Yellow colour decreases to 127.11 km$^2$ (17.22%), while the water body was 1.48 km$^2$. 0.20%.

**Minna image of 1996**

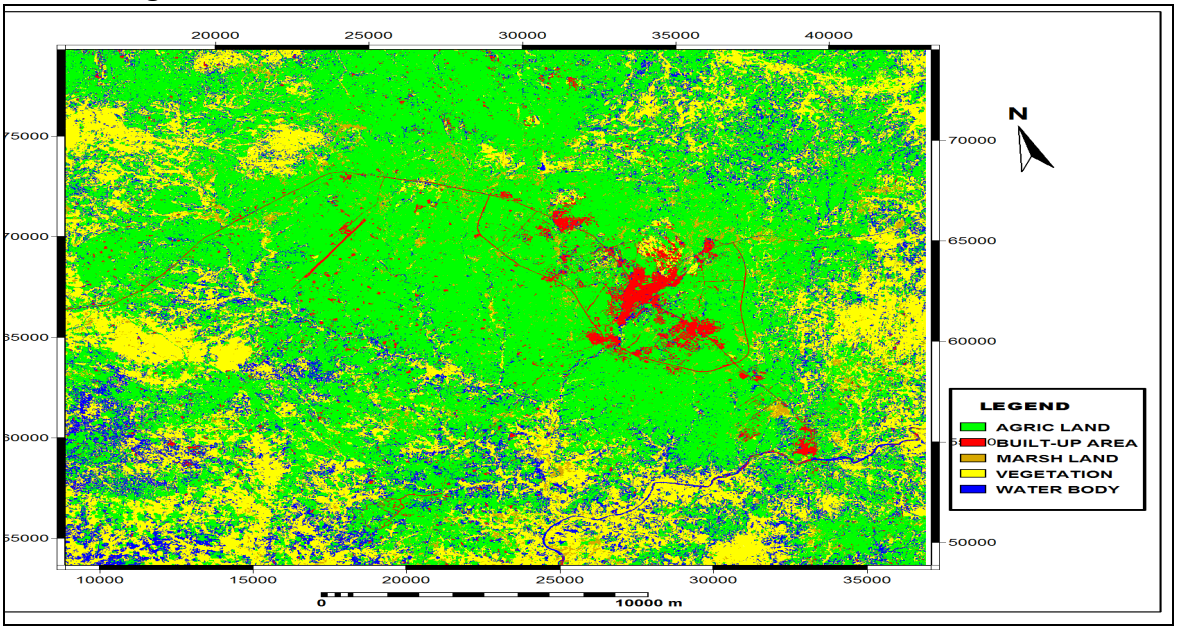
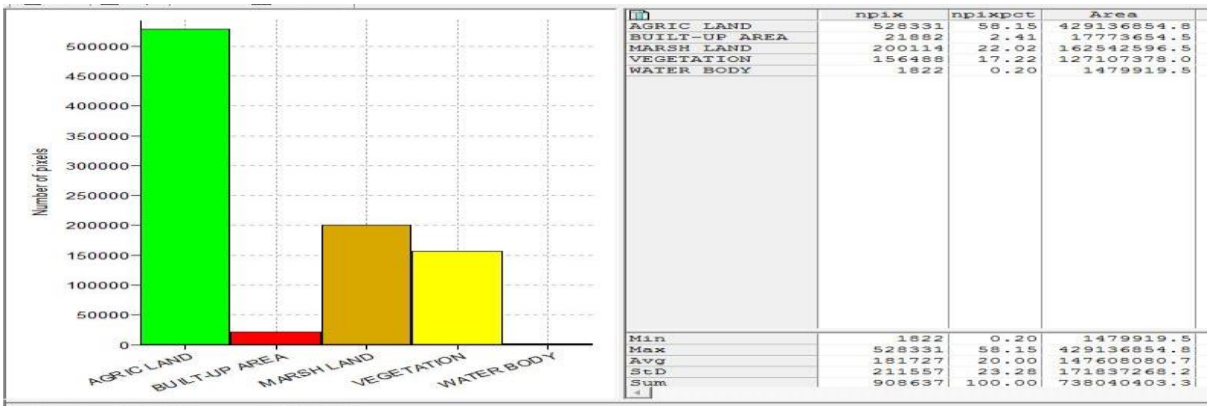



Figure 6: Minna satellite image of 1996

The histogram below shows visually the quantities of Built up and Nonbuilt up land class changes in 1996.




