

## Monitoring Urban Sprawl in Greater Karu Urban Area (Gkua), Nasarawa State, Nigeria.

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### Abstract

Greater Karu Urban Area (GKUA) has been experiencing a large influx of population due to unprecedented rate of urbanization from all parts of Nigeria and elsewhere. This has led to rapid expansion and sprawl of the young settlements resulting in land use and land cover changes, transforming the entire landscape from rural to urban. The techniques of using Remote Sensing and Geographical Information System (GIS) to monitor and map urban sprawl are described in this paper. The built up areas were obtained from Land Sats and Nigerian Sat1 imageries of four different periods covering a 35 year period. Further analysis of the imageries revealed significant dynamic changes in the growth of the settlements in GKUA over time. The study shows a discontinuous spread of settlements leap-frogging into each other along the Keffi-Abuja High way, fast spreading into the hinterland and converting viable agricultural lands into urban development, an evidence of rapid sprawl. The study also shows more intense physical development along the high way and settlements closer to the Federal capital Territory like Mararaba, Karu, Nyanya and Masaka than settlements farther away. This study has provided quantitative and qualitative data for effective planning, policy and decision making for a more sustainable development of settlements in GKUA.

**Key Words:** Urban Sprawl, GIS, Built-up, Monitor, Patterns of sprawl

### 1.0 Introduction

Across the world, there has been a growing awareness and concern about urban sprawl and its consequences. Urban sprawl is a remarkable characteristic of urban development pattern that has emerged as a dominant mode of growth worldwide in the last decades (Leichenko and Solecki, 2005). The background and degree of urban sprawl as well as their consequences however vary between developed and developing countries. In developing countries, cities are experiencing alarming and uncontrolled rates of development due mainly to unprecedented urbanization and urban population growth. In Nigeria, urban areas have been developing rapidly since independence in 1960 to date. Cities are expanding and growing both in number and in physical size. Arguably, this rapid growth relates positively with massive development of Nigeria's oil resources beginning from the 1970s, concurrent rapid improvements in urban infrastructure, increasing incomes and car ownership; thus creating an increasingly urbanized and urban-oriented society.

In more recent years, the rate of land development in urban areas especially in Greater Karu Urban Area (GKUA) adjacent the Federal Capital Territory Abuja, has been accelerating, land consumption by constructions and urban development has continuously expanded blindly in haphazard and unguided directions without due consideration to interrelated factors such as transport, employment, health and livable factors.

The rapid rate of urbanization and uncontrolled population growth coupled with increases in social, economic and political activities has led to competition for land for various uses. This has influenced large urban sprawl and changes in urban land use especially at the fringes, resulting in increase in built-up areas and changes in land use patterns that are unguided and uncontrolled in GKUA (Rikko, 2000). In addition are the serious environmental problems already noticeable in settlements like Mararaba, Karu, Masaka and Nyanya all within the GKUA.

The phenomenon of urban sprawl in Greater Karu Urban Area is very severe and the tendency of scattered development and sprawling growth has been observed with serious propensity to impede the sustainable growth and development of the settlements in the region and indeed the modernization process of the Federal Capital Territory, if control measures are not put in place. Monitoring urban development according to Shektar, (2001) is principally to assemble data on current type, amount of sprawling and land conversion. According to Abimbola (2008) the inability of the administration and planning machinery to visualize sprawl growth and probable areas as persistent with the lack of appropriate spatial information and indicators provides no framework for a clearer vision of growth of the communities. The purpose of this research is to monitor the trend and pattern of such changes using GIS and to understand the processes in order to curb the problems and consequences for a more sustainable growth.

## 2.0 Defining Urban Sprawl

Even though urban sprawl has received so much attention in literature in the last decade, the definition and concepts have been varied. The term 'urban sprawl' has been used commonly to describe physically expanding urban areas. According to Ewing et al (2004), urban sprawl is the process in which the spread of development across the landscape far outpaces population growth. But urban sprawl is not just growth; it is a specific and dysfunctional style of growth regarded as a by-product of suburbanization by human geographers (Feng, 2009). On the other hand, Peiser (2001) conceives it as "the gluttonous use of land, uninterrupted monotonous development, leapfrog discontinuous development and inefficient use of land" which Nelson et al, (1995) describe as "unplanned, uncontrolled, and uncoordinated single use development that does not provide for a functional mix of land use and/or is not functionally related to surrounding land uses and which variously appears as low density, ribbon or strip, scattered, leapfrog, or isolated development".

