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Exploration of urban growth trends in States of South East Nigeria: 1986 to 2016

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Abstract

The aim of this study was to explore the combined application of geo-spatial methods to enhance understanding of urban growth dynamics in South-East Nigeria. This is premised on the fact that the growth and broad spread of urban areas are better captured when mapped and visualised at the metropolitan-region scale, which provides the “big picture”.

Findings revealed that;

1. The spread in built-up area increased with time from one year to another.
2. Ebonyi was the fastest growing State in the South East between 1986 and 2006, followed by Imo State, while Anambra State recorded relatively lower growth in terms of annual change.
3. Enugu State had the highest record of annual built-up area in 1986, 2006 and 2016 respectively.
4. Between the periods 2006 and 2016, there was a shift in annual urbanisation rate among the States. Anambra became the fastest growing State in the region, followed by Enugu, while Abia slowed down.

The implications of these findings on the growth and development of the region is that whereas, newly created states tend to have increased growth due to available space and the intentional hand of Government driving urban growth, the older states with significantly established urban areas had attained a plateau in terms of urban growth. It can be concluded that the dynamics of urban systems in South East Nigeria can be understood from a geo-spatial analysis of historical processes, events and trends of urban growth.

Keywords: urban environment, urban growth trends, spatial urban planning, urban management.

Introduction

Spatial interactions are regulating the relative size of urban areas in South-East, Nigeria. These spatial interactions among a huge number of factors have proven to have unknown non-linear relationship. These non-linear interactions result in unknown globally ordered land use options. The order is typically represented by large-scale urban growth or clustered patterns (Cheng, Masser, Ottens & Turkstra, 2011). Research in the field of urban growth has evolved models that search for drivers and components of urban growth dynamics (Banai & DePriest, 2014). The use of spatial models of urban growth in geographical boundaries of low income nations could be a means to aid planners and decision makers, to appreciate and project the process of urban growth, as well as test the results of different development strategies.

Urban systems are quite complex and their exact evolution is unpredictable. Hence, its development process is a function of unknown initial conditions such as war, natural disaster, and new policies of the central government. These conditions are usually not predictive, particularly in quantitative terms (Bretagnolle, Daude & Pumain, 2015). If the urban system is chaotic, prediction of the values of all system variables is possible only within a usually short time horizon, owing to limited information production.

Urban environment

Urban systems are rather complicated (Bretagnolle, Daude & Pumain 2015). However, the evolution of urban systems can actually be predictable particularly within a given space and time. The growth and the spontaneous spread of the urban environment are better grasped

when mapped and visualised at the metropolitan-region scale, which provides the “big picture” (Banai & DePriest, 2014). The need to explore the basic dynamics of urban growth, for a region in tropical Africa that is well known for high rate of urbanisation, poor agricultural resource base, high population growth rate and crude density (Ajaero & Madu, 2014), cannot be over emphasized.

The term urbanisation describes a condition at a particular time, including the proportion of total population or area in urban localities or areas (cities and towns), or the increase of this proportion over time (Batten, 1995). The growth and subsequent expansion of territorial boundaries of capital cities in South East Nigeria has resulted in the annexation of surrounding hinterlands due to the adverse impact of urban growth on contiguous rural areas (Onyewuchi, 2012). Knowledge of the anticipated shape complexity of urban areas in South East Nigeria is crucial to determine the level of sustainable management required for the urban areas, presently and in the future.

Global and regional trends of urban growth and implications

The failure of countries to provide basic infrastructure that will proportionally contain the high rate of urbanisation and ensure sustainability of metropolitan settlements has led to unpleasant developments in different areas (UN-Habitat, 2009). This development has affected both experts and governments in both developed and developing countries. The unavailability of the needed infrastructure in urban areas has created suburbs or sprawl, slums and environmental problems such as flood, subsidence, collapse of bridges, landslides, and fire disaster, etc; (UN-Habitat, 2009; Nyambod, 2010). In Nigeria, the challenge ranges from non-implementation of the Nigerian Urban and Regional Planning Law (Decree No. 88 of 1992, amended as No. 18 of 1999), inadequate funding of physical planning programs, lack of planning tools, undue political interference by government officials, poor public enlightenment on physical planning programs, inadequate monitoring of planning schemes amongst others (Vivan, Kyom & Balasom, 2013; Aluko, 2011).

