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Assessment of Spatial Urban Dynamics in Enugu City Using GIS and Remote Sensing

Presented By

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INTRODUCTION

In recent times, there is an increase in the rural-urban migration in Nigeria, this is made evident by the population surge in Enugu metropolis; this population growth has increased the rate of physical developments and renewals in the city. Spatial urban dynamics are the processes underpinning changes taking place in the spatial organization of large cities; this phenomenon has effects on the morphology, functional form and character of an urban environment over time. The aim of this research is to assess, model, study and predict the urban dynamics in Enugu metropolis. In this study, the urban dynamics of the case study city was spatially assessed and modeled using GIS and remote sensing techniques, the dynamics were assessed for 1995, 2000, 2005 and 2010 using LandSat Imageries (Enhanced Thematic Mapper plus (ETM+) and Thematic Mapper (TM)) the changes were presented spatially and graphically. A graphical projection was made in order to estimate/predict the extent of the dynamics by the year 2015.

INTRO-CONTD

An Urban area is a system of interacting industries, housing and people (Forester, 1969). Urban Development is a process of growth undergone by urban areas; it comes as an interaction between industries, people and housing. The urban system is influenced by the housing market and the labour market in line with the factors mentioned above as demonstrated in figure 1 below.

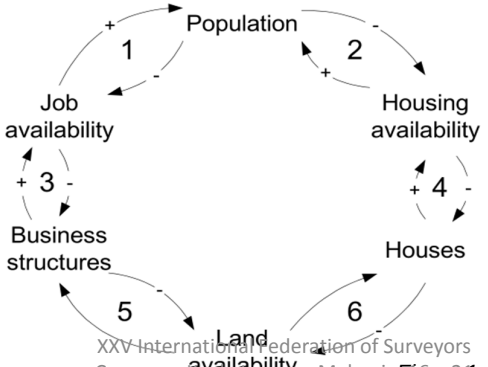

Figure 1: Urban System and its interacting sectors (Source: Alfred and Graham, 1976)

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STUDY AREA

The major study area is **Enugu Urban**, in Enugu state, Nigeria. **Enugu** (***Énugwú***) is the capital of Enugu State in Nigeria. it is situated within the following Coordinate limits: 6°27′9.60″N 7°30′37.20″E, Coordinates: 6°27′9.60″N 7°30′37.20″E ; The city core has an area of about 90 km^2. The Enugu urban area is made up of Enugu East, Enugu North and Enugu South Local Government areas of Enugu State in Nigeria. The city has a population of about 722,664 individuals according to the census carried out in 2006; it has a population density of about 6,400/km2. see figure 2.0 below

