Growth
Vol. 1, No. 1, 10-17, 2014
http://asianonlinejournals.com/index.php/Growth

Geographical Determinants of the Structural and Functional Growth of Damaturu Town in Yobe State, Nigeria

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Abstract

Damaturu town became the capital of Yobe State when the state was created in 1991. Since then, the town has been experiencing rapid changes in the landuse/landcover types due to urban expansion, economic development, and social transformation in the town. This study examined the geographical determinants of the growth of Damaturu town from 1986 to 2009. The satellite imageries of Damaturu were obtained processed and analysed using Remote Sensing and Geographic Information System techniques to determine the growth rate of the town within the period of study. This was complemented with the information acquired from the field survey to achieve the objectives of the study. Findings revealed that within this period (1991-1999), Damaturu built-up area increased about four times while the urban area increased more than four times. This significant growth was influenced by the location of the administrative offices and housing estates at the periphery of the town, categorisation of the land into administrative, residential, commercial, and industrial areas; as well as the transportation network and substantial population growth within the period. The most influential change within the second period (1999-2005) was increased agriculture and significant urban expansion. Within the current period (2005-2009), the urban area expanded by about 22Km^2. This remarkable expansion of urban area is responsible for the significant reduction of more than two-third of Damaturu wetland and significant reduction of shrub land. The geographical determinants of change within the period is the location of the State University, the construction of over 1000 housing units at Gujba and Gashua roads, as well as the relocation of other government ministries and agencies far away from the centre of Damaturu town. Besides, the structural growth of the town within this period engulfed four nearby villages. This study demonstrated the role of Remote Sensing and GIS techniques in understanding the dynamics of urban growth. Therefore, GIS should be employed for continuous monitoring and management of landuse change in the town to control development.

Keywords: Geography, Structural change, Functional change, Remote sensing, GIS Model.

Contents

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1. Introduction

Urban growth results from complex dynamic interactions between the spatial, socioeconomic and physical systems (Cheng and Masser, 2003) which lead to structural and functional changes in towns and cities. Urbanization brings about landuse change (Rimal, 2011) and triggers socioeconomic transformation which sets in natural ecosystem imbalance manifesting in environmental pollution and climate change. Change in land use patterns has implication on local environmental conditions as well as human, economic and social welfare as it affects environmental sustainability. The determinants of landuse change vary from one geographical location to the other. Therefore, an understanding of the peculiar determinants of landuse change in an area is necessary to guide informed urban and regional planning to attain sustainable development. One of the challenges faced in urban development especially among developing countries is urban sprawl which is an unplanned inconsistent expansion of urban area into the surrounding countryside or periphery. The magnitude and consequences of urban sprawl differ from one country to the other because it depends on availability and productivity of land resources as well as the level of development in an area (Alabi, 2009). Urban sprawl affects the structural growth and economic system of an area as it affects administrative planning, planning for utilities and infrastructure, provision and distribution of services, accessibility and travelling distance within the city.

The current trend of urbanization in developing countries requires considerable attention not only as a basis for transformation of societies in the developing countries but also for sustainable development. (Lwasa) (n.d) observed that several factors such as demographic change and economic transformation policies influence the urban growth of Kampala. These have led to the proliferation of informal sector which is different from developed countries and significant in employment generation within the city.

Moreover, Igbokwe (2006) utilized satellite image data (NigeriaSat-1) to examine the growth of major urban centres in parts of Southeastern Nigeria. The study also included spatial characterisation of essential growth features of these cities by comparing the generated maps with existing topographic maps of the areas. It was found that the urban areas in southeastern Nigeria have been growing at a very fast rate. Results showed that between 1965 and 2004, the cities (Awka, Onitsha and Nnewi) experienced different annual rates of growth. The study also observed that the expansions have completely overstretched the urban infrastructures within the cities.

Abiodun *et al.* (2011) observed that Lagos is growing at an unprecedented rate that requires constant monitoring. He reported that many parts of Lagos especially the suburbs have witnessed great urban sprawl in recent times spreading fast into the neighbouring states. Therefore, they recommended the need to critically study and understand the pattern of growth and possible checks in to avoid possible negative results.

Similarly, Adedokun (2011) analysed the spatial pattern of activities in Ilorin city of northcentral Nigeria. He classified the economic activities within the city into educational, artisan/technician, commercial, and civil service/administration, financial and other services. Of these activities, those connected with education was found to be dominant while financial activities occupied the lowest position.His findings showed that the activities were fixed in space and that there is no significant linkage between the activities. The study also found that spatial structure of activity in Ilorin is different from what obtains in Western cities where there is strict zonation in the usage of space.

