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Spatio-temporal analysis of urban sprawl in a fringe area around Ibadan, Southwestern Nigeria

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Abstract

In most developing countries, particularly in Nigeria serious attention has been targeted at urban redevelopment in the core of the cities ignoring the uncoordinated urban development process at the peripheral areas. The emerging development requires urgent attention to forestall the impending environmental and social problems. The study therefore adopts scientific research approach which involves the use of remotely sensed data and GIS techniques to carry out a detailed measurement of urban sprawl in urban fringe areas of Ibadan, one of the mega cities in Nigeria. The study revealed that of all the spatial forms of sprawl mapped, low density development was found to predominate, and the sprawling growth was found to be more pronounced between 1986 and 1993 than between 1993 and 2000. The study further generated sprawl metrics for developing countries such as rate of urban expansion, population growth rate, population change, per capita land consumption. The study concluded that a vast agricultural land and 32 villages had been lost to sprawling growth and urban development occurred in total neglect of Town Planning Laws.

Keywords: GIS, Urban Sprawl, Remotely sensed data,

Introduction

Urban sprawl is a global phenomenon because almost all cities and towns in the world are somewhat undergoing sprawling growth in the face of rapid population growth, technological advancement and high economic growth. The impacts of increased urbanization and sprawl development are also apparent in many regions worldwide (Vitousek et al., 1997; Marzluff, 2001 and Alberti et al., 2003). Brueckner (2000) argued that Cities, in the United States of America take up too much space, encroaching excessively on agricultural land, loss of aesthetic benefits from the presence of open space, excessive urban expansion also means overly long commutes, which generate traffic congestion while contributing to air pollution. He further submitted that unfettered suburban growth tends to reduce the incentive for redevelopment of land closer to city centers, contributing to the decay of downtown areas and by spreading people out, low-density suburban development may reduce social interaction, weakening the bonds that underpin a healthy society.

Urban sprawl as a typical multidisciplinary phenomenon has attracted several attentions of scholars that precipitate lack of agreement over its definition. However, most of these definitions tend to have placed emphasis on dispersed or low-density development at the fringe of an existing urban centre and over large areas of previously rural landscape (Ottensman, 1977; Pendall, 1995; Weitz and Moore, 1998; Morgan, et al 2002; Madhevi et al., 2002; Anna, 2003). The focus of those definitions is in line with Brueckner's argument that urban expansion results mainly from three powerful forces namely, a growing population, rising incomes and falling commuting costs, Therefore, sprawl needs to be considered in a space-time context not simply as the increase of urban lands in a given area, but the rate of increase in urban land area relative to population growth (USEPA, 2001).

The urban centres in developing countries have been experiencing unprecedented population growth coupled with uncontrolled and unguided urban expansion in recent times. This often results in land fragmentation and so poses serious threat on the resource base of the areas. Adindu and Ogbona (1998) argued that rapid urban expansion into the fringe areas causes rapid increase in land values and that land fragmentation by speculators makes future large scale land assemblies difficult and consequently makes coordinated physical planning difficult. The urban expansion remains uncoordinated and scattered all over the urban fringes, and continues to extend into the rural fringe agricultural areas at an alarming rate (Wildgen, 2004). Normally, when rural pockets are connected to a city by a road, in the initial stages, development in the form of service centres such as shops, cafeteria, etc. is seen on the roadside, which eventually become the hub of economic activities leading to sprawl.

The rapid urban expansion consumes land and disregards the economic, environmental and societal costs that usually form the end-results of abandoning or under-utilizing old land in search of new ones. Due to uncontrolled and unmanageable development, the physical, environmental and socio-economic aspects apparently suffered the largest impact (Ahris et al., 2005) .The emerging development is often characterized by leapfrog or scattered development, commercial strip development, large expanse of low density or single-use development, rapidly developing suburbs and destitute inner cities (Ewing, 1997; Diao, 2007).

Studies have shown that most of the urban development in developing countries is in form of urban sprawl (Turkis, Z.et al., 2006; Yeh, 2003; Oyinloye, 2003; Onibokun, 1995 and Areola, 1994). For example, Onibokun (1995) observed that in the 1980s, the Ibadan-Lagos expressway generated the greatest urban sprawl east, north and towards the west of Ibadan. Similarly, Ibadan, one of the fastest growing metropolitan cities in Nigeria has been observed to have been growing at a rapid rate of 5.02% in 1973, 6.08% in 1988, 14.3% in 1989 and 4.8% in 2000 (Oyinloye, 2003).

From the ongoing, it is obvious that urban sprawl has become synonymous with the creation of visual bright and the loss of natural habitat but not all its effects are negative (Chad Lynch, 2008). This phenomenon is becoming a 'hard nut' to crack, since it emanates from uncontrolled or uncontrollable expansion of built-ups of a city or town. Much have been said about the rapid expansion of the built-ups of Ibadan metropolitan city into the neighbouring rural Local Government Areas, which has generated great urban sprawl (see Onibokun, 1995 and Oyinloye, 2003), but little or no attention has been given to the quantitative measurement of urban sprawl in the adjacent rural local government areas of the city. The process of human agglomeration into cities introduces a variety of physical and social ills into society's life patterns (Okewole, 2002). The perpetuating of human agglomeration in cities inevitably increases the demands on the carrying capacity of the cities, whether the people are packed into high-density areas or not. Carrying capacity refers to the number of individuals who can be supported without degrading the natural, cultural and social environment, that is, within resource limits and without reducing the ability of the environment to sustain the desired quality of life over the long term (U.S. Population – Environmental Balance, 2001). Okewole (2002) further observes that the congested housing area breeds all types of social ills – crimes, poor health, and low quality of life. He noted that it was the inevitable reaction against these unacceptable conditions, which eventually pushed people outwards into developing new shelter in the peripheral area of settlements.