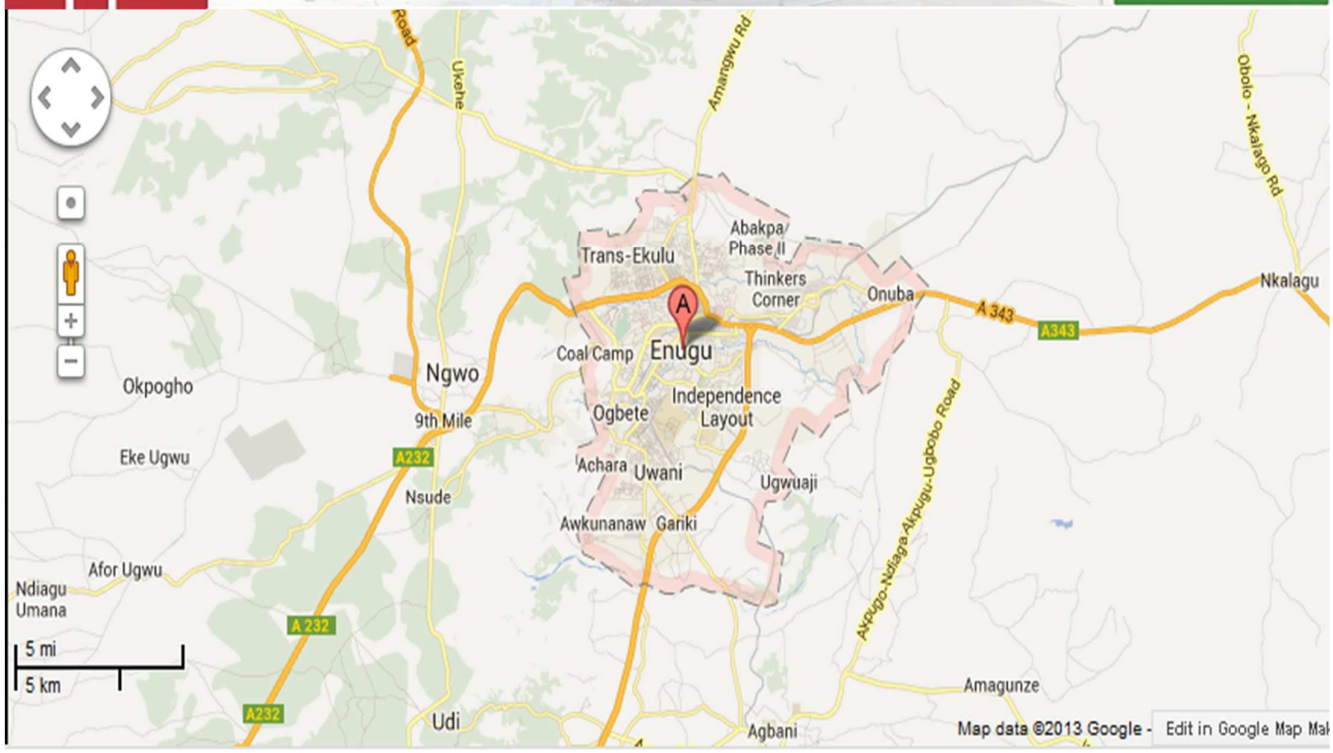

Figure 2.0: A Map showing Enugu Urban (the boundaries are verged red) (Source: Google Map).

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DATA

The following data were used in this study :

- LandSat Imageries of 1995, 2000, 2005 and 2010 respectively. Landsat thematic mapper (TM) was used for 1995, while Landsat Enhanced Thematic Mapper plus (ETM+) was used for 2000, 2005 and 2010.
- An analogue administrative map of Enugu Showing Local Government Boundaries.
- Ground coordinates taken before and during Ground truthing

METHODOLOGY

The Land Sat Imageries were already georeferenced, but the position accuracy of the imageries was further enhanced and precisely ortho-rectified using ground coordinates observations from dual frequency Hi-Target GPS systems. The Images were also enhanced for good spectral and radiometric qualities through image enhancement and fusion technigues in ArcGIS.

The areas derived from the measurements on the vectors were plotted graphically against their respective years; an upward trend was formed from the graph. The trend was projected to 2015 in order to estimate what the area covered by the city may be by then.