By its very nature, sprawl is endemic to the urban fringe, where land is inexpensive enough to allow for spatially expansive development patterns and free from regulation, compared to more established areas closer to the urban centers (Daniels 1999). That is why it has been considered as the leading edge of urban growth with little planning control of land subdivision. In other words, it is seen as the scattering of urban land uses and development across rural landscape which leads to improper development (Kumar et al, 2005). In some instances, sprawl has been used as an aesthetic judgment about a general urban development pattern. Thus, it is widely branded as ugly development with tendency to discontinuity and haphazard layout which reveals the outcome of improper planning, inadequate policies and lack of good governance as is the case with Greater Karu Urban Area.

The accurate definition of urban sprawl may be debatable but the general consensus is that it is characterized as the low density, suburban and exurban style development patterns that have emerged as the dominant mode of growth (Ewing et al, 2004). The flexibility of these definitions makes it possible to include all sorts of development patterns, from planned communities with clustered housing and mixed uses to exurban rural estates

## 3.0 Research Area

Greater Karu Urban Area (GKUA) is situated within the administrative boundaries of Karu Local Government Area of Nasarawa State in the heart of Nigeria, approximately between latitudes 8° 5"N and 9° 25"E and longitudes 7° 54"E and 10° 42'N east of the Greenwich Meridian. GKUA is a designated Planning Area covering a spatial extent of about 800sqkm (KAPDA Report, 2001). It extends from the eastern boundary of the Federal Capital Territory Abuja, (Old Nyanya) to Gora about 15 kilometers to Keffi. The planning area shares common boundaries with the Federal Capital Territory (FCT) Abuja to the west, Keffi Local Government Area (LGA) to the south, Nasarawa LGA to the west in Nasarawa State and Jaba Local Government Area of Kaduna state to the north, (see figures 1 and 2). Greater Karu Urban Area has both urban and rural settlements. The major urban settlements comprising of Mararaba, New Karu, New Nyanya, Masaka and Uke are the main focus of this study including rural areas that have been overtaken by new urban development and engulfed by the larger ones such as Zhenwu, Luvu, Kuchikau, Kodepe, Aso Pada, Ado, Koroduma and One Man Village.

Settlements in GKUA like many other settlements around the Federal Capital Territory (FCT) Abuja are experiencing unprecedented and accelerated pace of urban sprawl. The establishment of the FCT in Abuja since 1975 and the proximity of the settlements around the territory brought sudden prosperity to the area and have transformed it from isolated frontier to a vibrant economic region.

As a 'development corridor' to the FCT in the last 35 years, GKUA has become the largest urban area in central Nigeria and one of the fastest growing urban areas in the world, with a growth rate of over 40 percent recorded annually following the rapid rate of urbanization and development largely as a result of an influx of migrant residents from other parts of the country. Prior to the establishment of the FCT in 1975, the entire Karu area was a traditional agrarian community important for producing yams and grains to larger towns in Plateau and Niger states. It was dominated by small, sparsely populated settlements, with about 85% of the settlements having populations between 50-500 inhabitants (Gaza 1990). Significant urban growth became a common landscape feature in the area only in the early 1990s following the construction of the new FCT and the subsequent transfer of the Federal Capital to Abuja in December 1991 (Rikko, 2000). These generated large influxes of people to the FCT and the neighboring settlements which were in themselves unplanned and with minimal resources but which now accommodates over 60% of the Federal government and private sector workers in the FCT. This further resulted to remarkable changes in economic, social and political activities and in patterns of land use and other problems of urban sprawl.

Currently the exact population of the area is not known as the National Population Census (NPC, 2006) undoubtedly grossly underestimated the population of the settlements. However, claims by Manok (2008); Karu LGA; Nasarawa State Urban Development Board (NUDB); land registration and demand for facilities, opined that the population of the planning area is about 4 million inhabitants.