In a study carried out with an aerial photograph in 1973 it was revealed that Ibadan's urban landscape covered 210km^2 and 240km^2 in 1988 and 1989 respectively (Areola, 1994) while Onibokun (1995) projected that by 1995, Ibadan urban landscape would cover 400km^2. Apparently, the city of Ibadan has been expanding rapidly almost in all directions, along the major highways, extending at a faster rate into the adjacent rural areas, which resulted in large-scale urban sprawl. In this direction, several studies have been carried out about the rapid expansion of the built-ups of Ibadan metropolitan city into the neighbouring rural Local Government Areas (Areola, 1994; Onibokun, 1995 and Oyinloye, 2003) However, attention has not been given to the detailed measurement of urban sprawl pattern and trend in Egbeda Local Government Area (LGA), a neighbouring local council to Ibadan city. Moreover, in view of the attendant problems associated with urban sprawl, the study of this dynamic phenomenon, which has often been carried out through the descriptive method should be approached in a novel way. Thus, the Geographic information systems and Remote Sensing techniques adopted in this study are considered useful in furthering our understanding of the spatial and temporal pattern of urban expansion. This paper, therefore, aims to identify the spatial pattern, measure the degree of spatial dispersion of built-ups and generate measuring indices of urban sprawl in Egbeda Local Government Area (LGA).

Theoretical Framework

The theoretical principles of sprawl have anchored on the sector theory of urban spatial structure. The sector theory was developed by (Homer Hoyt, 1939) based on extensive empirical investigation of rent differentials and the ability of urban functions to bid for city lands. The effect of land pricing leads to the occupation of the central zones by Central Business District (CBD), the only group of functions that could afford the rent. The major lines of transportation constitute lines of least resistance for growth in addition to their being important arteries along which similar types of land use are situated. This leads to the emergence of a star-shaped pattern of city growth in which different types of land use radiate from the CBD along particular sectors towards the periphery of the city. In this perspective, urban expansion is "axial growth", pushing out from the centre along transportation lines (Ayeni, 1979). The forces that stimulate sprawl corroborate this. Okewole (2002) argues that 'centrifugal forces are directly opposite to the centripetal forces' in respect of urban sprawl. He observed that centripetal forces "tend to hold certain functions in the central zone of the city and attract other to it". However, centrifugal forces generate the desire to move from one part of a city and strengthen the urge to go to another, particularly to the surrounding rural areas of the city.

Nelson (1971) highlights five characteristics of the centrifugal forces. The first characteristic is the status and organization of occupancy. This refers to the set of forces that creates a need for a change. These forces include traffic congestion, high water and air pollution, erratic electricity supply and poor sewage disposal, which are rampant in the city centre and that are perceived to usher-in modern, dynamic functional patterns in the periphery. The second force is the site force, which facilitates consideration for the comparison of the intensively used central zone with the relatively underutilized peripheral areas. This makes peripheral areas more attractive than the central zone. Thirdly, situational force emanates from a consideration of the functional spacing and alignments between the central zone and the periphery. Fourthly, spatial force initiates the deploying of congested activities from the central zone into the empty spaces of the peripheral zones. The fifth force is considered as the force of social evolution. This force is translated in form of high taxes and rates, and high land values that push residents of the central zone into less costly periphery.

Rondinelli (1991) considers that the influence of *urban bias* theory and the increasing poverty in rural areas have played a determinant role in a certain "neglect of cities" in development policy during the 1970s and 1980s. This effect has been reinforced by the evidence of the disparities in living conditions and conditions of development between urban and rural areas, and by the planners' perception of the rapid growth of some metropolitan areas of the biggest cities in the Third World as something pernicious and ultimately uncontrollable.

Volchenkov and Blanchard (2008) apply the simple trade-off models to dual graphs in order to predict the appearance of urban sprawl with the local land-use scheme. The decisive factor for the emergence of star graphs is the supremacy of the centrality (integration) objective, while the physical (Euclidean) distance between graph vertices is of no importance. It is well known that the humbleness of physical distances is among main factors shaping the sprawl land use patterns. In return, being highly dependent on automobiles for transportation; the low density sprawl development consumes much more land than traditional urban developments.

In view of the discussion above, sprawl is conceived as spatial expansion of urban development towards the peripheral areas of the city and beyond. It should be borne in mind that sprawl needs to be considered in space-time context, not as simply the increase of urban lands in a given area, but the rate of urban expansion relative to population growth (USEPA, 2001).

It is believed that urban expansion portrays improvement in the urban economies, but the resulting development from sprawling affects planning. Urban sprawl militates against healthy infrastructure planning since new

developments are scattered over space in the direction of the surrounding rural areas. As a global phenomenon, diverse strategies have been put forward for mitigating the problem of urban sprawl but these strategies have been observed to have capability for ameliorating sprawl only in the short-run. This reflects the dynamic nature of urban sprawl, which requires conscious and regular monitoring through the measurement of its numerical magnitude and spread over time. This is better enhanced with the use of Geographic Information Systems and Remote Sensing Techniques

Geographic Information Systems and Remote Sensing Techniques for Assessing Urban Sprawl

Geographic Information System (GIS) is a powerful computerized tool that transforms remote sensing data and manipulates them to generate new information for making well-informed decision or problem solving. GIS and remote sensing can be used separately or in combination for application in studies of urban sprawl. In case of a combined application, an efficient, even though more complex approach is the integration of remote sensing data processing, GIS analysis, database manipulation and models into a single analytic system (Michael and Gabriel, 1996; Sudhira et al, 2002).