| | npix | npixpct | Area |
|---|---|---|---|
| AGRIC LAND | 528331 | 58.15 | 429136854.8 |
| BUILT-UP AREA | 21882 | 2.41 | 17773654.5 |
| MARSH LAND | 200114 | 22.02 | 162542596.5 |
| VEGETATION | 156488 | 17.22 | 127107378.0 |
| WATER BODY | 1822 | 0.20 | 1479919.5 |
| Min | 1822 | 0.20 | 1479919.5 |
| Max | 528331 | 58.15 | 429136854.8 |
| Avg | 181727 | 20.00 | 147608080.7 |
| StD | 211557 | 23.28 | 171837268.2 |
| Sum | 908637 | 100.00 | 738040403.3 |

Figure 7: Minna built and non-built up in 1996

**Minna Land Use in 2006**

Figure 8 shows the image characteristic of Minna in 2006. Agriculture land is represented in Green colour and has an area of 433.42 km$^2$ (57.79%).Built-up area has an area of 21.95 km$^2$ (2.93%) and is represented in Red colour. Marshland is represented in gold colour and covers an area of 22.23 km$^2$ (2.96%).Vegetation is represented in Yellow colour and covers an area of 182.43 km$^2$ (24.32%). Water body is represented in blue colour and covers an area of 89.97 km$^2$ (12.00%).

**Minna image of 2006**

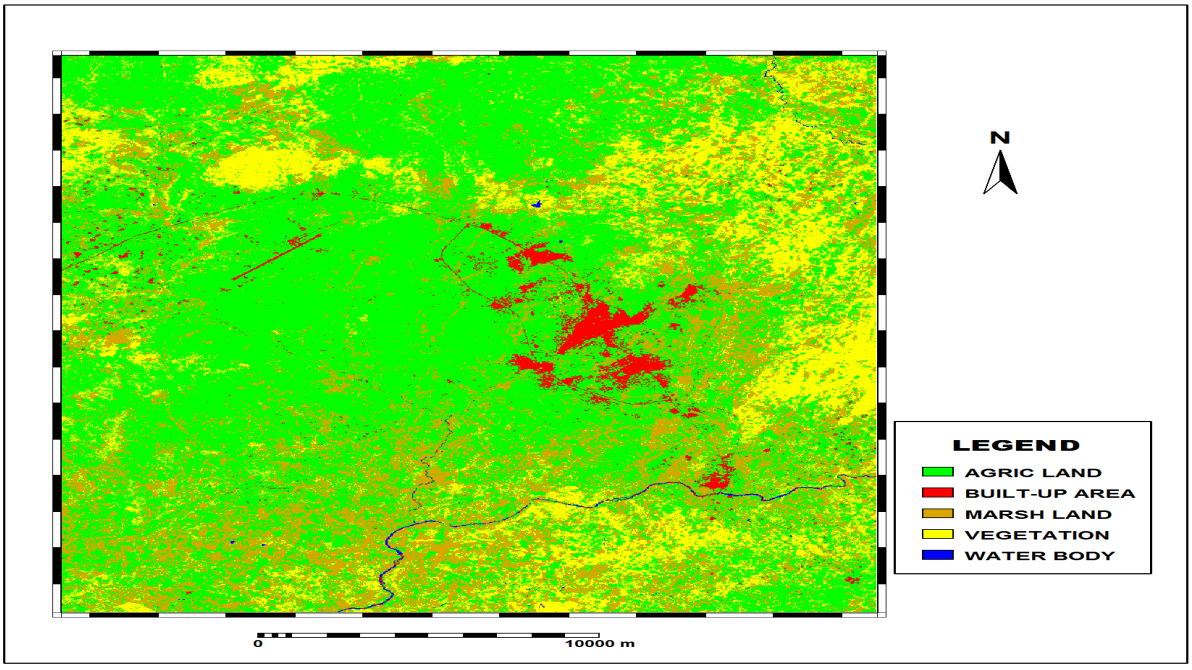
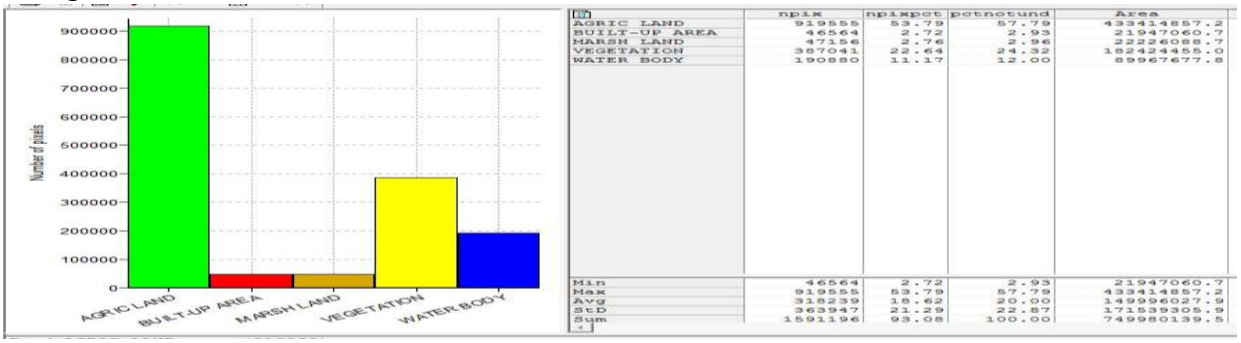