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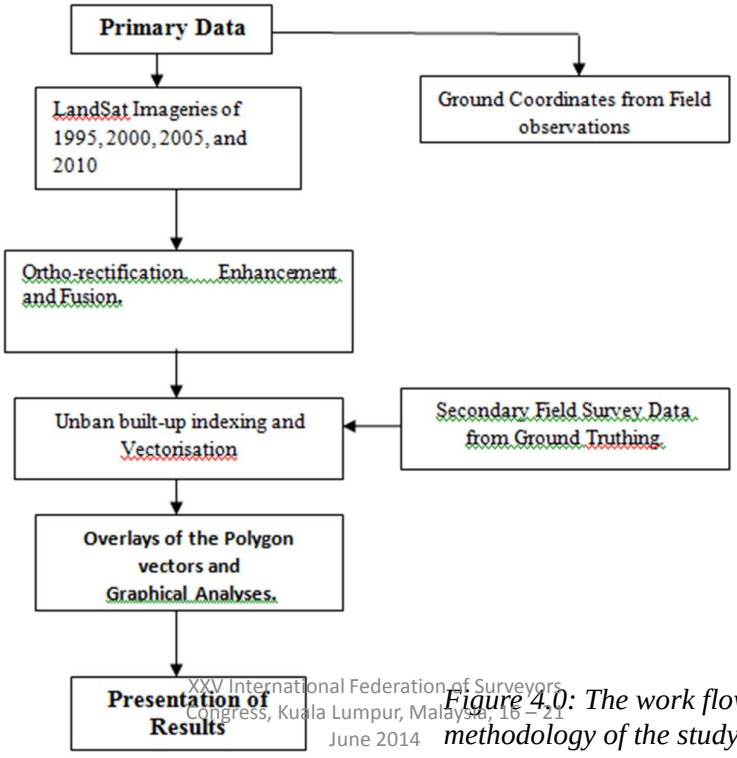

Figure 4.0: The work flow diagram of the methodology of the study.

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RESULTS

This study was able to achieve the following end results;

- A vector map showing overlays of the spatial dynamics between 1995 and 2000
- A vector map showing overlays of the spatial dynamics between 2000, 2005 and 2010
- A vector map showing overlays of the spatial dynamics between 2000 and 2005