The study of urban sprawl as a dynamic phenomenon may be better enhanced through the use of satellite imageries. Satellite Imagery is considered very essential as a result of large volume of data embedded and repetitiveness of its production. It has been observed that the physical expressions and patterns of sprawl on landscapes can be detected, mapped, analyzed using remote sensing and GIS (Kurd et al 2001; Nautilus, 2001; Yeh and Li, 2001 Angel et al., 2005; Civco et al., 2005). It is noted that remotely sensed data could be used to assess, map and systematically analyze the spatial pattern of urban sprawl over different time periods (Lata et al 2001; Sudhira et al 2002). In this regard, the importance and effectiveness of remote sensing in the measurement and assessment of urban sprawl cannot be over emphasized. Morgan et al. (2002) note that monitoring sprawl and urban growth requires repetitive images of the same scene over time, a requirement that makes the use of satellite imageries provide planners, policy makers and other land-use decision-makers with timely and accurate data for evaluating sprawl and taking decisions pertaining to its control. Thus, remote sensing data are being widely used for mapping and monitoring of urban sprawl of cities. Sudhira et al (2002), in a study of urban sprawl pattern recognition and modeling along highway between Udupi and Mangalore employs remotely sensed data and GIS techniques to identify linear and radial pattern of growth.

Study Area

Egbeda Local Government Area lies between 7^0 20'N, $3^0$54' E and 7^o 29'N, 4^o 07'E (See fig. 1). Egbeda Local Government Area is one of the six rural Local Government Areas in Ibadan region with population of 143,275, according to 2006 population census (NPC, 2007). The study area is adjacent to the city of Ibadan, which accounts for about 52% (1.8million) of the total population of Oyo State (3.5 million). The bulk of the population of the Ibadan region is concentrated in the city of Ibadan which consists of five local government areas. These local government areas account for 67% of the population of Ibadan Region – while the other six local government areas in the country side account for the remaining 33 percent. This is an indication of population agglomeration in the urban areas. In this direction, urban land uses are observed to have been encroaching on the adjacent rural land uses/covers (Areola, 1994; Onibokun, 1995; Oyinloye, 2003).

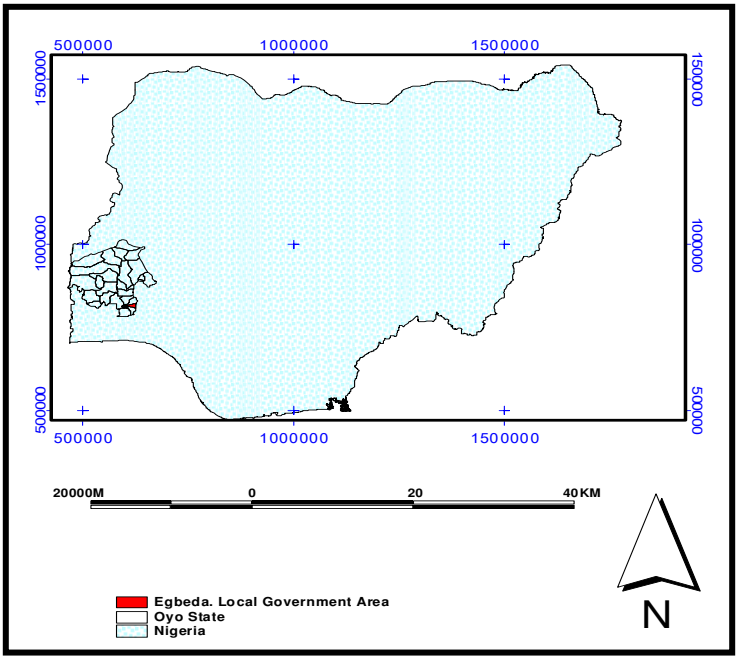

Figure 1: Map of Nigeria Showing Oyo State and the Study Area

Egbeda Local Government Area is located in the sub-equatorial climate which support luxuriant and dense rainforest vegetation and therefore suitable for the tree crop cultivation (Ekanade, 2007). The soils are of Iwo and Egbeda Associations (Ekanade, 1985). These soils are used for growing tree crops such as Cola Spp (Kolanut) and Theobroma Cacao (cocoa). The

area is drained by rivers Ogbere and Osun. The latter is dammed at Asejire in Egbeda Local Government Area. The lake behind the dam is the major source of water supply to Ibadan metropolitan city which is complemented by Eleyele and other smaller water schemes. Of all the land uses (commercial, industrial, airport, rural use and agricultural) in the area, urban use has been expanding at a fast rate at the expense of the rural use/covers. Thus, the most striking feature of the land use in Egbeda Local Government Area is perhaps the rapid encroachment of rural land use/covers by the fast expanding urban use.