Since the 1980's, the rate of expansion of cities in Nigeria has been very rapid with resultant accelerated urban growth (Adesina, 2007). Various reasons have been given for this rather enormous growth, ranging from increased birth rate and migration, congestion in the central business district, to the urban bias system of development that is very common with developing countries (Adesina, 2007; Wizer, 2012; Iwuoha & Arokoyu, 2014). And the recommendations for policy, planning and strategy have hitherto been tailored in the direction of the above stated reasons. The implication of rapid urban growth on infrastructure and human conditions such as population growth and migration, urban bias development and territorial annexation in South-East Nigeria abound in the literature (Chuks, 2001; Ajaero & Madu, 2014; Iyi, 2014; Okoroafor, Ibiam, Nwazue & Ukpabi, 2014). However, apart from poor implementation, either arising from weak institutions, technical incompetence or lack of executive will and capacity to implement, it is likely that previous planning strategies adopted to manage urban growth, failed due to lack of adequate knowledge of the nature of urban growth.

Incidentally, the dynamics of urban growth is a concept better captured by using satellite imagery/remote sensing (Masek, Lindsay & Coward, 2000; Veldkamp & Verburg, 2004). Urban growth can appear in distinct geometric forms and their patterns and determinants remain little understood (Chi, Shubo, Nao & Shuqing, 2015).

Materials and methods

This study utilised longitudinal research design, which allows the analysis of time extent of a particular phenomenon and allows survey researchers to discover the kinds of causal explanations usually attainable only with experiments (Eugene & Lynn, 2015). Longitudinal design was applied on land cover analysis to describe the patterns of change and help to establish the direction and magnitude of causal relationships. Measurements were taken on each variable over two or more distinct time periods. This allowed for measurement of change in variables over time. Landsat Thematic Mapper imagery analysed using ENVI 5.0 and ArcGIS 10.5 constitutes the foundation data layer from which the land use and land cover (built-up and non-built up) maps were derived. The study required the acquisition of three Landsat TM scenes which were corrected for interference as indicated in Table 1. These corrections were executed at ground receiving stations. System correction refers to the corrections performed at the ground receiving station based on previously known sensor (system) distortions such as the pitch, roll, and velocity of the satellite platform.

Table 1: Landsat ETM Scenes.

Data Type	Acquisition Year	Source	Cloud Cover
Landsat ETM+	18/11/1986	USGS	0%
Landsat ETM+	02/12/2006	NASRDA	0.02%
Landsat ETM+	06/02/2016	NASRDA	0.02%

Source: Author's computation, 2019

Study area

Present day Nigeria consists of six geo-political zones namely; south - south, south - east, south - west, north - east, north - west and north - central. Each of these zones consists of a number of Federating States, including the Federal Capital, totalling thirty six. Figure 1 is the five States of South East Nigeria within the context of thirty six States of Nigeria. The States of South East Nigeria include; Abia, Anambra, Enugu, Ebonyi and Imo states. Their State Capitals include; Umuahia, Awka, Enugu, Abakaliki and Owerri respectively. More than 30 million people inhabit South East Nigeria, and they are predominantly of Igbo ethnic extraction with a population density ranging from 140 to 390 inhabitants per square kilometre (Ezeokana, 1999). South East Nigeria has been attested to be the most densely populated area in Africa after the Nile Valley (Eze-uzomaka, 2000). South East Nigeria has an approximate land area of about 40,900 to 41,400km² (Uchendu, 1965; Edeh, 1985).



Fig. 1: States of South East Nigeria.

Method of Data analysis

The acquisition dates of the ETM Scenes employed in the change detection process fall within an acceptable anniversary window: November 18th, 1986 and February 6th, 2016. The best time for phonological stability in this region is during the dry season from November to February. Selecting the driest period of the year for the locale, will enhance spectral detachment, yet minimise spectral similarity due to excessive wetness prevailing

during other periods of the year (Burns & Joyce, 1981).