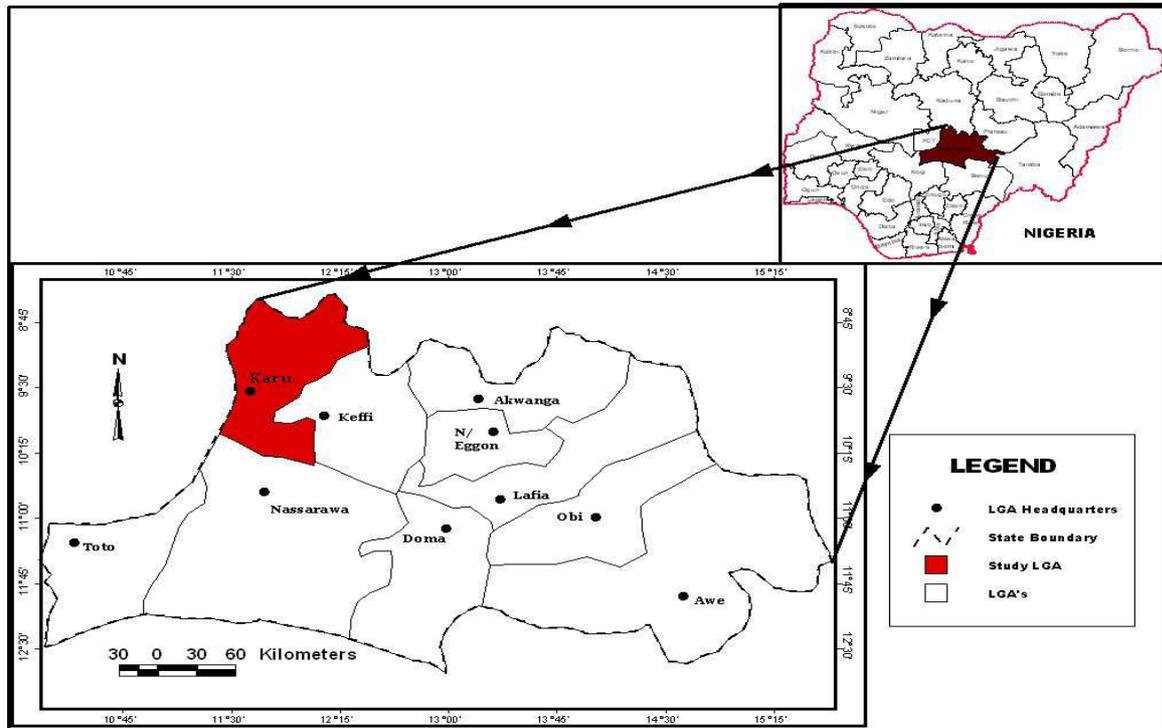


Figure 1: Nasarawa State Showing Karu Local Government Area (LGA).