Methodology

The data sources for the study were primary and secondary. The primary data utilized include SPOT-XS 1986, SPOT-P 1993and Landsat ETM+ 2000 satellite images and aerial photos (1964and 1974) obtained from Regional Centre for Training in Aerospace Surveying (RECTAS), Nigeria. The secondary data used include a 1989 1:50,000 settlement map of Egbeda L.G.A. Ibadan and environs map 1995 and population census data. For the purpose of delineating the study area on aerial photos and satellite images acquired, Egbeda map of 1989 was scanned and digitized using on-screen digitizing technique. Ibadan and environs map was used to georeferenced the maps of Egbeda Local Government Area from which point maps were created. Submaps of the study area were created from the aerial photos and the satellite images of Ibadan region using visual image interpretation technique. On each of the submaps created from multi-spectral images (SPOT-XS 1986 and Landsat ETM+ 2000), colour separation and colour composite operations were performed. These images were enhanced and filtered using linear contrast enhancement and High frequency filter techniques respectively. The images were geo-referenced and supervised image classification operation was carried out on each of the images. The operations were collaborated with ground truthing observation of the study area. Thus, from the air photos, panchromatic and classified images, the urbanized parts were identified and digitized. The operation created four classes of features which were arranged in layers, namely, water body, built-up areas, highlands and vegetated areas (symbolizing rural uses/covers). Based on the results, rates of urban expansion were calculated accordingly. From the population data, total land area and total built-up layers of the study areas, the indices for measuring sprawl in the study area were generated.

The spatial pattern of sprawl was examined by way of identifying and digitizing the spatial forms of sprawl on the enhanced satellite images for the study periods. The results were displayed in different GIS data layers. GIS overlay operation was carried out to produce the required map. Entropy method with GIS integration described by (Yeh and Li 2001), was used to

measure the degree of spatial dispersion of built-up area for each of the periods. The study utilized GIS methodologies in ILWIS 3.6 academic and Arc View 3.2 softwares.

Results and Discussion

Ibadan as one of the mega cities in Nigeria continued to extend its urban influence gradually at urban fringe areas. This is evident in (table 1, Figure 2a and 2b) below which showed rapid rates of urban expansion encroaching into the agricultural lands. Precisely, the untailored expansion had been found to have continued to reduce rural lands by 0.53km^2 in 1973, 40.7 km^2 in 1986, 59.04km^2 in 1993 and 76.50km^2 in 2000. Obviously rural lands decreases by 32.6% because the net urban development is 75.97km$^{2.}$ This is almost similar to the situation in Brussels where it has been observed that since the 1990s, especially the rural commuting zone has become increasingly popular for new residents (Vanneste et al., 2007) Thus, the rate of urban expansion in 1986 (39.6 percent) happened to be the highest in the study periods (see Figure3a, 3b and table 2). This may be connected to the rapid urban expansion propelled by the construction and completion of Lagos-Ibadan expressway in late 1970s, which Onibokun (1995) observed to have generated greatest urban sprawl in the 1980s. Also decentralization of urban functions, from the city centre to the fringe areas, such as relocation of New Gbagi market, Nigerian Breweries and Ibadan Airport indeed contributes immensely to supposedly chaotic urbanization process.

This agrees with viewpoint that government spatial planning policy is one of the main factors leading to urban sprawl (Dieleman and Wegener, 2004). In the same manner, it is apparent that Ibadan-Ife expressway and Ibadan-Iwo road constructed in 1990s have continued to generate ribbon sprawl which begins in form of commercial strip development and subsequently paves way for low density development (See fig. 5, 6 and 7). Table 5 showed that in 1986, ribbon urban sprawl, leapfrog sprawl and low-density development covered 24.1km^2, 3.3km^2 and 6.39km^2 respectively. In 1993, leapfrog sprawl increased to 3.6km^2 about 9.1 percent, low density development increased to 9.1km^2 (42.4% increase) and ribbon urban sprawl dropped to 12.8km^2 (45.6% decrease). By 2000, leap frog sprawl rose to 11.2km^2 (239%), ribbon sprawl increased to 32.4km^2 (34.4%). This implies that many of the working forests are themselves fragmented by roads which increase the potential for human impacts (Rochelle et al., 1999). For example, in his study of suburban forest fragments in Delaware, Matlack (1993) showed that sites adjacent to roads were significantly more affected by human activities than those away from vehicle access.

Table 1:The Rate of Urban Expansion in Ibadan Metropolitan City

YEAR	ESTIMATED TOTAL BUILT-UP AREA (KM^2)	RATE OF EXPANSION
1952	36.8*	-
1973	103.8*	5.02**
1988	210*	6.08**
1989	240*	14.3**
2000	400*	4.8**

Source: *Total built-ups: Areola (1994), Onibokun (1995) and Oyinloye (2003).
**Rate of Expansion: Author, 2006.