Figure 8: Minna satellite image of 2006

The chart below (Figure 9) shows visually the quantities of Built up and Nonbuilt up land changes in 2006.




| | npix | npixpct | pctnotund | Area |
|---|---|---|---|---|
| AGRIC LAND | 919555 | 53.79 | 57.79 | 433414857.2 |
| BUILT-UP AREA | 46564 | 2.72 | 2.93 | 21947060.7 |
| MARSH LAND | 47156 | 2.76 | 2.96 | 22226088.7 |
| VEGETATION | 387041 | 22.64 | 24.32 | 182424455.0 |
| WATER BODY | 190880 | 11.17 | 12.00 | 89967677.8 |
| Min | 46564 | 2.72 | 2.93 | 21947060.7 |
| Max | 919555 | 53.79 | 57.79 | 433414857.2 |
| Avg | 318239 | 18.62 | 20.00 | 149996027.9 |
| Std | 363947 | 21.29 | 22.87 | 171539305.9 |
| Sum | 1591196 | 93.08 | 100.00 | 749980139.5 |

Figure 9: Minna built and non-built up in 2006

**Minna Land Use in 2011**

Figure 10a and 10b shows the image characteristic of Minna in 2011. Agriculture land is represented in Green colour and has an area of 568.55 km$^2$ (89.11%). Built-up area has an area of 30 km$^2$ (4.06%) and is represented in Red colour. Marshland is represented in gold colour and covers an area of 1.30 km$^2$ (0.20%). Vegetation is represented in Yellow colour and covers an area of 36.84 km$^2$ (5.77%), while water body covered 0.21 km$^2$.