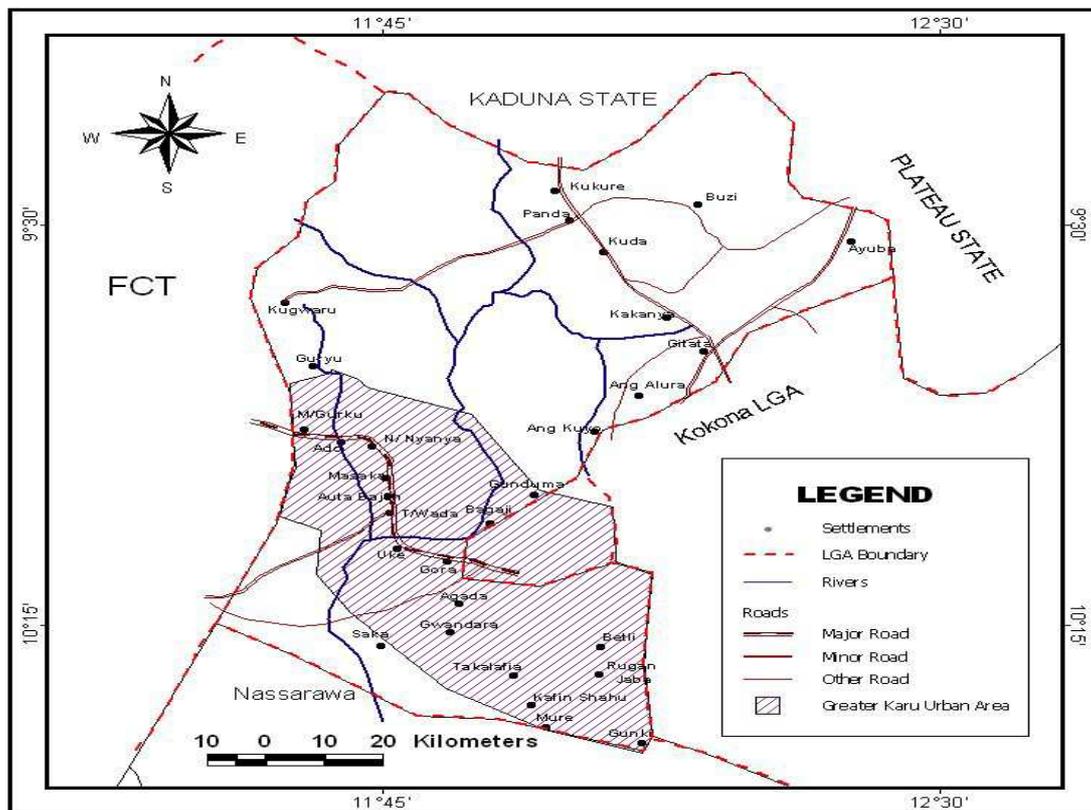


Figure 2: Karu LGA showing the Study Area

#### 4.0 Methodology of the Research

For the purpose of this research, secondary data in form of Land Sats and Nigerian Sat1 imageries covering a 35 year period were assembled from National Centre for Remote Sensing, Jos and Maps & Solutions office in Abuja (Table 1)

**Table 1: Sources of Data**

S/No	Sensors	Date Acquired	Resolution
1	Landsat MSS	January, 1976	32m
2	LandSat TM	November, 1986	30m
3	Landsat ETM	November, 1999	30m
4	NigeriaSat1 Image	2009	28.5m

**Source: NCRS, Jos; Maps and Solutions Abuja, 2011**

Sub-sets of the image covering the study area were acquired and projected to Universal Traverse Mercator (UTM) projection, zone 32. To enable overlay of imageries for various years, epochs of images which had different spatial resolutions (geo-reference properties) from others were re-geo-referenced to the same reference and rectified. Four stages of spatial data analysis methods were adopted in this study. Namely: Image Resampling, Supervised (Maximum Likelihood) Classification, Calculation of the Area in hectares and overlay operations. Each image epoch analyzed revealed some dynamics between land cover over time and space.

A Land use Land cover classification scheme was adopted for the study and modified after Anderson et al (1967) classification. The classification scheme developed gave a rather broad classification with the land use land cover identified by a single letter.

**Table 2: Sources of Data**

CODE	LAND USES CATEGORIES
V	Vegetation
B	Bare land/Rock Outcrop
Bu	Built-up land
W	Water bodies
C	Cultivated land

*Note: The definition of bare land as used in this research work denotes land without scrub, sandy areas, dry grasses, rocky areas and other human induced barren lands.*

The process of spatial analysis leading to the extraction of relevant data is presented in the scheme adopted after Feng (2009) in figure 3