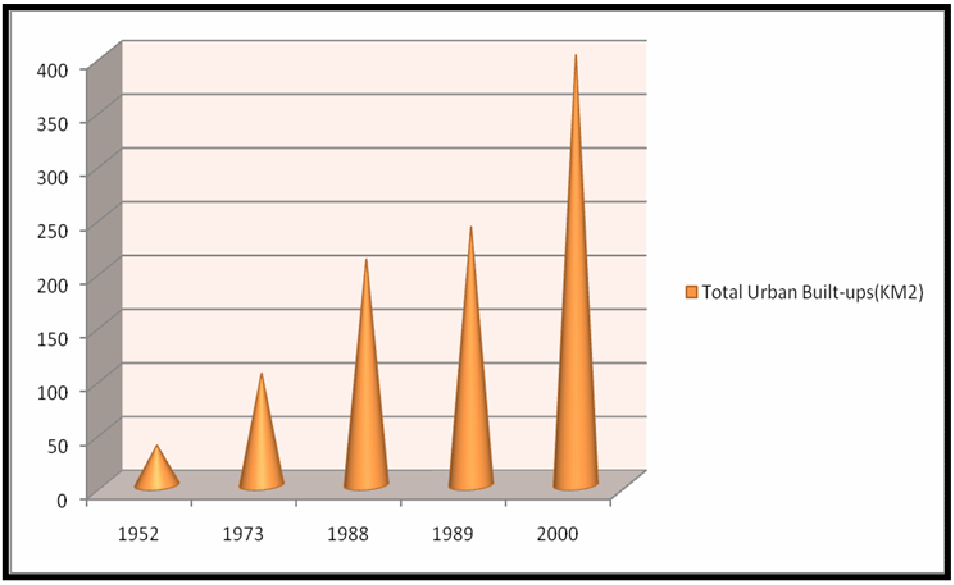

Figure 2a: Urban Built-ups of Ibadan Metropolitan City

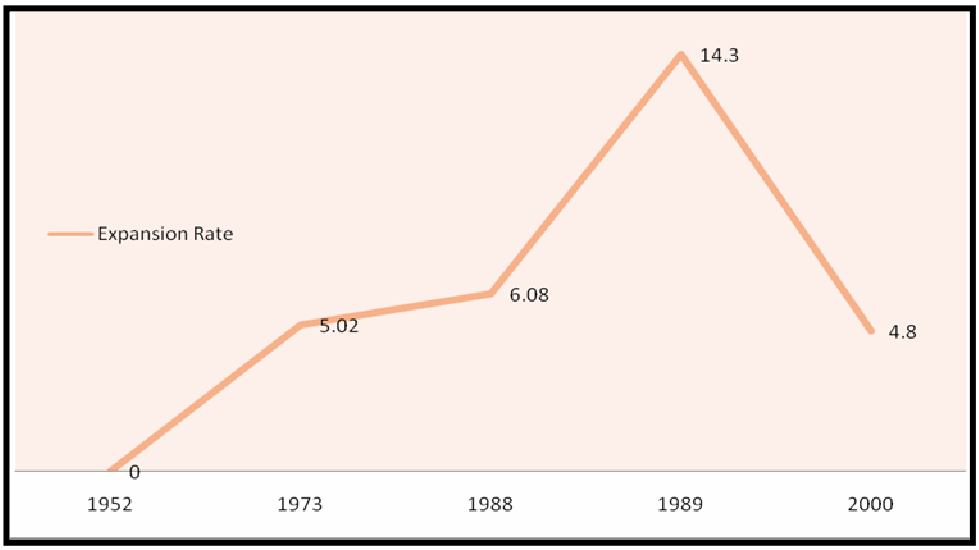

Figure 2b: Rate of Urban Expansion in Ibadan Metropolitan City

Table2: Total Built-ups and Rate of Urban Expansion in the Study Area

Year	Estimated Total Built-Up Area (Km^2)	Rate Of Expansion
1973	0.53	-
1986	40.7	39.6
1993	59.04	5.5
2000	76.50	3.8
2020	191.7**	4.7*

Source: Author's Air Photos 2006.
SPOT-XS Imagery Clasification 2006
SPOT-P Imagery 2006
Landsat ETM+ Imagery Classification 2006
**Projection to 2020
* Using average expansion rate between 1993 and 2000.

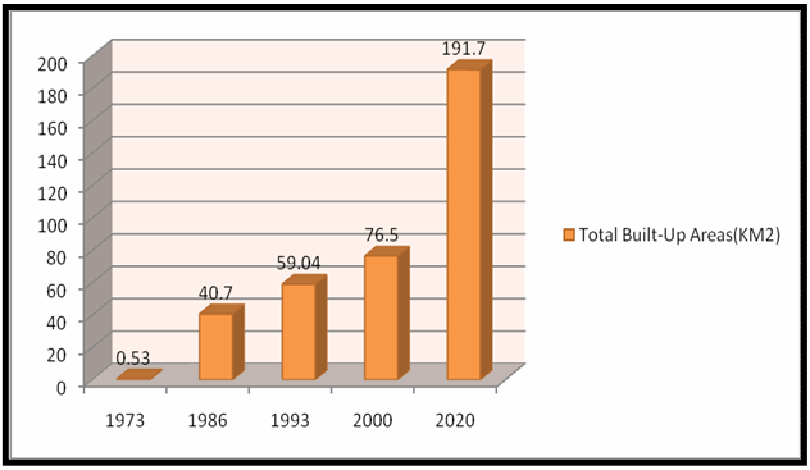

Figure 2a: Areal Extent of Urban Expansion in the Study Area

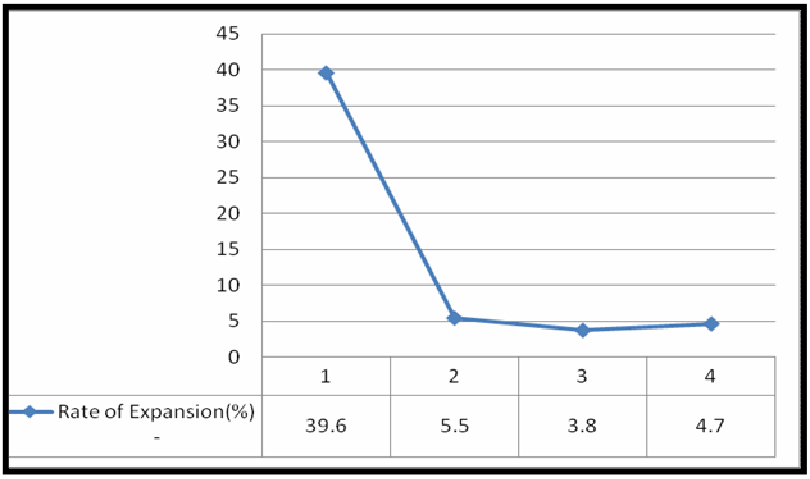

Figure 3b: Rate of Urban Expansion from 1986 to 2020

Table 3 : Error Matrix for SPOT –XS 1986 of Egbeda Local Government Area Image Classification