Yobe State was created in 1991 with Damaturu as the capital city. Twenty three years after the creation of Yobe State, Damaturu town has experienced profound growth in economic activities coupled with development of infrastructure to meet the need of the growing population. The population growth is as a result of migration of the staff of federal agencies and ministries, traders and other people to the new capital from Old Borno. Consequently, this leads to expansion of Damaturu town to engulf nearby villages resulting to changes in landuse and rural economy especially along the highways and in the immediate vicinity of the town. This dispersed development outside the traditional settlement of Damaturu along highways and rural countryside is devoid of basic amenities due to the fact that the development is unplanned. Daura *et al.* (2006) studied the problems of Damaturu urban development focusing on the growth of residential neighbourhoods. Besides, Mamudo (2009) reviewed Damaturu developmental plan of 1992 with a focus on conformity analysis. However, dynamics of Damaturu urban growth needs to be properly understood for proper urban and regional planning to attain sustainable economic growth and development of the city.The focus of this study is to examine the geographical factors responsible for the structural and functional changes within the Damaturu town for effective planning, land management, and sustainable urban development.

2. The Area of Study

Damaturu is located between latitude 11^0 39’ 30’’ – 11^0 47’ 00’’ N and longitude 11^0 54’ 00’’ – 12^0 02’ 00’’E as shown in Figure 1. The town has been the district headquarters of the then Borno province. It was later made the headquarters of Damaturu Local Government in 1976, and in 1991 it became the capital of Yobe State in northeastern Nigeria. The town covers a land area of 206,241Km^2. Damaturu was founded in 1813 and it is multi-ethnic with the Fulani and Kanuri as the dominant ethnic groups. Others are the Hausas, Karai-Karai, Bade and other minority tribes of the state. With the creation of Yobe state in 1991, a growing number of Igbo and Yoruba from southern Nigeria migrated there. Tivs and other southern tribes are also found as traders and public servants in Damaturu town.

According to the 1991 census of the National Population Commission, the population of Damaturu was 30,970. The population increased to 39,233 in the year 2000. It was estimated at 48,014persons according to 2006 census, and the population of Damaturu increased to 69,952 in 2010. The landuse and landcover of Damaturu consist of settlements, agricultural activities such as farming and animal rearing, and public structures such as schools, offices, road and markets etc. Being the administrative centre of the state, it is inhabited majorly by civil servants and traders.