- A vector map showing overlays of total spatial dynamics between 1995 and 2000, 2000 and 2005, 2005 and 2010 respectively.
- A graphical illustration showing the variation/increase in area from 1995 to 2010.
- A graphical projection/estimation of the area of Enugu City in 2015.
- The differences were shown in kilometer square.

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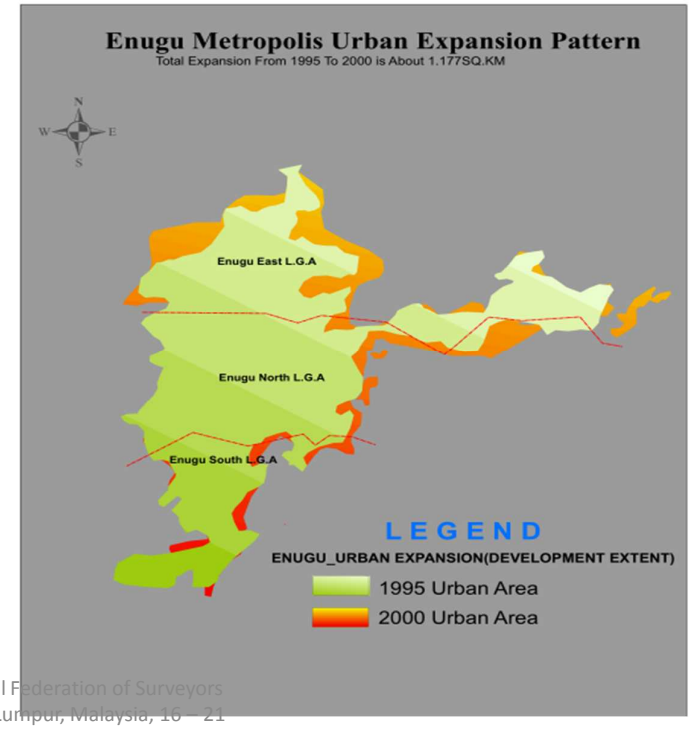
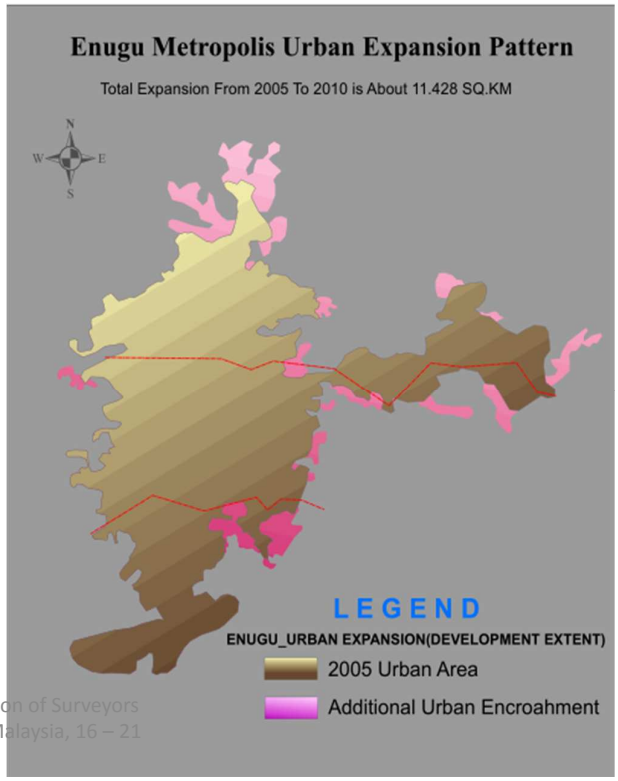
ANALYTICAL STEPS