	Ground Truth				
Classification	Urban Built-Up	Highlands	Vegetated Area (Rural Area)	TR	Accuracy
Urban Built-Up	85,000	0	21	85021	99.98%
Highlands	7	1712	1307	3026	56.58%
Vegetated Area (Rural Area)	0	532	48313	48845	98.90%
TC	85007	2244	49641	136892	
Reliability	100%	76.25%	97.32%		

Where TC = Column Totals; TD = Sum of Major diagonal; TR =Row totals: Average Accuracy = 85.15%; Average Reliability =91.20%; Overall Accuracy = TD/TR (135025/136892) = 98%. Error was considered to be consistent with limits of the available technology.

Table 4 : Error Matrix for LANDSAT ETM+ 2000 of Egbeda Local Government Area Image Classification

	Ground Truth				
Classification	Urban Built-Up	Highlands	Vegetated Area (rural areas)	TR	Accuracy
Urban Built-Up	101,750	42	194	101986	99.75%
Highlands	50	542	5	597	91%
Vegetated Area (rural areas)	211	2	18706	121502	98.90%
TC	102011	586	18905	121502	
Reliability	99.70%	92.50%	98.95%		

Where TC = Column Totals; TD = Sum of Major diagonal; TR =Row totals: Average Accuracy = 96.54%; Average Reliability =97.05%; Overall Accuracy = TD/TR (120999/121502) = 99.53%. Error was considered to be consistent with limits of the available technology.

The low density urban sprawl increased to 33.2km^2 (419%) and predominated over the other spatial forms of the urban sprawl in the study periods. This indicates that the scattered, low-density development characteristic of sprawl occupies far more land than does multi-storied and higher-density urban centers (Bullard et al., 2000), and has significant effects on the land and its resources.

Table 5: The Identified Spatial Forms of Urban Sprawl in the Study

IDENTIFIED SPATIAL FORMS OF URBAN SPRAWL	1986 (KM^2)	1993 (KM^2)	1986-93 (%)	2000	1986 – 2000 (%)
(1) Leap Frog Sprawl	3.3	3.6	9.1	11.2	239
(2) Low Density Sprawl	6.39	9.1	42.4	33.2	419.7
(3) Ribbon Sprawl	24.1	2.8	48.6	32.4	34.4

Source: Author's SPOT-XS, SPOT-P and Landsat ETM+ Classification 2006.

The study shed more light on the spatial dispersion of built-ups at urban fringe of the city that constituted the urban section of the Local Government Area. The entropy value calculated in 1986 was 0.0933. The value increased to 0.180 in 1993 (93.5%) and dropped to 0.178 (91.4%) in 2000 (see table 6). These entropy values indicated that land development (built-ups) was dispersed away from Ibadan-Iwo road and Ibadan-Ife expressway.

Analysis of temporal change of spatial patterns of urban sprawl in the study area showed that the change in entropy between 1986 and 1993 was 0.087. This indicates an increase in sprawl development, and hence, land development (built-ups) tends to be more dispersed. Between 1993 and 2000, the result of change in entropy calculated was -0.002 (see table 6 and Figure 4). This indicates a decrease in the value of entropy. This reveals that urban development has been sprawling at varying intensity in the study areas over the study period. In other words, the land development (built-ups) was more dispersed between 1986 and 1993 than between 1993 and 2000.

Table 6: The Entropy Values and Change in Entropy between 1986 and 2000

YEAR	ENTROPY VALUE (E)	%	CHANGE IN ENTROPY
1986	0.093	-	-
1993	0.180	93.5	0.087
2000	0.178	91.4	-0.002

Source: Author's SPOT-XS, SPOT-P and Landsat ETM+ Images Buffering 2006.

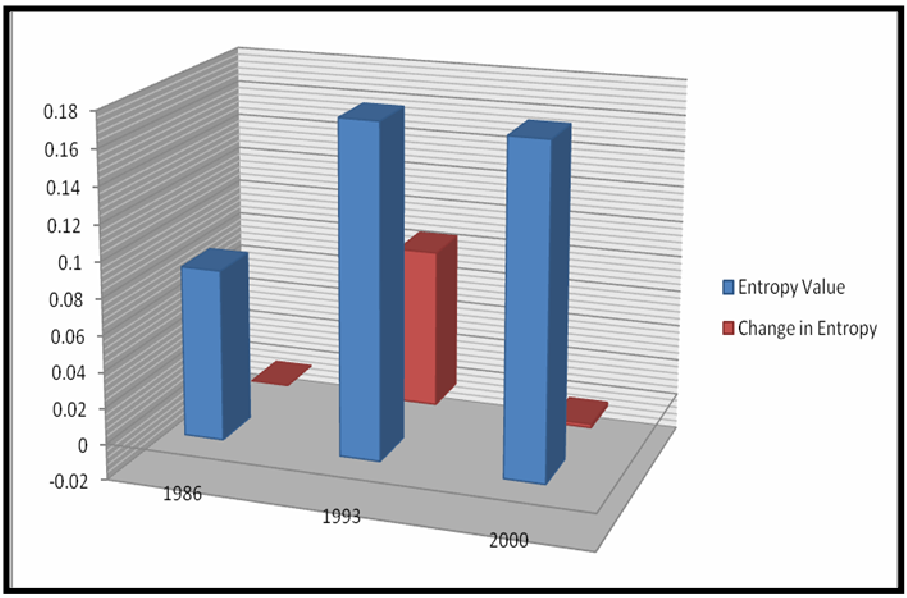

Figure 4: Entropy Values and Change in Entropy over the study period

Table 7 showed that the percentage urban built-up continued to increase from 0.23 percent in 1973 to 17.5 per cent in 1986, exactly, thirteen years later. It increased to 25.3 percent and 32.8 percent in 1993 and 2000 respectively. This reveals that as the percentage urban built-up increase the total rural area under rural land uses/covers decreases. At this rate by 2020, the total area of Egbeda Local Government Area under urban uses is projected to be 191.7km^2.