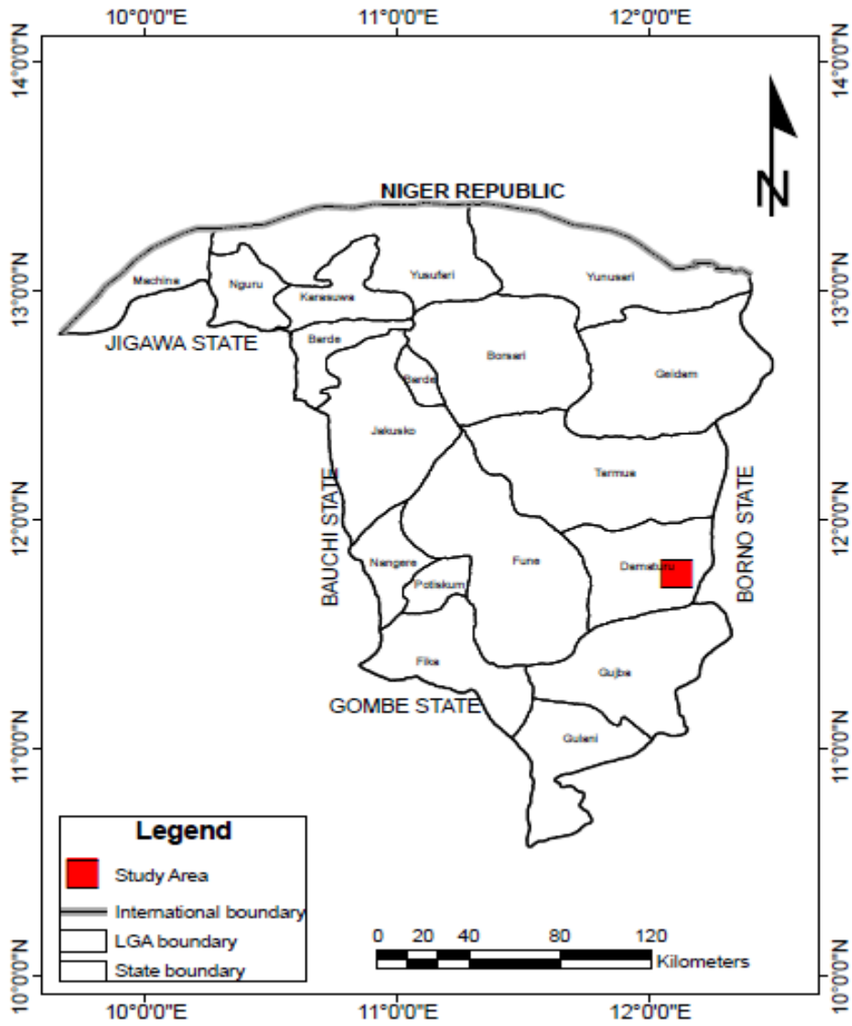

Figure-1. Yobe State showing Damaturu

Source: Yobe State Ministry of Lands and Survey

3. Methodology

3.1. Types and Sources of Data

The primary data used for this study include four sets of satellite imageries. The satellite imageries of Damaturu Township used are: LandSat Multispectral Scanner (MSS) – 1985, 1991, Landsat Enhanced Thematic Mapper (ETM) – 1999, and Nig-sat1 Enhanced Thematic Mapper (ETM) of 2009. All these imageries were obtained from National Centre for Remote Sensing in Jos, Nigeria.

Information was also obtained from the residents and key informants (which included government officials and traditional rulers) in the town through questionnaire survey and interviews.

In addition, secondary data used for this study include Damaturu base map before the creation of Yobe State in 1991, Damaturu development plan of 1992. These were obtained from Yobe State Ministry of Land and Survey. The population data of 1991, 1999, 2006, and 2011was obtained from National Population Commission, Yobe State Office, Damaturu. Other secondary data were sourced from journals and reports of Yobe State Ministries of Land and Survey, Works, and Housing Development.

3.2. Image Processing and Change Detection

Firstly, subsets of Damaturutownship were extracted from the full scene of the satellite imageries of 1986, 1999, 2005 and 2009. Then the 1986, 1999, 2005 Landsat images, and the 2009 Nig sat-1 were rectified and georeferenced to the UTM map projection (zone 32), Minna Nigeria. A supervised classification approach and maximum likelihood algorithm was used to classify the images into five classes: the built-up, bare surface, cultivated land, wetland and shrubland. Then the image statistics provided information on the rate of changes within the period of study. This was combined with the information collected through field survey.

3.3. Field Survey

Interviews were conducted to obtain relevant information from the residents of the town and key informants which included government officials and traditional rulers. In selection of residential sampling units, the entire study area was divided based on the three zones (traditional areas, new layouts, and housing estate) in the town, upon which 3 wards were selected from each zone based on simple random sampling method. In this case, the house numbering by National Water Rehabilitation Project was used for the sampling in the absence of population data at the level of wards/layouts. Stratified sampling was employed by selecting housing estates, new private and traditional layouts. Then in selecting respondents from these sampling units, systematic sampling was employed, and the number of respondents selected from each sampled layouts was proportional to its size as shown in Table 1. The residents were asked about their duration of stay in Damaturu town, the rate and pattern of growth of the town, the

structural and functional changes within the town, the problems of urban planning policies of Damaturu town, as well the solutions to the problems.

Table-1. Sampling frame for Damaturu residents

S/No	Strata	Sampled wards	No of houses	Sample size	Total sample size per zone
1	Traditional Areas	Ajiyari Ward Abasha Ward Nayi-nawa Ward	305 209 409	29 24 36	89
2	New Layouts	SabonPegi Ward Kiri-Kasama Ward Nasarawa Ward	361 Nil Nil	32 32 32	96
3	Housing Estates	Nyanya Waziri Ibrahim Ben-kalio	440 250 130	44 27 13	84

The key informants included a total of 20 respondents from various departments of Ministry of Land and Survey. The departments included town planning, survey and land administration. In addition to this, traditional rulers in the area were also interviewed. The selection of these respondents was through purposive sampling technique. The key informants were asked about the evolution of Damaturu town, the nature of Damaturu urban growth before and after 1991, the factors responsible for the growth of Damaturu, and the urban development problems in Damaturu town. They were also asked to proffer solutions to these problems.