After the processing and classification of satellite imagery began, a site visit at some sites for verification purpose was done using Global Positioning System (GPS) equipment. This was to allow for the determination of accuracy assessment of classified satellite imagery (Congalton, 1991). This survey was performed in order to obtain accurate location point data for each land use and land cover class included in the classification scheme. The land

use and land cover categories of focus were urban coverage, vegetation, agricultural land, barren land, and water bodies. The urban areas were further categorised as built-up, while the vegetation, agricultural land, barren land, and water bodies were considered as non-built up. Within the scope of this study, image classification is defined as the extraction of differentiated classes or themes, land use and land cover categories, from raw remotely sensed digital satellite data.

A multilevel, hierarchical land use classification was derived from the author's a priori knowledge of the study area and is roughly based upon an Anderson level II classification (Anderson et al, 1976). The land use was further classified into built up and non built up classes, with urban areas considered as the former while agricultural land, forest land, water bodies, and bare land were considered as non built up. For the purposes of this study, the terms land use and land cover have been combined as one entity for the description of the landscape within the area of study. It should be noted that while land use and land cover are recognised as separate entities (Myers, 1995), they have been combined in this study in order to

conform to the level of detail employed. This study utilised base maps of South-East Nigeria in the GIS environment to determine the nature of growth in urban areas of the study area. In this regard, urban areas in the five States of South East Nigeria were mapped. The outcome was a spatial outlook of urban coverage in urban areas of South-East Nigeria. Accordingly, the outcome of the image analysis was interpreted based on well known urban growth types including; infilling and spontaneous growth, and outlying growth. Subsequently, the figures from the spatial outlook of urban coverage were also converted to percentages for purposes of analysis.

Results and discussions

Table 1 is the outcome of analysis of base maps and imagery of urban areas in South East Nigeria. Based on this, urban areas in the five States of South East Nigeria were mapped in three epochs (1986, 2006 and 2016) covering thirty years. The outcome was a spatial outlook of urban coverage in urban areas of South-East Nigeria. The spatial outlook was also converted into percentages for the purpose of analysis.

Table 2: Spatial outlook of urban coverage in South East, Nigeria.

ABIA STATE			
Land use class	1986 (Sq. Km)	2006 (Sq. Km)	2016 (Sq. Km)
Built up area	223.2	285.18	405.72
Non built up area	4510.36	4448.38	4327.84
ANAMBRA STATE			
Land use class	1986 (Sq. Km)	2006 (Sq. Km)	2016 (Sq. Km)
Built up area	377.78	599.15	1795.96
Non built up area	4344.58	4123.21	2926.4
EBONYI STATE			
Land use class	1986 (Sq. Km)	2006 (Sq. Km)	2016 (Sq. Km)
Built up area	812.37	1074.50	1453.91
Non built up area	5508.04	5245.91	4866.5
ENUGU STATE			
Land use class	1986 (Sq. Km)	2006 (Sq. Km)	2016 (Sq. Km)
Built up area	1866.31	1929.28	3353.49
Non built up area	5799.69	5736.73	4312.52
IMO STATE			
Land use class	1986 (Sq. Km)	2006 (Sq. Km)	2016 (Sq. Km)
Built up area	155.07	309.06	642.40
Non built up area	5019.72	5019.72	4686.38

Source: Authors' computation

Urban growth trend in South East Nigeria (1986)

In 1986, Abia State urban built up was observed to be sparse with a little concentration of growth in Umu-Nneochi, Aba, and Isikwato (Figure 2). The built up within the period covered an area of 223.2 sq. Km (Table 2). We visualised edge-expansion and outlying growth in Umu-nneochi, Aba, and Isikwato. The pattern of urban coverage in Anambra State tended to be quite uniform. There was no dominant urban area, but several built up areas scattered around and within Anambra, indicative of opportunities and social amenities distributed in a near uniform manner. In 1986, the built up areas in Anambra covered 377.78 sq. Km. Also, there was outlying growth in the Northern parts of the State with areas like Ayamelum and Anambra West showing sparse built up. Ebonyi State also witnessed a near uniform pattern of built up. There was no dominant urban area, but several sub-centres scattered around within the area. These were obviously locations where jobs and social