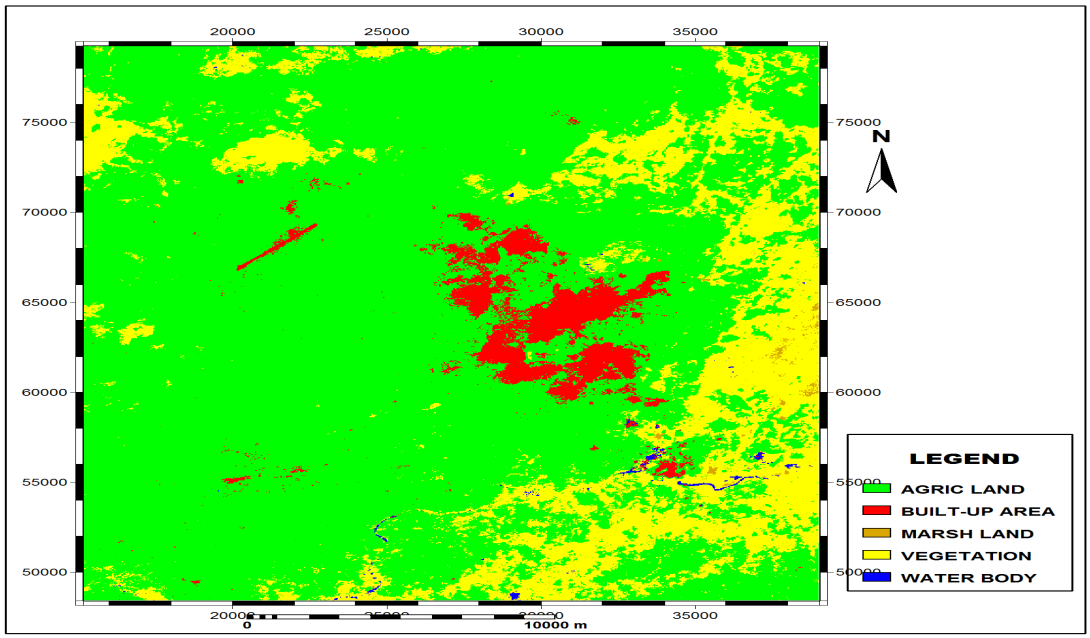
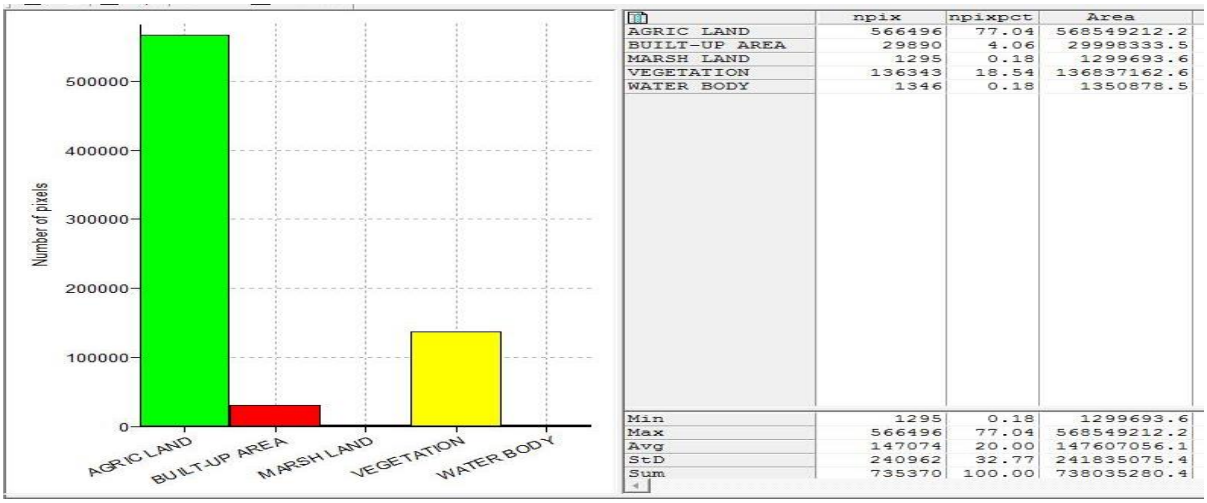



Figure 10a: Minna satellite image of 2011




| | npix | npixpct | Area |
|---|---|---|---|
| AGRIC LAND | 566496 | 77.04 | 568549212.2 |
| BUILT-UP AREA | 29890 | 4.06 | 29998333.5 |
| MARSH LAND | 1295 | 0.18 | 1299693.6 |
| VEGETATION | 136343 | 18.54 | 136837162.6 |
| WATER BODY | 1346 | 0.18 | 1350878.5 |
| Min | 1295 | 0.18 | 1299693.6 |
| Max | 566496 | 77.04 | 568549212.2 |
| Avg | 147074 | 20.00 | 147607056.1 |
| StD | 240962 | 32.77 | 241835075.4 |
| Sum | 735370 | 100.00 | 738035280.4 |

Figure 10b: Minna built and non-built up in 2011

**DISCUSSION**

Virtually every area in Minna has expanded substantially in land area in recent years. Between 1986 and 2011 Minna urban land area has increased almost five times that of 1986 , from 0.81% to about 4.06%. (see figure 11)