4. Results and Discussion

Damaturu urban growth passed through different stages starting before the creation of Yobe State in 1991, the emergence of the town as capital city up to the present stage of development. This is presented in the following sections:

4.1. Geographical Determinants of the Growth of Damaturu within the 1st Period (1986-1999)

The first period (1986 to 1999) took place before and after the creation of Yobe State. There were insignificant changes in the physical landscape of Damaturu town especially between 1986 and 1991, but more significant changes in the human landscape have taken place before the creation of the state in 1991. This can be seen in Figure 2.1 and results from field survey.

After the creation of Yobe State in 1991, the location of the administrative offices and housing estates at the periphery of the town away from the downtown provided a growth pole within this period (1991-1999). Another geographical determinant of the growth of the town was variation in landuse density classified into high density area as in the core traditional settlement, medium density as in housing estates, and low density around the Government Reserve Area as shown in Figures 2.1, 2.2 and 3. Besides, it was during this period when the lands were categorised into administrative, residential, commercial, and industrial areas as shown in Figure 3. Moreover, the growth of Damaturu was also influenced by the transport network. Findings revealed that the major urban sprawl occurred along the major roads linking Maiduguri, Gashua, Gujba and Potiskum. These four major roads cross Damaturu from all the four cardinal directions to become the major growth poles, forming what can be described as bottleneck growth pattern. Furthermore, the population growth of about 7000 people in the town is another significant determinant of growth resulting to landuse changes, increased economic activities as well as massive construction of housing to meet the increasing demand of the population.

Consequently, within this period (1991-1999), Damaturu built-up area increased about four times while the urban area increased more than four times as shown in Table 2 and displayed in Figure 2.1 and 2.2. However, this expansion of the built-up area is more significant than that of Kazaure town in northwestern Nigeria, which expanded by about 1% over the same period as reported by Isma'il *et al.* (2013)