amenities were distributed in a near uniform manner. The built up areas for Ebonyi covered 812.37 sq. Km. In 1986, Enugu State built up pattern was observed to have no dominant urban centre. Built up was concentrated at the North and Western parts of the State, evidence of infilling and spontaneous growth was visible in the Northern and Western parts of the State. These areas included Nsukka, Oji River, Eze-Agu, and adjoining areas. Sparse built up was also visible around the Eastern parts of the State. Part of Enugu North and Enugu East were also included in these dense built up areas. The urban spread in Enugu covered 1866.31sq.km. **In 1986, the overall built up pattern in Imo State was observed to be sparse**, with a little random concentration. Infilling growth was visualised in Owerri Municipal, Owerri North and Owerri West, urban spread within the period covered an area of 155.07sq. k.m.

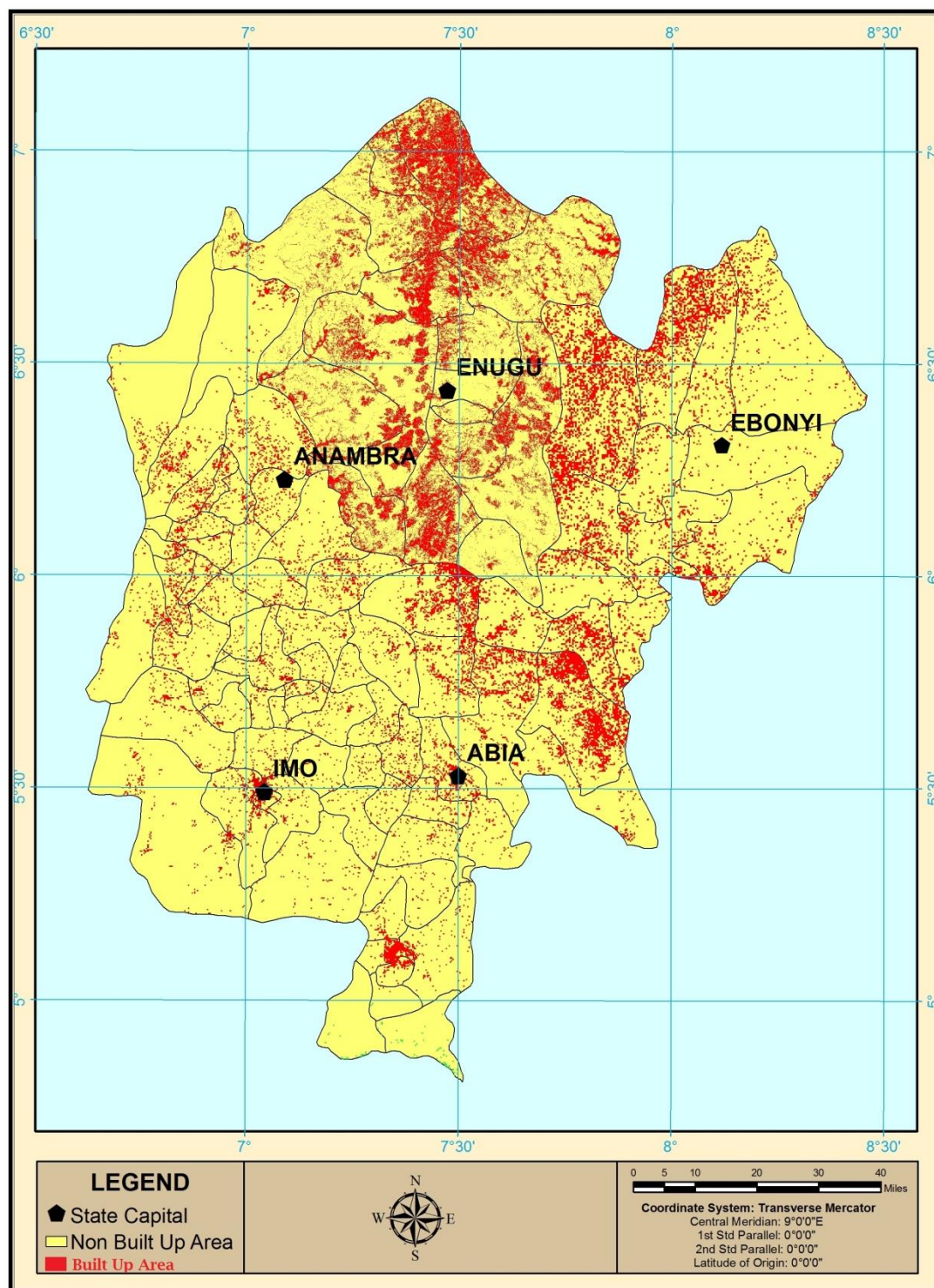


Fig. 2: Urban growth trend in South East Nigeria (1986)

Urban growth trends in South East Nigeria (2006)

In 2006, (Figure 3) built up in Abia State was concentrated as observed in Ohafia, Ohafia had witnessed infilling growth while Isikwato became sparse. Built up area grew to 285.18 sq. km during the period (Table 2). The situation in Anambra State changed slightly by 2006 with the Southern parts of Ogbaru and Ihiala becoming more sparsely built up. Built up area increased to 599.15 sq. km in 2006. In Ebonyi State built up area increased to 1074.50 sq. km in 2006. It was observed that in all the images analysed from 1986 to 2016, the Capital city: Abakiliki did not have a dominant built up pattern. Afikpo South recorded outlying growth at the initial stages (1986) and later witnessed

infilling growth. This area appeared to be quite dense than any other part of the State. In Enugu State, the dense built up witnessed in the eastern parts of the state in 1986 increased slowly in intensity and coverage around their borders in 2006, indicative of edge expansion growth. The dominant urban growth type in Enugu State was outlying growth, resulting in dispersion of the urban areas. Overall, built up area grew to 1929.28 sq. km in 2006. **In 2006 built up increased in intensity and coverage in Owerri.** Significant edge expansion and outlying growth occurred at the borders of major urban areas resulting in annexation of the adjoining rural hinterlands. Urban spread grew to 309.06 sq. km during this period.