**Percentage of change in Minna built up from 1986 to 2011**

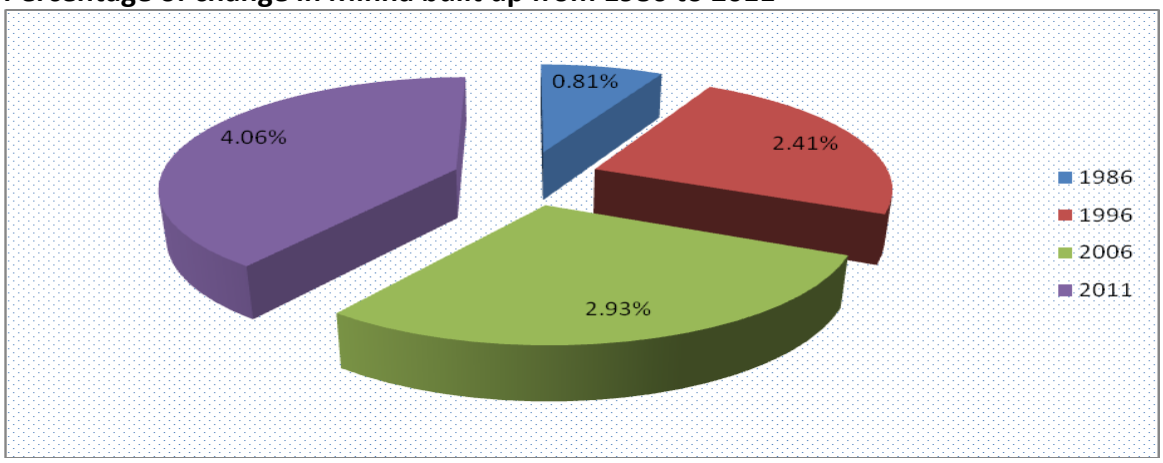



Figure 11: Growth in Built up Area in Minna (1986-2011)

**Agricultural Land Development in Minna**

Cumulative land use by Agriculture in 1986 was 404.05sq.km, agriculture occupied more space of 568.55sq.km in 2011, as population grows Agricultural land in Minna increases. To support this finding, NigerGis, 2012 reported that Agriculture is the back bone of the economy of Niger State, more than 80% of the population depends either directly or indirectly on it for their livelihood. By reason of its location, climate and soil, the state is one of the largest and most fertile agriculture lands in the country and has the capacity to produce most of Nigeria's stable crops. It also has ample opportunities for grazing, fishing and forestry. Unique opportunities exist in the State for the establishment of large scale farms (see figure 12).

Percentage change of Minna Agricultural land from 1986 to 2011

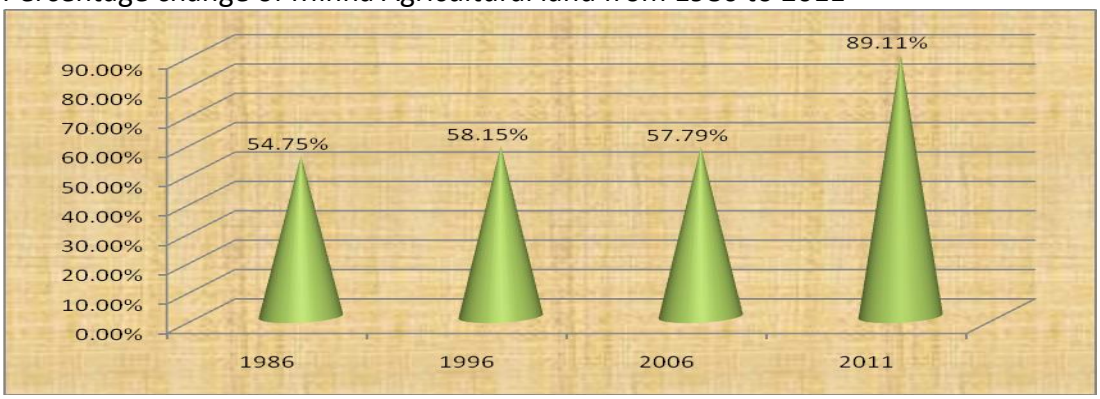



Figure 12: Cummulative Increase in Agricultural Land Use ( 1986- 2011).

**VARIATION IN WETLAND**

**Minna has experienced slight loss of wetland since last 25years i.e. From 1986-2011, though 1996 frequency shows very high wetland coverage of 162.54sq.km, this is not a true representation of the actual marshland coverage of 1996 as the image was captured during wet season. Wetland decreased from 2.26sq.km in 1986 to 1.3sq.km in 2011, the major factors responsible for the decrease is as a result of farming activities, commercial and residential development (see figure 13).**

Cummulative variations in Wetlandland ( 1986- 2011).