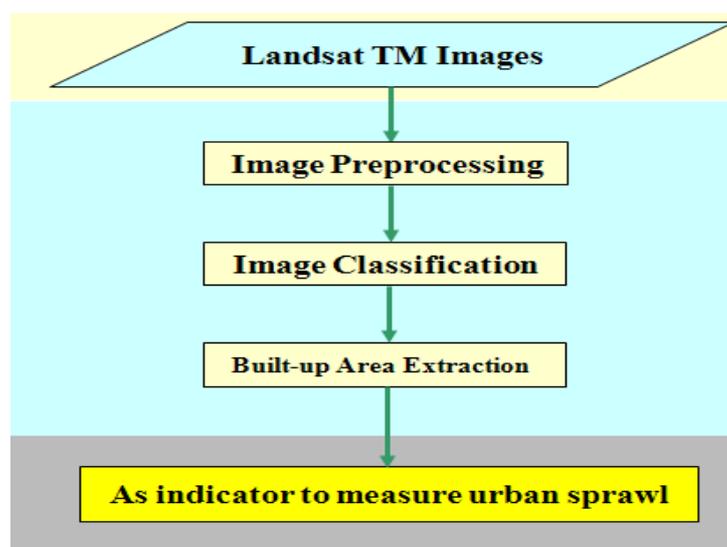
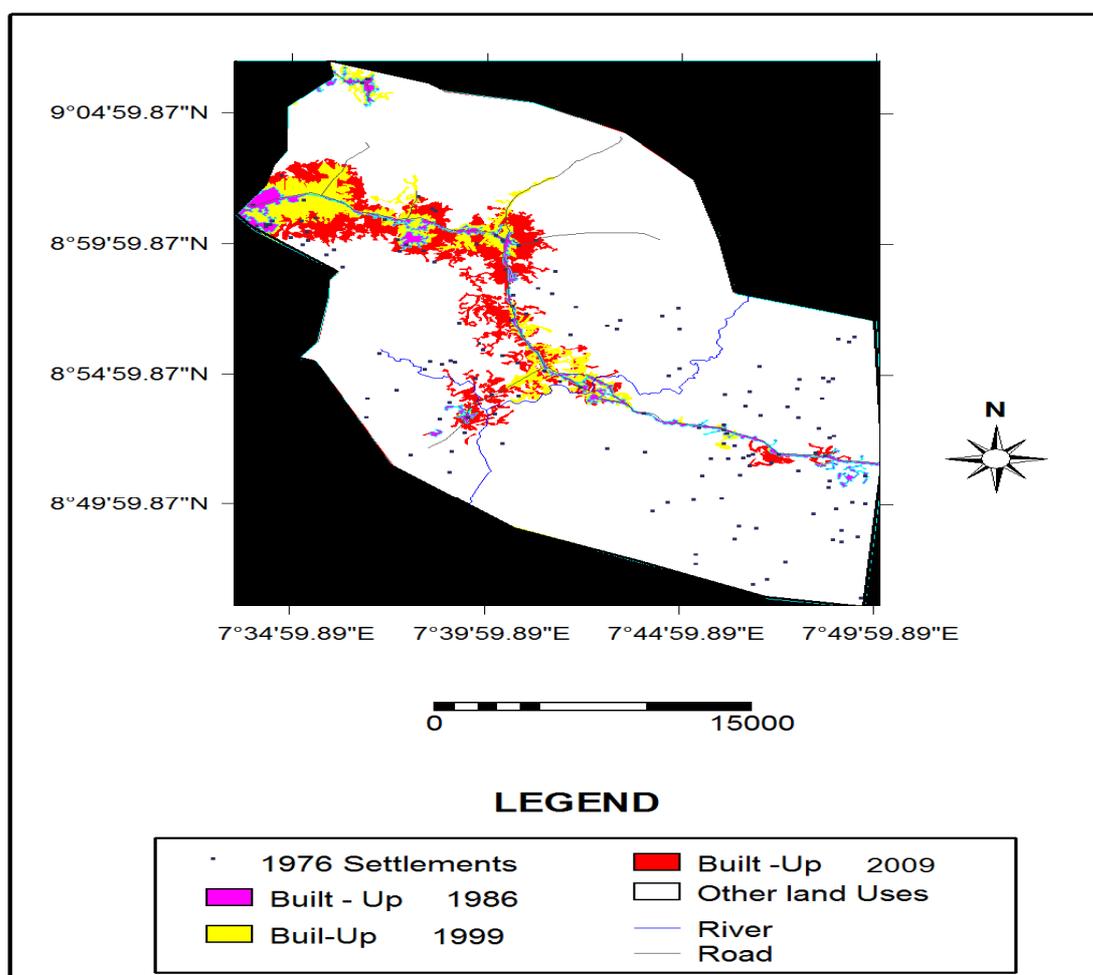


Figure:3 Area Data Extraction Adopted from Li Feng, (2009)

#### 4.0 Results and Discussion

Information obtained from the four images classified from 1976 to 2009 revealed that urban sprawl is proceeding in Greater Karu Urban Area (GKUA) at a very rapid rate. The five types of land use/land cover

classes studied revealed that there exists a continuous change in each cover over the years of study (Figure 4). Of particular interest are the dynamic changes evident in built-up area in the different epochs of years. Spatial analysis of the 1976 image revealed the study area as composed of isolated and scattered farmsteads; this observation is collaborated by Yari (2001) and also falls within the period that the Federal Capital Abuja had not been established yet. Therefore, the primary activity in the area was farming and population concentration was also very low and dispersed. The bulk of other LULC were difficult to identify due largely to the period that the image was taken (November) when the north east wind of the hamattan covered the country giving poor visibility of the landscape.