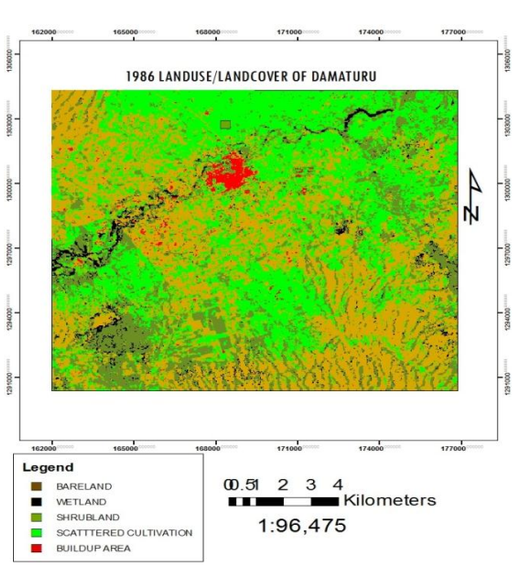

Figure-2.1.1986 LULC of Damaturu

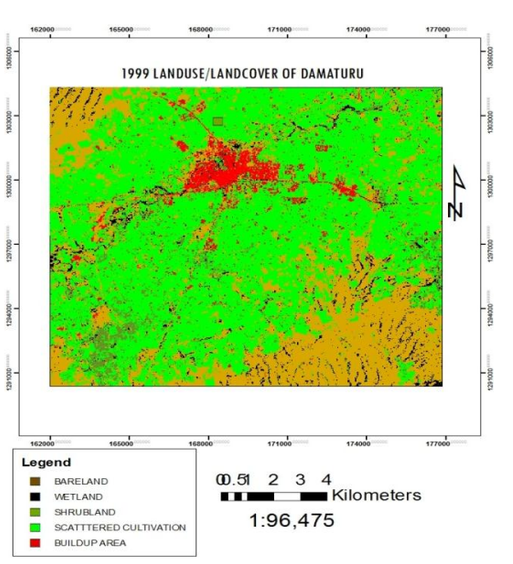

Figure-2.2.1999 LULC of Damaturu

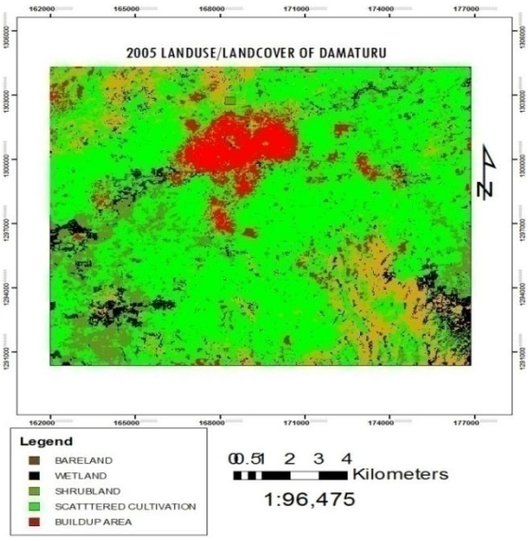

Figure-2.3. 2005 LULC of Damaturu

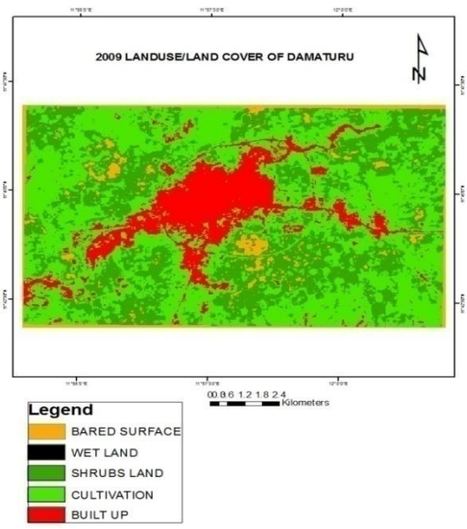

Figure-2.4. 2009 LULC of Damaturu

Figures 2.1 – 2.4 Landuse/Landcover Change (LULC) of Damaturu Town from 1986 – 2009