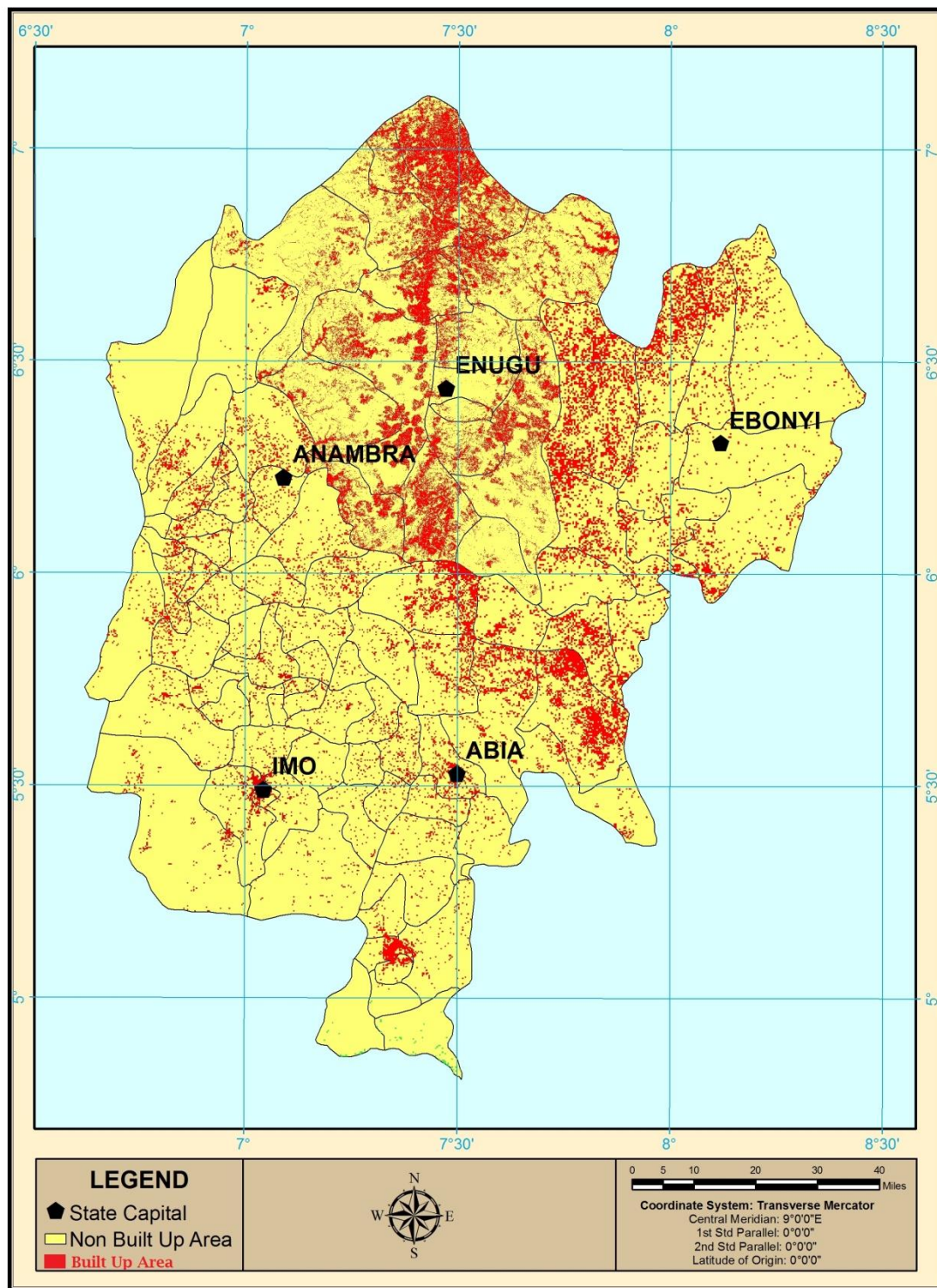


Fig 3: Urban growth trend in South East Nigeria (2006).

Urban growth trends in South East Nigeria (2016)

In 2016 (Figure 4), there was a strong high density of built up at Aba South and Aba North, followed by Umu-nneochi, then Ohafia and Umuahia North. The built up within this period covered an area of 405.72 sq. Km (Table 2). The three maps for Abia State revealed that built up occurred along major roads. The driving force for such growth was the presence of social amenities, job opportunities, and access road network. There was also radial movement of people from the periphery towards the area of highly dense built up. And in 2016 there was spontaneous growth in Aba South and Aba North, followed by Umu-nneochi, Ohafia

and Umuahia North. **Built up area in Anambra State increased to 1795.96 sq. km in 2016.** However, it seemed almost uniformly, with major infilling and spontaneous growth in areas like Onitsha North, Idemili North, Onitsha South, Idemili South, Orumba North, Annocha, Orumba South, Aguata, Ekwusigo, Nnewi South and Dunukofia. Built up in these urban areas was very dense. In Ebonyi State built up area increased to 1453.9 sq. km in 2016. Though most establishments and Government presence was felt in the State Capital Abakaliki, other locations including Afikpo South, Ohakwu, Ishelu, Ezza North, Afikpo North, Afikpo South and Ivo witnessed spontaneous and infilling

growth. This was demonstrated with quite a decent share of the built up. The reason for this outcome may not be far from the agrarian and indigenous nature of the Ebonyi people. Ebonyi is one of the major producers of rice and other cash crops in Nigeria. In 2016, the strong high density built up observed in the North and Western parts of Enugu State, indicative of infilling and spontaneous growth, spread to all parts of the State. Sparse built up and edge expansion growth was observed at Isi-Uzo, Uzo-Uwani, and parts of Enugu East. Urban built up within this period covered an area of 3353.49 sq. km. Enugu State had the largest urban spread within the entire South East, Nigeria. It was also observed that Enugu Capital city did not

necessarily account for the highest density. Areas such as Igboeze North and South, Udeenu, Nsukka, Igbo Etiti, and adjoining areas accounted for the highest density of all times from 1986 to 2016. In 2016, there was infilling and spontaneous growth leading to high density built up in Owerri Municipal, Owerri North and Owerri West, followed by Oguta and Oru West. The high density within Owerri increased to adjoining areas such as Mbaitolu and Ikeduru. Urban spread within this period covered an area of 642.40 sq. km. However there was outlying growth leading to an increasing built up pattern within the Northern part of Imo State during this period.