**Figure 4: Patterns of Sprawl of GKUA**

Over the study years, Built-Up areas increased significantly with over 1319% amplification between 1976 to 2009 (Table 2). Settlements in the area are relatively young but have already sprawled and are still sprawling into each other very rapidly consuming and engulfing surrounding villages and other land uses such that it is difficult to establish defined boundaries. Settlements such as Mararaba, Karu and Nyanya are observed to have experienced more changes which can be premised on their close proximity to the Capital City Abuja, and the urban functions that they perform. Peri-urban areas such as Ado kasa, Luvu Masaka, Kuchikau and Kodepe already show evidences of land sub-divisions, fragmentations and discontinuous urban growth posing the problems of land speculation and provision of basic amenities.

As development spreads further away from the larger towns, the characteristics of urban sprawl are revealed in four major patterns (see Galster et al.2001). Figure 5, revealed the physical patterns of sprawl in the area as:- a) scattered and uncontrolled development at the fringes, b) linear development especially along the Abuja-Keffi high way and other main arteries, c) compact development particularly in more developed urban centers like Mararaba, Karu, Masaka and Nyanya and c) a leap-frog development of residential areas.

In order to establish the facts of urban sprawl in the area on the basis of indicator system, GIS technique was employed for this research. Findings have already established that the rapid and unprecedented rate of urbanization and population growth in the study area since the movement of the federal capital seat of Nigeria to

Abuja in 1991 has influenced and driven urban sprawl significantly. Accordingly, the total area of built-up and non-cultivable land give strong evidence for discontinuous and leapfrog development due to lack of planning.