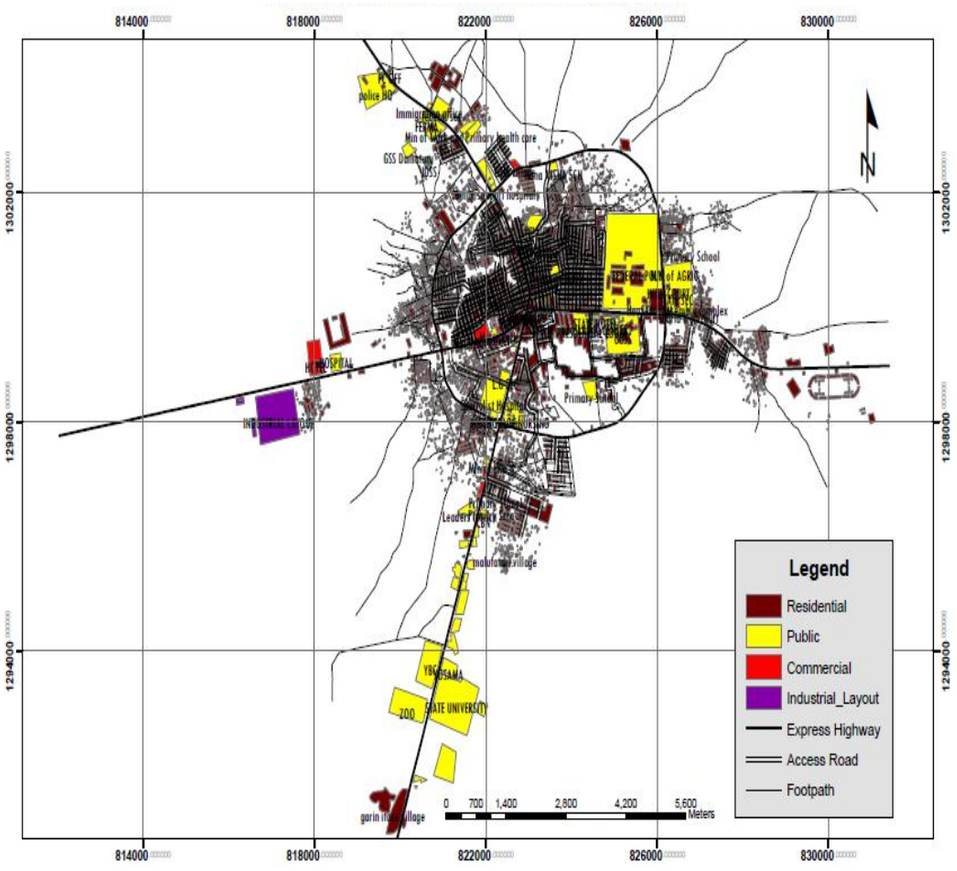

Figure-3. Damaturu urban landuse

Source: Google Earth Image

4.2. Determinants of Change within the 2nd Period (1999-2005)

The built-up area of Damaturu increased by about 7 Km^2, while the urban area expanded by about 11 Km^2 within this period as illustrated in Figures 2.2 , 2.3 and Table 2. The most influential change within this period was increased agriculture to meet the food demand of the growing population. Consequently, the reduction of bare surface by more than half is the most significant of all the landcover changes that have taken place within this period. This is similar to that of Kazaure town during which bare surface decreased by more than two-third (Isma'il *et al.*, 2013). The growth pattern of Damaturu within this period could be regarded as radial, radiating outward from the city centre forming concentric zones of varying landuse densities.

Table-2. Damaturu landuse/landcover change from 1991-2009

Years Classes (Km^2)	1991	1999	2005	2009
Built-up	3.06	12.12	19.02	23.42
Bare surface	81.47	62.11	25.35	23.13
Urban area	4.99	21.95	33.32	54.37
Wetland	4.56	6.65	11.02	4.05
Cultivation	95.99	107.92	124.43	117.63
Shrub land	41.63	20.95	18.56	9.10

4.3. Current Determinants of Damaturu Urban Growth (2005-2009)

Within the period of 4 years (2005-2009), the urban area expanded from 33.32 Km^2 – 54.37 Km^2 as shown in Table 2 and displayed in Figures 2.3, 2.4 and. This remarkable expansion of urban area is responsible for the significant reduction of more than two-third of Damaturu wetland and significant reduction of shrub land.

The geographical determinants of change within the period is the establishment and the location of the State University, the construction of over 1000 housing unit each, at Gujba and Gashua roads, as well as the relocation of other government ministries and agencies at a far distances from the centre of Damaturu town. The structural growth of the town within this period engulfed four nearby villages. Also, making more villages vulnerable to swallowing in the near future, as a result of the rapid radial expansion of the town.However, the engulfment process of Dikumari Village along Potiskum Road has been decelerated by the industrial layout development which is going at very slow rate. But as a result of locating the State University opposite GarinItace village, the Ministry of Land Survey designed new layout adjacent the village, where development has already started. Moreover, field survey revealed that private property developers are providing private hostel accommodation for students. Presently the village is turning into university village, a case scenario of Sangere with LamidoAdama University Yola, in Nigeria as it can be seen in Figure 4.

4.4. Results from Field Survey

Majority of the respondents from among Damaturu residents are heads of household, males of between 30 – 55 years of age, comprising of mostly civil servants, some traders and farmers. They observed that the town is fast becoming heterogeneous due to influx of immigrants into the town from other parts of the country. About 52% of the respondents did not appreciate the government planning policies of developing the town. Furthermore, observations from the field survey revealed that some residential areas have encroached the water logged areas thereby changing the structure of the drainage basin in the area. Field survey revealed that the roadsides are converted to commercial layouts contrary to the layout plan of the town. In addition, 88% of the respondents believed that inadequate facilities and utilities have seriously affected the growth and development of Damaturu town.

In addition, responses from the key informants revealed that the Damaturu urban area is made up of 5 segments: the CBD (Central Business District) which comprises of Abasha Business Area, Motor Park, banks around the central roundabout and government offices. While the outskirt is divided into four parts forming a linear pattern along Gujba, Maiduguri, Gashua and Potiskum Roads