Table 7:The Percentage Urban Built-up and Agricultural Land Loss of the Study Area from 1964 to 2000

Year	Total Urban Built-Up (Km^2)	% Urban Built-Up	Agricultural Land Loss (Km^2)	%
1964	-	-	-	-
1973	0.53	0.23	0.53	0.23
1986	40.7	17.5	40.17	7579.2
1993	59.04	25.3	18.34	45.1
2000	76.50	32.8	17.46	29.6

Source: Author's Fieldwork

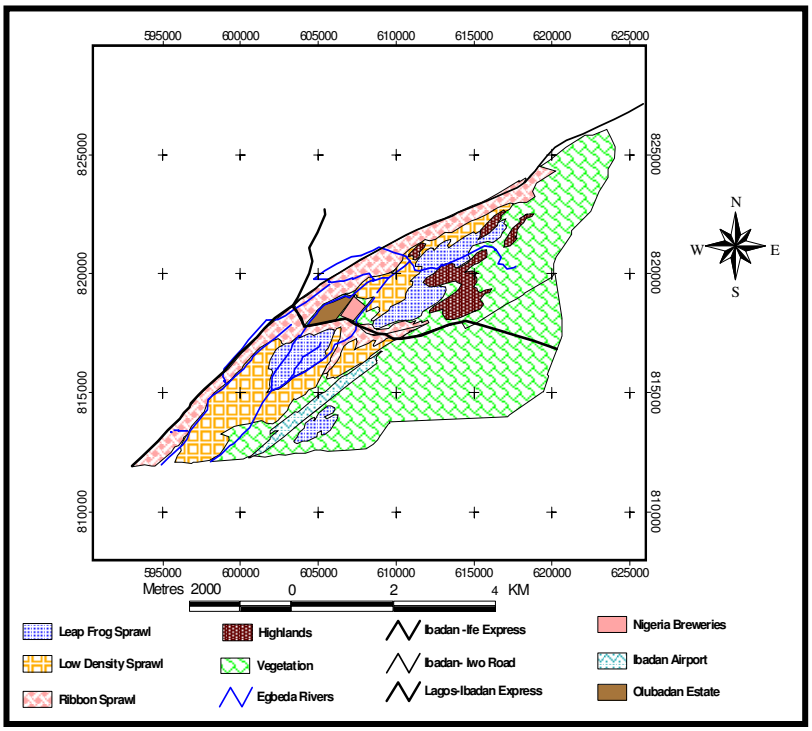

Figure 5: The Spatial Pattern of Urban Sprawl in Egbeda L.G.A. in 1986

Table 8:The Percentage per Capita Land Consumption Between 1986 and 2000

Year	Total Population	Total Built-Up (M^2)	Per Capital Land Consumption (M^2)	%
1986	112189	40700000	362.8	-
1993	136392	59040000	432.9	19.32
2000	165817	76500000	461.4	27.2

Source: Fieldwork, 2006.

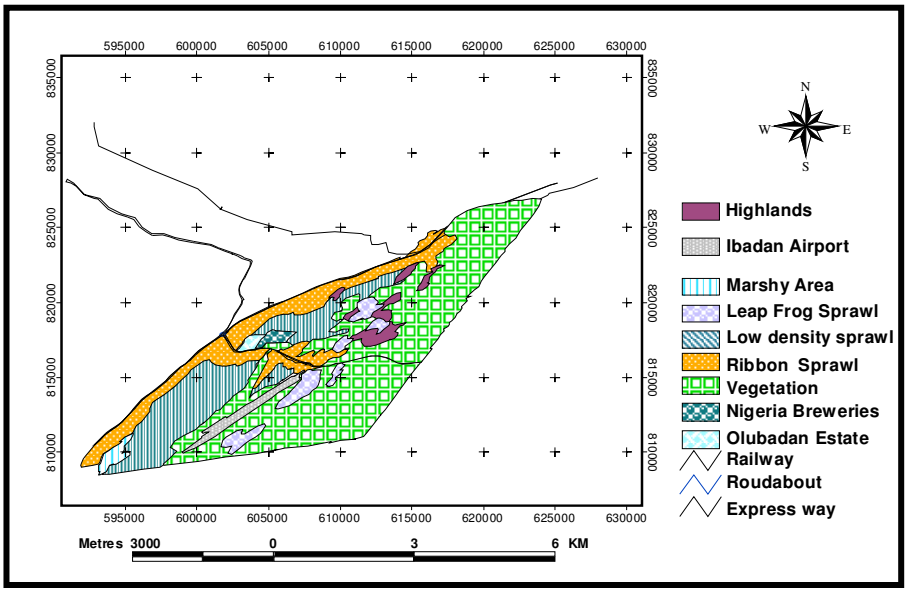

Figure 6: The Spatial Pattern of Urban Sprawl in Egbeda L.G.A in 1993

Table 9: Percentage Change in Population of Egbeda Local Government Area from 1986 to 2000

Year	Total Population	% Change In Population
1986	112189**	-
1989	121986**	8.73
1991	128988*	5.74
1993	136392**	5.74
2000	165817**	21.6

Source:*1991 Population Census Data (National Population Commission, Federal Secretariat, Ikolaba, Ibadan).
**Projection Population Data, 2006 by the Author.