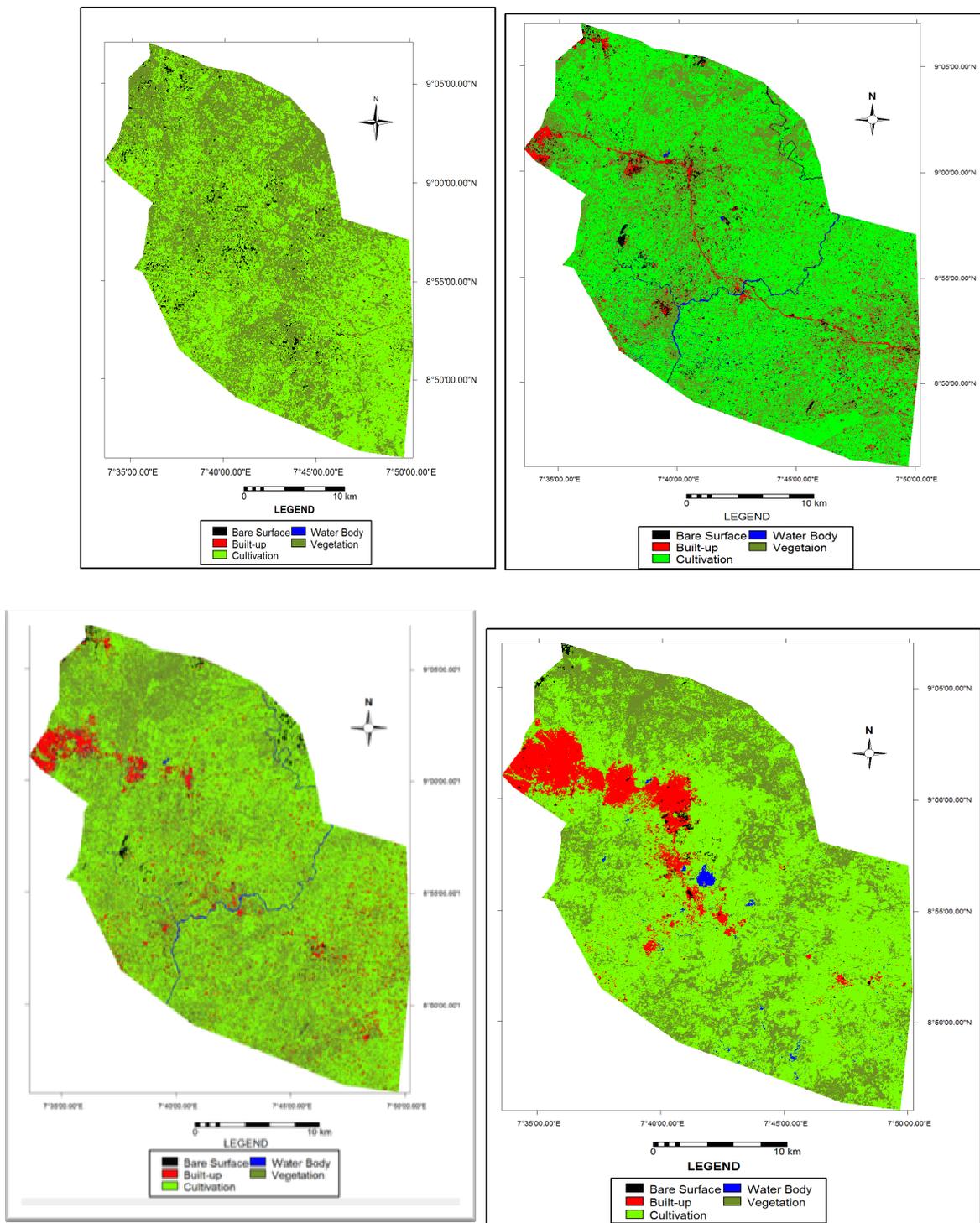


Figure 5: Classified images of the study Area: 1976, 1986, 1999, 2009

**Table 2: Dynamics of Land Use Change From 1976 - 2009**

	Area				Magnitude of Change				% Change
	1976 (km <sup>2</sup> )	1986 (km <sup>2</sup> )	1999 (km <sup>2</sup> )	2009 (km <sup>2</sup> )	1976- 1986	1986- 1999	1999- 2009	1976- 2009	1976-2009
Built-Up	4.17	19.85	41.25	59.18	15.68	21.4	17.93	55.01	21.1
Cultivation	384.38	434.8	374.48	455.53	50.42	-60.32	81.05	71.15	27.3
Vegetation	312.19	230.56	281.14	191.38	-81.63	50.58	-89.76	-120.81	46.3
Bare Surfaces	14.02	18.88	11.76	4.24	4.86	-7.12	-7.52	-9.78	3.7
Water Body	0	10.67	6.13	4.43	10.67	-4.54	-1.7	4.43	1.7
<b>Total</b>	<b>714.76</b>	<b>714.76</b>	<b>714.76</b>	<b>714.76</b>				<b>0</b>	<b>100.0</b>

Source: Author's Analysis, 2012

#### 4.1 Factors influencing Urban Sprawl in GKUA

Studies have shown diversely that population growth, rise in income, ineffective land use and excessive growth as well as social problems in central cities, rise of the automobile and employment are generally major causes of urban sprawl in different parts of the world (Tofowomo, 2008). While these may be true of GKUA, this study has further established that

since the establishment of the FCT, Abuja in 1976 and the movement of the federal government offices and parastatals in 1991 as well as the demolition of informal settlements in 2006, mass movements of people into the suburbs has been unparalleled. As a result, settlements in GKUA have experienced unprecedented urbanization, increase in demand for and rapid development of infrastructural facilities, social services and housing, changes in land tenure, increase in real property development and value, economic, social and political activities which are each contributing significantly to rapid sprawling of the area.

Secondly, the availability of large chunks of farm lands released into the land market for development purpose by the customary land owners has further influenced the urban sprawl. This has facilitated indiscriminate land transactions and provided unrestricted access to acquisitions of large chunks of land for varied development purposes. As a result, large quantum of land has been acquired by individuals, private and public organizations some of which have been developed without any recourse to planning while larger proportions are yet to be developed. This could further be blamed on the absence of a physical plan or policy document to guide and manage the growth of the settlements in GKUA. Thus, planning regulations and development control measures are implemented with less aptitude and seriousness. Consequently, development occurs without necessary planning and building control thereby encouraging the development of land use patterns that are uncoordinated and unfavorable for service provision and sustainability.