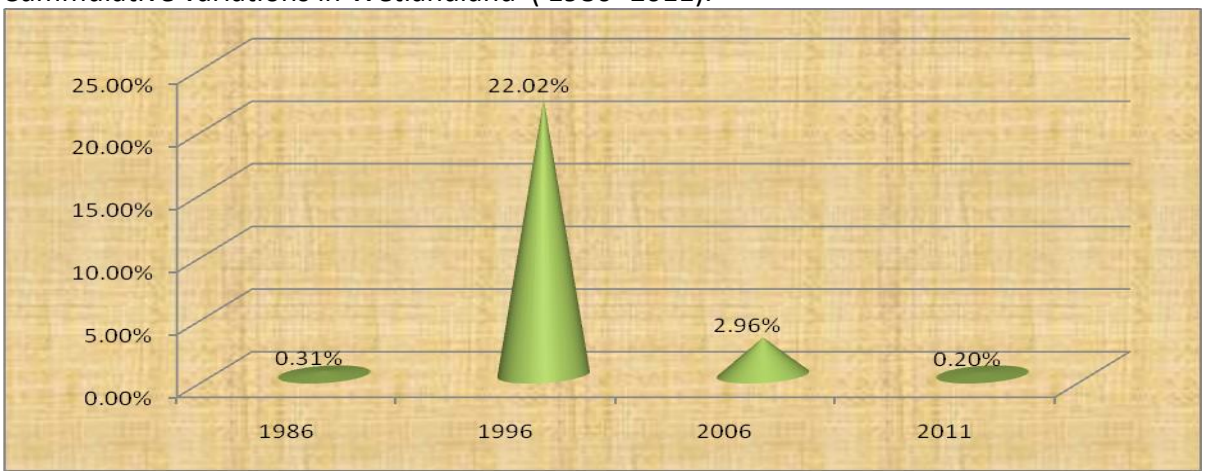



Figure 13. Extent of Wetland in Minna (1986-2011)

**Percentage change in Minna Land use (1986-2011)**

Agricultural land increased from 54.94% in 1986 to 89.11% in 2011, Built-up area rose from 0.81% in 1986 to 4.06% in 2011, Vegetal cover shows varriation between the study period, it was 43.79% in 1986, 24.32% in 2006 and 5.77% in 2011. Marshland was 0.31% in 1986, 22.07% in 2006 and 0.18% in 2011, The reason accounted for the varriation is that the image of 2006 was captured during the wet season.

**Magnitude of change (1986-1996)**

In the table 2 the magnitude of change between 1986 and 1996 was calculated by subtracting B from A ( Land use in 1986 from 2001). 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/15*100). Agric land has been growing at 1.67sq.km yearly and Built-up are at 1.18sq.km.

**Table 2: Magnitude and percentage of change in Land Use between 1986 and 2010**

| CLASSES | (A) 1986 | (B) 1996 | (C) Magnitude of changes(B-A) abs | (D) Annual frequency of change C/10 | (E) Percent age of change C/A x 100 |
|---|---|---|---|---|---|
| Agriculture Land | 404.05 | 429.14 | 25.09 | 2.51 | 6.21 |
| Built-up | 5.99 | 17.77 | 11.78 | 1.18 | 196.66 |
| Vegetation | 323.15 | 127.11 | -196.04 | -19.60 | -60.67 |
| Marsh land | 2.26 | 162.54 | 160.28 | 16.03 | 7092.04 |
| Waterbody | 2.58 | 1.48 | 4.06 | 0.41 | 157.36 |
| Total | 738.03 | 738.04 | 5.17 | 0.53 | 7391.36 |

**Magnitude of change (2006-2011)**

In the table 3 the magnitude of change between 2006 and 2011 was calculated by subtracting B from A ( Land use in 2006 from 2011). 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/5*100). Agric land has been growing at 27.03sq.km yearly and Built-up are at 1.61sq.km.

**Table 3**: **Magnitude and Percentage of change in Land use between 2006 and 2011**

| CLASSES | (A) 2006 | (B) 2011 | (C) Magnitude of changes(B-A) abs | (D) Annual frequency of change C/5 | (E) percentage of change C/A x 100 |
|---|---|---|---|---|---|
| Agriculture land | 433.42 | 568.55 | 135.13 | 27.03 | 31.18 |
| Built-up | 21.95 | 30.00 | 8.05 | 1.61 | 36.67 |
| Vegetation | 182.43 | 36.84 | -145.59 | -29.12 | -79.81 |
| Marsh land | 22.23 | 1.30 | -20.93 | -4.19 | -94.15 |
| Water body | 89.97 | 0.21 | -89.76 | -17.96 | -99.77 |
| Total | 750 | 636.9 | -113.1 | -22.63 | -205.88 |