Analytical (Spatial) Step One: In this step, the difference between the developed area in Enugu City 1995 and that of 2000 were assessed. In 1995, the area was 66.757SqrKm while in 2000 it was 67.934SqrKm, the difference was 1.177SqrKm. The development was more evident only in the Northern part (i.e Enugu East) while Enugu South and North had slower paces. There were minimal changes for this period.



Analytical (Spatial) Step Two: This step tries to illustrate the difference between the developed area in Enugu City 2005 and that of 2010. In 2005, the area was 78.604SqrKm while in 2010 it was 90.032SqrKm, the difference was 11.428SqrKm. The development was evenly distributed and has a steadier pace than in 1995/2000. This is believed to be as a result of the increased rate of government and community layout surveys and parcellations/allocations of land in the state within that season..



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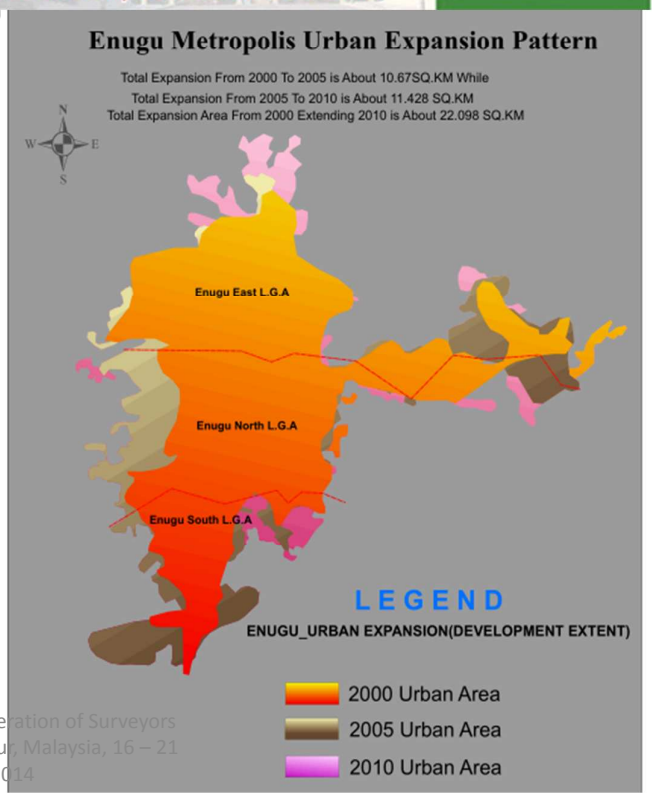
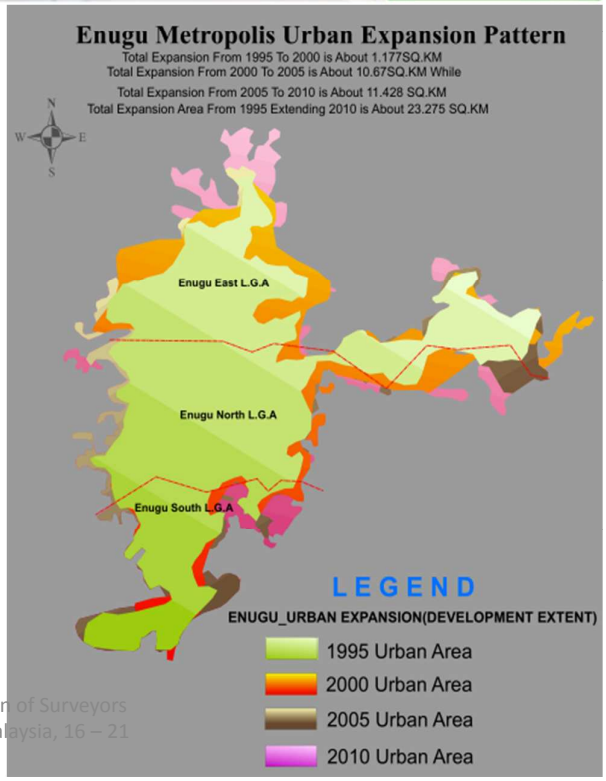
Analytical (Spatial) Step Three: Here, the difference between the developed area in Enugu City 2000, 2005 and 2010 were assessed. In 2000, the area was 67.934SqrKm; in 2005 it was 78.604 SqrKm, while in 2010 it was 90.032SqrKm. The difference between 2000 and 2005 was 10SqrKm while the difference between 2005 and 2010 is 11.428SqrKm. The total difference from 2000 to 2010 is 22.098SqrKm. The expansion/changes are evenly distributed in the metropolis between 2000 and 2010.



Analytical (Spatial) Step Four: This step assesses the total dynamics in the developed area in Enugu City from the beginning to the end of the study period. In 1995, the area was 66.757SqrKm; 2000 was 67.934SqrKm; 2005 was 78.604SqrKm, and 2010 was 90.032SqrKm. The difference between 1995 and 2000 was 1.177SqrKm; difference between 2000 and 2005 was 10.67SqrKm; and the difference between 2005 and 2010 is 11.428SqrKm. The total difference from 1995 to 2010 is 23.275SqrKm. It is clear that the developmental expansion in Enugu metropolis increased rapidly within 2000-2010.