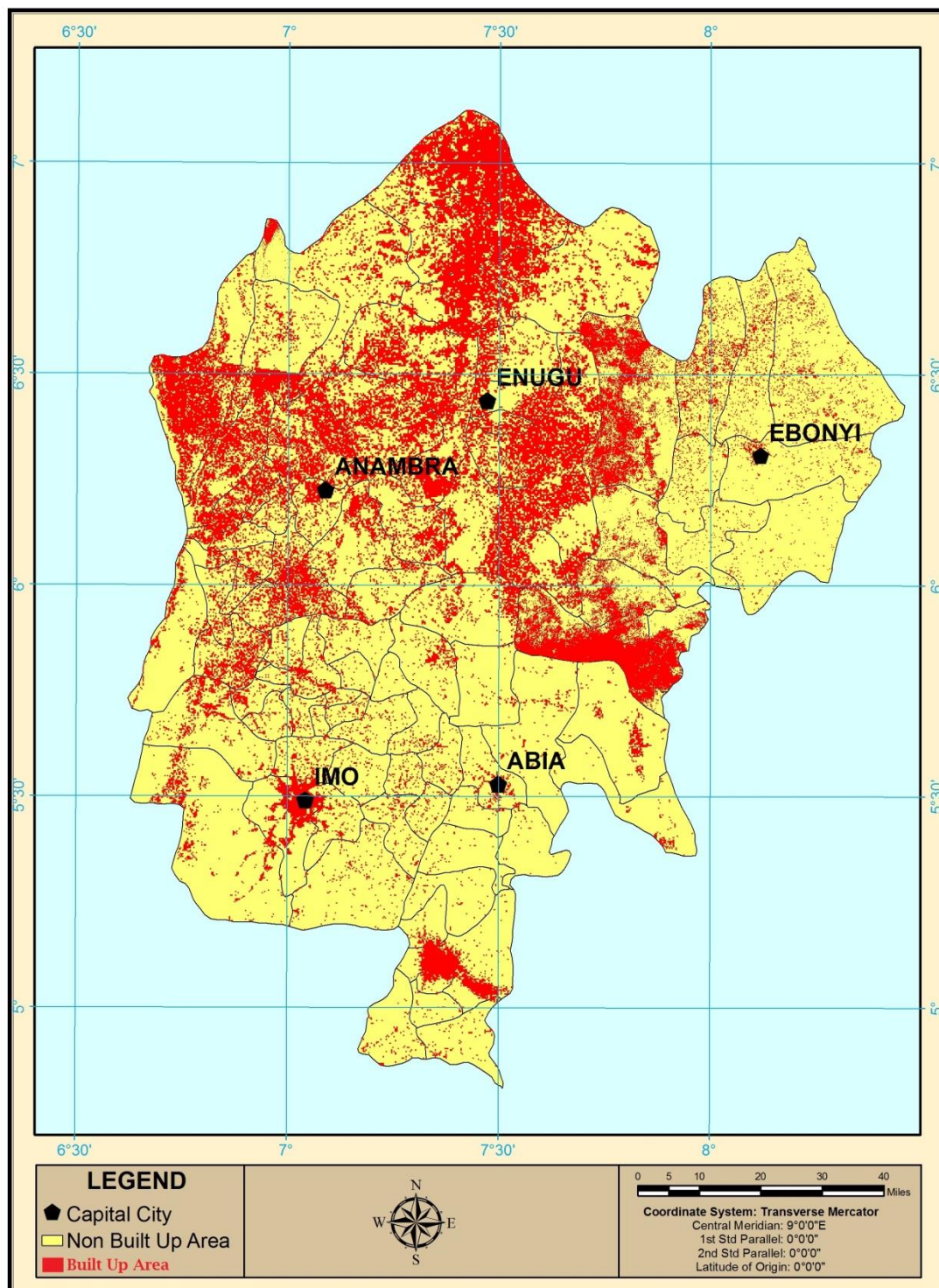


Fig. 4: Urban growth trend in South East Nigeria (2016).