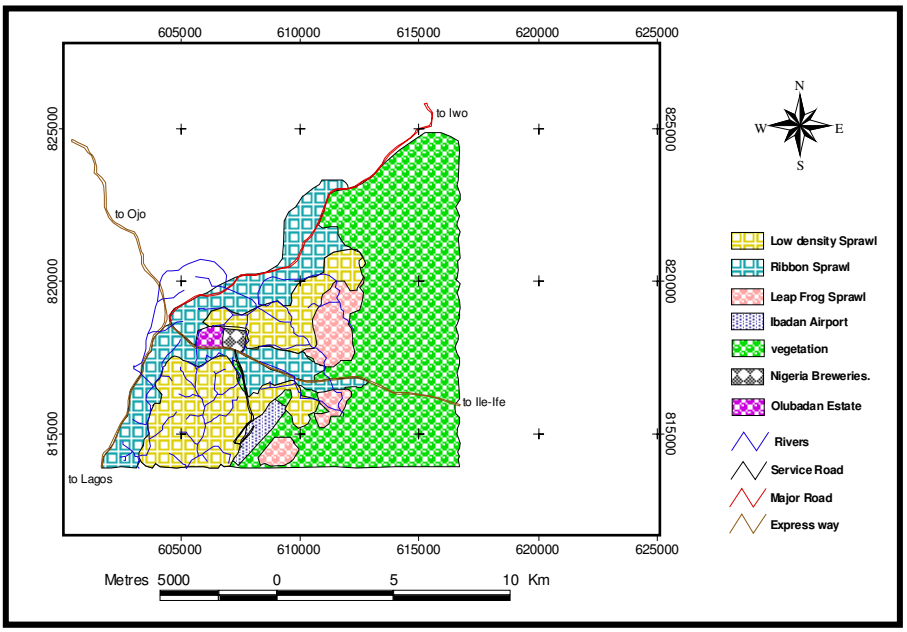

Figure 7: Spatial Pattern of Urban Sprawl in Egbeda L.G.A. in 2000

The table further showed that in 1973, 0.53km^2 (0.23%) of agricultural land had been lost to urban expansion. Between 1973 and 1986, it increased to 40.17km^2 and between 1993 and 2000, the agricultural land loss were 18.34km^2 (45.1%) and 17.46km^2 (29.6%) respectively. This constitutes a great threat to food security, a very vital component of sustainable development, in the area. Urbanization, particularly sprawling urbanization can have negative influences on hydrological systems, principally by reducing the permeability of land and increasing surface runoff, with implications for the introduction of pollutants into ecosystems (Ewing 1994). Further, table 8 showed that the per capita land consumption in 1986 was 362.8m. It rose to 432.9m, that is 19.32% in 1993 and 461.4m (27.2%) in 2000. This indicates that the per capita land consumption in the study area is high; this is in agreement with population trend in the study area. Table 9 showed that the percentage change in population was 8.73 percent in 1989. Population of the area decreased to 5.74 per cent in 1991

and 1993. By 2000, it increased by 21.6 percent, this reveals tremendous increase in the population of Egbeda Local Government Area.

Similarly, the rate of population growth is also an important index of measuring urban sprawl. The population growth rate (2.8%) as at 2000 when compared with the rate of urban expansion generates a good index of measuring urban sprawl. The logic is that when index, the rate of urban expansion exceeds the rate of population growth, the prevailing urban expansion would be in form of urban sprawl. This agrees with Yeh (2003), that most of the urban development (big towns and cities) in developing countries is in form of urban sprawl.

Conclusion and Implications of the Study

This study demonstrated the capability of Geographic Information Systems and remote sensing in undertaking quantitative measurement of urban sprawl pattern and trend at Egbeda Local Government Area, Ibadan. The study showed that the area designated as Egbeda Local Government Area covered 233km^2 and as at 1964, the area was completely in rural land uses/covers. However, Ibadan Metropolitan city had been stretching into Egbeda Local Government Area at a fast rate, which averaged 3.0km^2 per annum. The urbanized part of Egbeda Local Government Area was estimated to cover 76.50km^2 in 2000. By projection, the total area of Egbeda Local Government Area under urban uses would be 191.7km^2 by 2020. Of all the spatial forms of urban sprawl identified in the study area, low-density sprawl was found to predominate between 1986 and 2000. Further, the study showed that the entropy value which was 0.093 in 1986, increased to 0.180 (93.5%) in 1993 and dropped to 0.178 (91.4%) in 2000. These entropy values indicates that land development (built-ups) was dispersed away from Ibadan-Iwo road and Ibadan-Ife expressway, and that land development

(built-ups) was more dispersed between 1986 and 1993 than between 1993 and 2000. The study, therefore generated urban sprawl indices like population growth rate, rate of expansion, percentage agricultural land loss, per capita land consumption, percentage built-ups, percentage change in population and density of land development within the period of 1964 to 2000.

Emanating from this study is the fact that local government generally does not develop adequate capacity to plan for and manage growth until it is too late to effectively channel development. It is therefore, necessary to sensitize the local authorities and create awareness in regard to the need to develop a geo-spatial mechanism for controlling rapid urban expansion in the adjoining local government areas to reduce urban sprawl.

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