**Overlay of extents and direction of growth of the study area in 1986, 1996, 2006 and 2011**

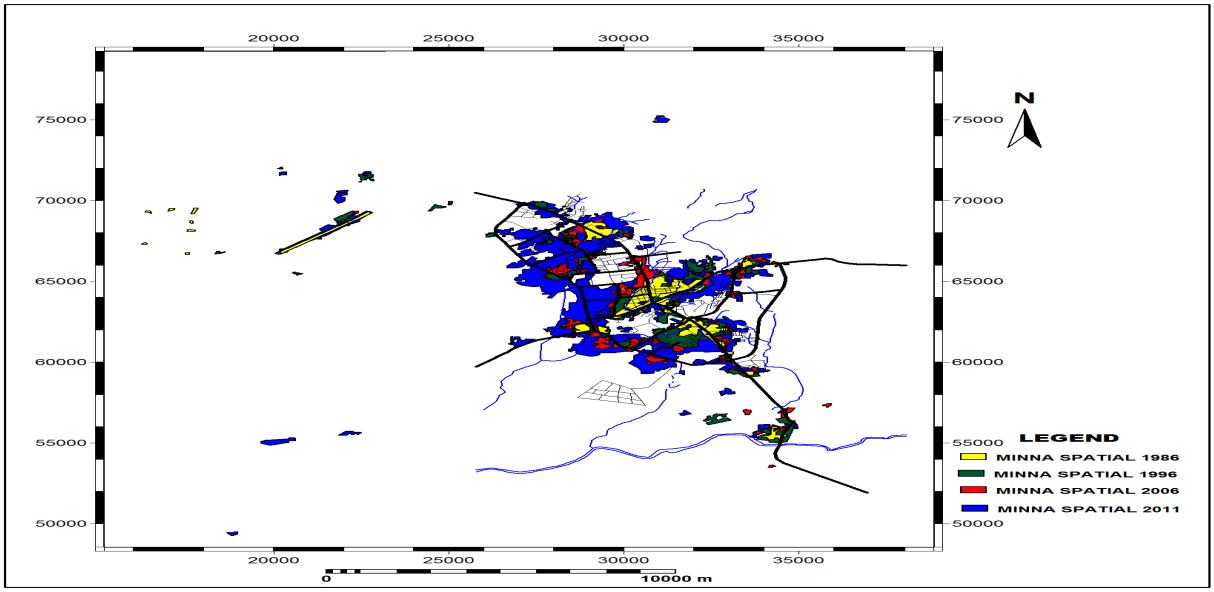



Figure 14: Overlay extent of Minna (1986-2011)

**Rate of growth in built-up area and direction of growth in Minna**

The period from 1986-2011 reveals a legible change as a result of urbanization, the built-up area increased from 0.81% in 1986 to 4.06% in 2011. The 2011 period has shown a rapid growth of built-up area in Minna which has led to the gradual elimination of vegetation and marshland. The city is growing towards the south-west of the country; this could be attributed to the movement of the National Examination Council headquarters and the Federal University of technology to this axis. Other reasons include amongst other: cheap land, availability of land for farming and availability of constant electricity.

## CONCLUSION

The study has examined the physical growth of Minna for the period of 32years (1979, 1986, 1996, 2006 and 2011). It was observed that some of the people that move from all parts of the country to Abuja in search of opportunities now settled their family in Minna because of its proximity (150km) to the federal capital territory and fearer means of living, this has contributed to the growth of Minna. Minna population has grown from 76,480 (Max Lock estimate of 1979) to 304,113 (2007 estimated). Minna is zoned for different land use but in most of the zones, mixed uses exist. There are formed residential, educational, commercial and industrial zones. Mobil is where could be referred to as the Central Business District of the town. The main residential zones are F lay-out, GRA, Bosso Estate and Low cost ( Low residential area) while Kpakungu, Barikin Sale, Maitunbi are high residential area. The industrial zone of the town is located at Sauka-Kahuta off Western bye-pass Minna. The locations of the two major organization and other secondary schools and agricultural firms towards the south-western part of the state have called for high demand of accommodations by staff and students.