Conclusion

In the face of population explosion and man's aspiration to meet contending basic and social needs, there has been a natural growth in urban built up areas. The resulting outcome has been an uncoordinated growth trend and human interference on the environment. This study has examined urban growth trends in the various States of South East Nigeria, from 1986 till 2016. A combined application of geo-spatial technique was deployed to enhance a **detailed** examination of the urbanisation history and evolving trend. Among the States in South East Nigeria, it was observed that Enugu had the highest record of built-up area with 32.18%, 33.63%, and 77.76% in 1986, 2006 and 2016 study series. Imo State had relatively lower coverage of built-up with 3.09%, 6.17%, and 13.71% in 1986, 2006 and 2016 respectively. Ebonyi State was the fastest growing State in the South East between 1986 and 2006, followed by Imo State, while Anambra State recorded the least growth in terms of yearly change. Abia, Enugu, Anambra, Imo, Ebonyi States recorded an annual growth rate of 0.07%, 0.07%, 0.04%, 0.16%, 0.29% respectively within this period (1986-2006). It can be concluded that understanding urban dynamics in South East Nigeria is based on the critical knowledge of the historical processes, events and trends of urban growth in the region.

Broad implication of findings and Recommendation

The urban growth trend in Abia State shall likely remain unchanged with a combination of edge-expansion, infilling and spontaneous growth, and outlying growth at the urban fringes. Infilling and spontaneous growth shall be dominant and more so in the core urban areas with marginal potential urban coverage. This would have severe implications on congestion and sprawl in the core urban areas with **consequences** of waste management and overcrowding. The pattern of urban growth in Enugu State will affect several land resources and water bodies, thereby causing severe congestion and serious pollution. Its urban growth pattern will also combine edge-expansion growth, outlying growth, infilling and spontaneous growth. The area of built up will likely increase. The near uniform pattern of urban growth in Anambra State shall remain unchanged. **However**, several land and water resources will be negatively impacted, thereby causing congestion and pollution in urban areas. Anambra State is worst hit with **gully** erosion compared to other parts of the entire South East; this has created conditions for leapfrogging, especially in coastal areas. The area of built up will also likely increase. The combination of edge-expansion growth, outlying growth, infilling and spontaneous growth types in Imo State will very likely remain unchanged. Infilling and spontaneous as well as outlying growth will be dominant especially in **Owerri**, Imo State Capital as the urban fringe continues to expand, while the urban coverage increases. The uniform spread of urban growth in Ebonyi State will remain unchanged, with a combination of edge-expansion growth, outlying growth, infilling and spontaneous growth. There is a huge prospect for outlying growth in Ebonyi State given the agrarian and indigenous nature of the people. However, the area of built up will increase marginally.

The recommendations arising from this study are directed at Policy being the most influential driving force on the nature of urban growth in South East, Nigeria. Urban

growth in South East Nigeria tends to follow a combination of infilling and spontaneous growth, outlying growth and edge-expansion growth types at various degrees and influenced by various factors. Spatial planning policy and urban development management would regulate growth in urban areas of South East Nigeria and make it sustainable. Spatial urban planning and urban development and management remain a valuable force for city leaders to achieve sustainable development. It is a means to bring about a difference by informing infrastructure and services investments, balancing demands for growth with the need to protect the environment. Specifically, the following guidelines should be applied in urban areas of South East Nigeria:

- i. There should be an introduction of zoning for land use control: This involves the designation of various land use in the State for different **purposes** such as agriculture, industries, residential, water course, open space, etc.
- ii. Conservation areas should be established to restrict the over-exploitation of open spaces for developmental activities.
- iii. Special development permits should be granted to individuals and corporate organisation to regulate unorganised development activities. The obtaining of such permits is based on the prospects of providing municipal services to the site in a reasonable, economical and orderly way.
- iv. There should be levy/charges on new developments to offset the cost of facilities and services for the developments.

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