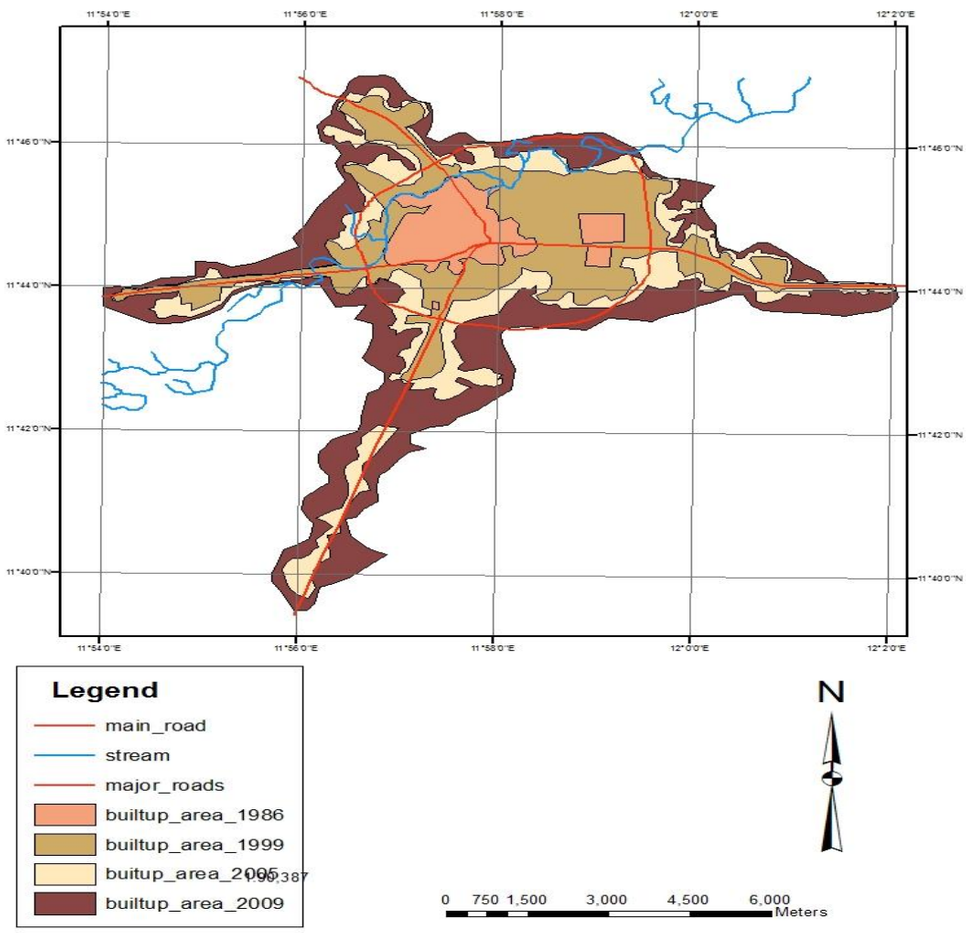

Figure-4. Damaturu Urban Landuse Changes

The only hydro-geomorphological barriers in the spatial growth pattern of Damaturu, identified by this study, include the dry valley behind Federal Polytechnic that passes through Pompomari, Shagari low cost, Nayinawa to Potiskum roads. Others include isolated water logs at Pawari, Nayi-nawa, behind Ajiyari, Abba Ibrahim housing estate, erosion at Pompomari extension. In spite of the presence of these hydro-geomorphological constraints, their impact in distorting the spatial pattern of Damaturu is insignificant.

4.5. Other Geographical Determinants of the Structural and Functional Changes in Damaturu

Each and every town or city has its peculiar spatial and temporal changes which depend on physical, social, economic, political and environmental factors. In addition to these factors, the traditional setting of Damaturu influenced the peculiar process of changes that have taken place within the town. Findings revealed that Damaturu town experienced different growth scenarios compared with such traditional Northern Nigerian cities as Kano, Zaria, Katsina Maiduguri. The sections that follow highlight other factors that influence the growth of Damaturu town.

4.5.1. Provision of Urban Infrastructure

The four major roads (Maidugari, Patiskum, Gujba and Gashua) as well as the Ring Road are fully dualised with solar security light. These roads link most of the strategic places as it can be seen in Figure 5, and almost all the 22 housing estates of Damaturu are located along these major roads. In addition, a large number of the respondents affirmed their areas have tarred access roads and drainages in their streets.

The whole of Damaturu urban area is fully connected with electricity and G.S.M communication networks. But pipe borne water supply is the most serious problem in the town. With the exception of few newly developed housing estates, most of the residents of Damaturu urban area don't have access to pipe borne, whereby about 85% of the respondents depend on water vendors for their water supply.

4.5.2. Provision of Basic Amenities and Utilities

It is evidenced from Table 3 that a lot of functional changes have taken place in Damturu town after the creation of Yobe State. The town underwent significant socioeconomic and functional transformations. It can be seen that four higher institutions of learning were established after state creation, which include the State University, National Open University, Federal Polytechnic and School of Nursing and Midwifery. There was no single manufacturing industry except small scale bread bakeries before 1991. But afterward, five functioning cottage and small scale manufacturing industries began operating. Besides, series of commercial and agricultural activities which include poultry farms, Orchards, fish farming and large scale crop production evolved.