## RECOMMENDATIONS

On the basis of the findings of the study, the following recommendations are made: Niger State Government should freeze the valuable plots of lands on the major and strategic location so as to regulate and stop leapfrog development. Niger State Government should procure appropriate remote sensing equipment for use in both the Head Office of Niger State Urban Development Board and its Zonal Offices. Niger State Government should partner with the National Center for Remote Sensing and the Federal University of Technology, Minna for the training and capacity building of the staff of the Niger State Urban Development Board. City wide infrastructure such as water supply, road and drainage should be provided at a rate, at least, equal to the rate of the sprawl and population increase of the city; The Niger Urban Development Board should build its capacity to carry out effective and sustainable advocacy and monitoring and evaluation of the role and responsibilities of the residence in the management of the city. The State Government should introduce Site and Services scheme to link with other existing neighborhoods by transport links and provide essential services such as light, water e.t.c. Government should immediately up-date its existing master plan and improve on computerized land records (GIS) for proper land registration in the state. Slum upgrading in Niger state cities should be done especially around Kpakungu and Barikin-Sale slums.

**Acknowledgement**
The researchers wish to thank the Federal University of Technology Minna, Nigeria for part funding this research.

**Corresponding Author**
Dr. Emmanuel Tanko Umaru, Urban and Regional Planning Department, Federal University of Technology, Minna, Nigeria**,** eumaru2001@yahoo.com

## REFERENCES

Arshad, A., Arif, A. & Sudhir, K. S. (2012). Study of Urban Land use Dynamics in Srinagar city using Geo-spatial Approach. 1(2), 18-24.
Bulletin of Environmental and Scientific Research. Retrieved at http://www.besr.org.in
Batisani, N. & Yarnal, B. (2009). Urban expansion in Centre County, Pennsylvania: Spatial dynamics and landscape transformations. 29(1), 235–249.

Daramola, A. & Ibem, E. (2010). Urban environmental problems in Nigeria: Implications for sustainable development. Journal of sustainable development in Africa, 12 (1), 27-34.

Duncan, E. E., Eluwa, E. S. & Ajagbe, A. M. (2012). Urbanization and 3D City Modelling for Developing Countries-A Comparative Study. Electronics Journal of Information Systems for Developing Countries, 54(5), 1-20.

Eluwa, S. E., Ajagbe, A. M., Umaru, E. T., Ojo, A. K. & Yusuf, O.G. (2012). Assessing Intra-City Road Traffic in an Indigenous African City, Ibadan, Nigeria. Engineering Science and Technology: an International Journal, 2(2), 221-228.
Goldstein, G. (1990). "Urbanization, Health and Wellbeing: A Global Perspective" The Statistician–Special Issue: Health of Inner Cities and Urban Areas, 39(2), 121-133.

Ho, C. S., Eluwa, E. S. & Ajagbe, A. M. (2011). Energy Consumption Pattern of Food Vendors in an Indigenous African City, Ibadan, Nigeria. Interdisciplinary Journal of Contemporary Research in Business, 3(7), 379-388.
National Population Commission (NPC) (1998). 1991 Population Census of the Federal Republic of Nigeria: Analytical Report at the National Level. Abuja: National Population Commission.

Peters, W. (2000). Green Cities- Urban Environmental Solutions, Global Issues-An Electronic Journal of the U.S Department of State, 5(1), 1-39.

Sanusi, Y. A. (2011). Pressure state response framework analysis of residential development on ecologically unstable land in Minna, Nigeria. Ozean journal of applied sciences, 4(2), 234-241.

Sanusi, Y. A. (2006). An assessment of the spatial relationship between poverty and environmental quality in Minna Metropolis. (Unpublished PhD Thesis) submitted to Geography Department of Federal University of Technology, Minna.

Soffianian, A., Nadoushan, M. A., Yanghmaei, L. & Falahatkar, S. (2010). Mapping and analyzing urban expansion using remote sensing imagery in isfahan, Iran. World applied sciences journal, 9(12), 1370-1378.

Sylvia, P. (2000). Built-up and associated land area increases in Europe. International Institute for Applied Systems Analysis (IIASA) Land use change and agriculture project. Retrieved from http://www.iiasa.ac.at/Research/LUC.
UN-HABITAT (2005). African Cities Driving the NEPAD Initiative an Introduction to the NEPAD Cities Programme www.unhabitat.org/downloads/docs/2558_81291_nepad.pdf
.
UNFPA (2007). State of the World Population 2007, Unleashing the Potential of Urban Growth, New York: United Nations Population Fund.

Umaru, T. E., Aiyejina, T. W. & Ajagbe, A. M. (2012). The Impact of Non-Residential Tertiary Institutions on Housing in Lagos: A Case Study of Lagos State University. Engineering Science and Technology: International Journal, 2(4), 592-598.
World Bank (2000). World Bank Report 1999/2000 'Entering the 21st century', New York: Oxford University Press.