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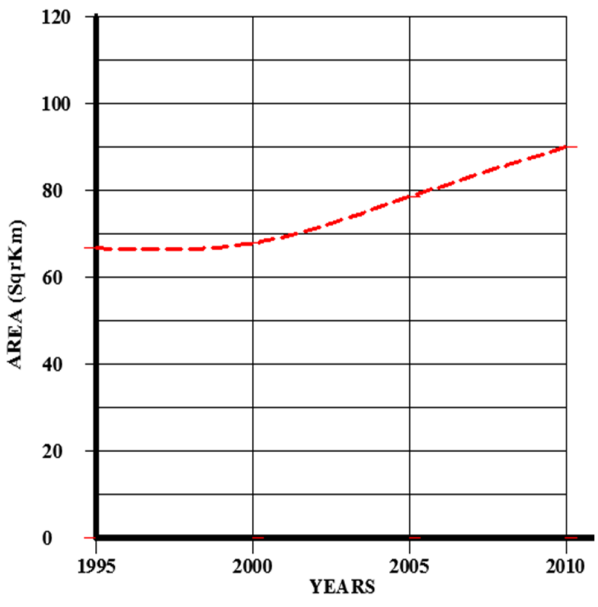
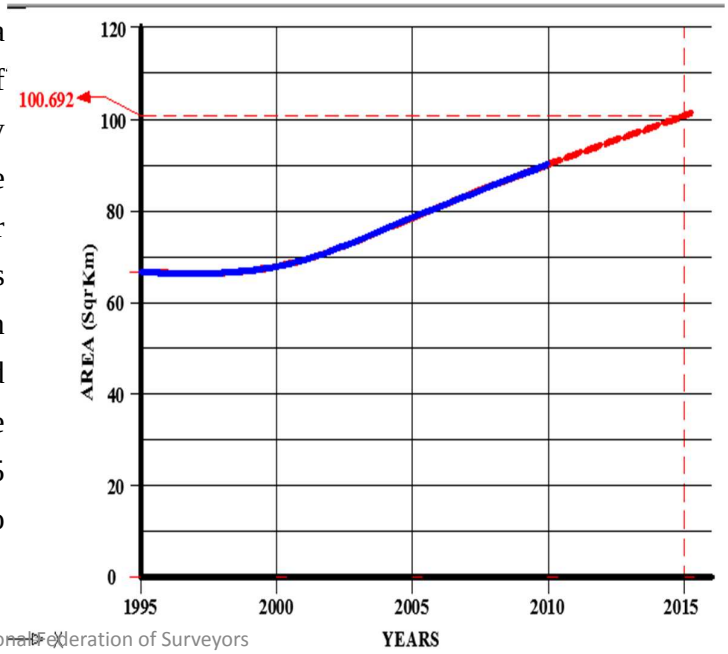
Analytical (Graphical) Step Five: This step was taken in order to illustrate graphically the rate of the expansion/changes in the developed area of the case study. In the graph below, the areas (in SqrKm) was plotted against their respective years. The graph line is shown in a red broken line in Figure 9.0 Below. If the trend is observed, the changes were lower between 1995 and 2000, and it went up at a steady acute angle till 2010. This shows us that there was a rapid increase in development from the year 2000, and the rate of increase did not vary much till 2010.



Analytical (Graphical) Step Six: This step was taken in order to obtain a predictive approximation/estimation of what the rate of development in Enugu city will be in 2015. In figure 10.0 above, the areas (in SqrKm) was plotted against their respective years. The blue line indicates the trend from 1995 to 2010 while broken red line shows the projected/estimated trend till 2015. The projection of the broken red line intercepted the year 2015 at a point where area equal to 100.692SqrKm.



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DISCUSSIONS

- It is evident from the foregoing analysis that there has been dynamics in boundaries/extents of Enugu Urban between 1995 and 2010; our graphical analysis shows that the dynamics were dormant between 1995 and 2000 but became rapid from the year 2000. This was because; the period between the Biafra Civil war and 1999 was a period of military regimes in Nigeria. The military ruled the country and regimented every aspect of the economy including land. The governance was unstable as a result of several coups and mutinies; therefore, there were fewer local and foreign investors in vesting in landed property and estate development. The democratic dispensation that started in 1999 opened so many local and foreign windows of opportunities in the land market; this is the reason why our graph went up from 1999 showing evidence in of the dynamics.
- More so, the major indigenous Igbo clans who are customary owners of Enugu urban are Nike, Awkunanaw, and Ngwo. The Nike clans are the customary owners of about 80percent of Enugu East and Enugu North; because the clan posses more expanse of land they are more generous in leasing land to individual and the government, this is the reason why the dynamics are more rapid in the Northern part of the map than the south (Awkunanaw) and west (Ngwo) (i.e. Enugu North and East Local Government Areas).

CONCLUSION

In Conclusion, this study has been able to assess Urban Dynamics in Enugu Urban and also assessed the rates of dynamics and causes. It is therefore recommended, that in order to contain these dynamics in Enugu Urban and other urban areas in Nigeria it is important to avoid/reduce the development of more slums, state government should embark on robust Town planning projects on the developing areas, and enforce development control measures in the planned towns.

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