Moreover, there were only 3 banks in Damaturu before state creation. These include 2 commercial banks and one cooperative. But afterward, almost all the Nigerian banks have their branches in the town. Other financial institutions found in the town include insurance companies. Furthermore, the functional changes included the establishment of numerous public housing estates, recreational areas/hotels, and modern shopping centers as shown in Table 3.

Before 1991, Damaturu town was a typical rural-urban settlement. About 100% of the key informants attested that after creation of Yobe State, the town experienced a lot of structural and functional changes as highlighted previously.

Table-3. Some of Socioeconomic Indicators of Change in Damaturu

Socio-economic parameters	Before state creation	After	Changes
Hospital	1	5	4
Higher institution of learning	0	4	4
Electricity	Yes	Yes	
Telecommunication	Yes	Yes	
Banks	3	21	18
Public housing estates	2	22	20
Manufacturing industries	0	5	5
Recreational areas/hotels	0	14	14
Modern store/shopping centers	0	32	32

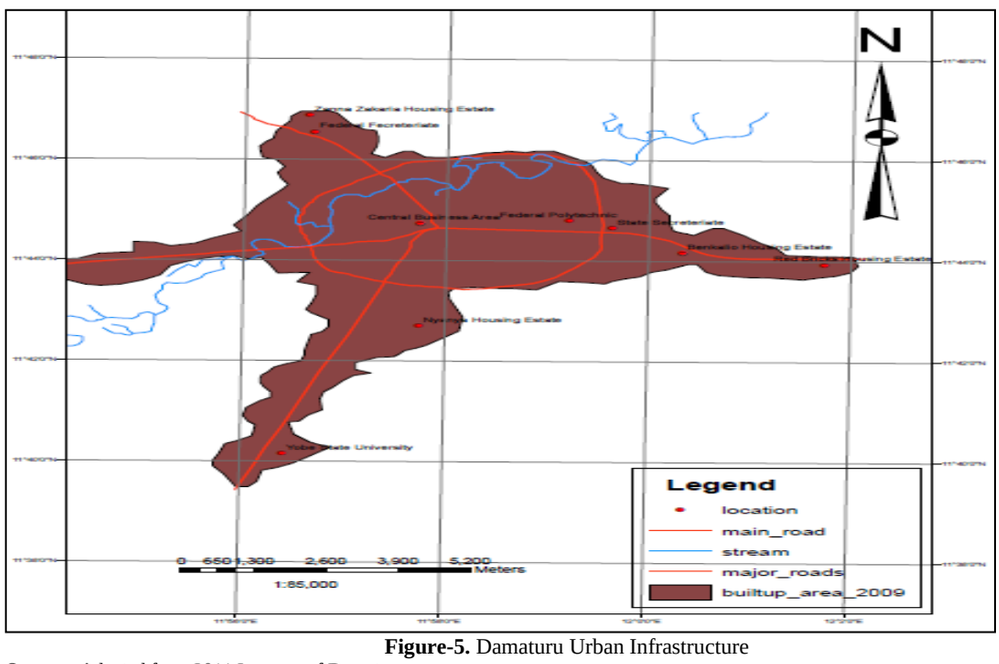

Figure-5. Damaturu Urban Infrastructure

Source: Adapted from 2011 Imagery of Damaturu

5. Conclusion

This study examined the geographical determinants of the structural and functional growth of Damaturu town from 1986 to 2009. Results showed that Damaturu built-up area and the urban area increased four times and more than four times respectively within this period (1991-1999). The geographical determinants during this period were the location of the administrative offices and housing estates away from the downtown, variation in landuse density consequently land value gradient, and categorisation of the lands into residential, commercial and industrial. The second period (1999-2005) was characterised by increased agricultural production. The geographical determinants of change within the current period (2005-2009) is the establishment and the location of the State University, the construction of over 1000 housing unit each, as well as the relocation of other government ministries and agencies at a far distances from the centre of Damaturu town. Other determinants of the structural and functional changes in the town are provision of urban Infrastructure,basic services, amenities and utilities.

This study demonstrated the use of Remote Sensing and Geographic Information System techniques in understanding the dynamics of urban growth and development.

5.1. Recommendations

Based on the findings of this study, the following recommendations are put forward:

- Modern planning techniques should be incorporated in the review of the current masterplan.
- This can be achieved through the use of Remote Sensing and GIS techniques.
- GIS should be employed for continuous monitoring and management of landuse change in the town to control development.
- There is also the need for strict adherence to the masterplan of the town to avoid haphazard development.

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