Additionally, is the demand for larger suburban lots and the desire of individuals for more living space. This explains why developers have preferred GKUA where large parcels of land is available at relatively cheaper rates than the Federal Capital city where land acquisition is restricted, costly and development control is more stringent. It also further explains why majority of the low and medium income groups whose houses were demolished from the FCT Abuja relocated to GKUA where about 60% of both the federal government and private sector workers reside and only transit to the capital city to work.

The presence of Abuja-keffi high way which ought to be a thorough road has developed into a beehive of commercial and recreational activities. This has significantly influenced the sprawl of land use activities along the corridor generating serious traffic problems, street trading, environmental problems and crime.

## 4.2 Effects of Urban Sprawl

Urban sprawl effects have a wide range of immediate and remote implications. Unlike many settlements in Nigeria whose history and growth are rooted in colonization, that of settlements in GKUA are connected to the establishment of the Federal Capital territory, Abuja.

However, like many states in Nigeria, Nasarawa state has not been able to evolve an up-to-date development strategy to effectively guide and control the growth of the region to achieve sustainable development. Though GKUA benefitted from technical cooperation provided by the UN-HABITAT and Cities Alliance that led to the preparation of a city development strategy in 2002, the plan was not fully implemented. Consequently, settlements are developing haphazardly and uncontrolled leading to land use conversions and patterns that are unfavorable for sustainable development, service and infrastructural provision, encroachment and loss of quality arable lands, surface water bodies and biodiversity, congestion, slum formation, housing shortages, poor environmental condition and challenges, poverty, inadequate and lack of access to social services and infrastructure (Rikko, et al., 2012). In addition, as private homes and businesses spread further apart, government is forced to where possible, provide for widely spaced services and infrastructure at higher cost. This according to economic theory is counter-productive as productivity is more enhanced with dense development since ideas move quickly when people are in close proximity.

Positively, the rapid sprawl of the settlements has influenced the growth of the informal sector. Some studies have argued that with increase in the economic activities in the area, more than 70% of the economic base of the Local Government Area is in this sector.

Some literatures have observed that urban sprawl encourages social segregation between the rich and the poor, with the poor abandoned in the core regions due to their inability to afford a car based lifestyle. The situation in GKUA portrays a different scenario where the place of residence is rather determined by availability and affordability of land or rent. As a result, the poor are found scattered at the peripheries where development is yet to reach but where land is relatively cheap and affordable, while the rich are found in the cities where rent is high and infrastructure and social amenities are available. The poor prefer to trade-off high transportation cost for cheaper and affordable land/rent. This initiates slum development before serious development reaches those areas due to lack of appropriate planning and as DungGwom (2012) noted, cities that develop chaotically see an increase in slums, lack of basic public services and leave the door open to exploitation of the weakest.

## 5.0 Conclusion

Urban sprawl has been recognized as a problematic aspect of growth and development in GKUA but the implications are not well understood for evolving policy and management options for effectively addressing the problem. The lack of planning policy to regulate and guide the growth and development of land use in planning area is a critical challenge that has resulted in unauthorized and haphazard development, emergence of slums and squatters and environmental degradation, lack of facilities and transportation problems. The inability of the government and the planning agencies to cope with the enormous planning challenges and the dearth of information required for planning purpose are a major concern. The experience of GKUA requires an urgent but comprehensive planning intervention that will evolve appropriate plans that are participatory in design and execution to address uncontrolled land development and promote social equity and environmental sustainability. Furthermore, there is need to involve more planners and other urban managers to evolve effective strategies to mitigate the implications of sprawl in all the settlements. The study suggests a strong synergy between Federal Capital Development Authority, Nasarawa State Government, Karu LGA, FBOs, NGOs, and other stakeholders to fashion out strategies to meet the infrastructure and service demands, housing and good environmental quality to make the settlements livable and their growth sustainable to enable them continue to provide the necessary support to the FCT as they are already doing.

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