Monitoring Urban Sprawl in Small Cities: The Case Study of Ado-Ekiti, Nigeria

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Abstract: Since the recreation of Ekiti State of Nigeria in 1996 with Ado-Ekiti as the state capital, the town has continued to grow, signifi cantly in size with an expanding population, land use, and infrastructure. Consequently, there was a need to assess the environmental impact of the developments in order to properly monitor and protect the environment. This paper analyzes spatial information on topography, vegetation, land use, and population demographics. The paper also analyzed the spatial information on changes in the urban expansion of Ado-Ekiti. The area of the city increased from 2.5 km² in 1956 to 6.9 km² in 1966; 9.7 km² in 1976; 13.3 km² in 1986; 19.6 km² in 1996 and 36.9 km² in 2006, being the span of five decades. The expansion of the city became more rapid after the creation of states, which increased the urban expansion of Ado-Ekiti by 17.3 km², which is equal to the expansion of the previous four decades - 19.6 km² of 1996 minus 2.5 km² of 1956. The results show that the trends of expansion were gradual during normal demographic tendencies but rose sharply after the creation of states that brought about a rapid influx of migrants across urban and rural migration divides. The result is applicable to small cities subject to rapid urbanization, particularly in small cities of the developing countries.

Keywords: Monitoring, Urban Sprawl, Geospatial Information, Land Use.

I. Introduction

All categories of cities in developing countries have, in recent times, been experiencing uncontrolled urban growth. It is estimated globally that more than five billion people will live in urban banana areas by 2025 and eighty percent of these are expected to be in cities in developing countries (ITC, 2005). Urban expansion is one of the most important aspects of man’s interaction with his environment. The impact on the natural landscape is tremendous as a result of migration from rural to urban areas within the country. This has resulted in unplanned growth of urban centres. The issue of urban sprawl is a growing problem as a result of residential and development in recent years at both local and metropolitan levels. Hence, there is an need to quantify the sprawl to enable governments and stakeholders understand the problems and proffer solutions thereto.

Ado-Ekiti was one of the Provincial Headquarters in the defunct Western Nigeria. The town retained its status under different administrative structures such as Ekiti Central Local Government Headquarters, the old Ondo State which was created February 13th, 1976. When Ekiti State was created in 1996, Ado-Ekiti became the state capital. With the creation of states, many civil servants of Ekiti State origin were transferred to Ondo State. This triggered a migration trend that caused a rapid population increase and urban growth in all urban centres in the state; however, majority of them immigrated to Ado-Ekiti.

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II. Literature Review

Monitoring urban development is mainly to find the type, amount and the location of land conversion for future planning (Shekhar, 2001). The monitoring of urban development helps to plan ahead against urban sprawl. Urban sprawl varies in degrees between the developed and developing world; and secondly, they have differing consequences. The process of urbanization is universal, phenomena taking place all over the world; however, each country has its phenomena, which is primarily due to the increase in population growth, economic and infrastructure initiatives. The extent of urbanization or urban sprawl is a phenomenon that drives the change in land use patterns. Urban sprawl is a multiple-faceted concept centered on the expansion of low-density development. Dimensions of urbanization topics range from the outward spreading of humanity and its suburbios and their logical limits, tollow density and auto-dependent development, and rural land; examination of the impact of the segregation between residential and commercial uses, and analyses of various design feature to determine the ratio of the residents (Oriye, 2008). Discussion and debates about sprawl are often made unclear by the uncertainty of the meaning associated with the phrase. For example, some commentators measure sprawl only with the average number of residential and per acre given area. But, others associate it with decentralization (spread of population without a well-defined center), discontinuity (leap-frog development), segregation of uses, and so forth.

Urban sprawl has created negative impacts on the health, environment, and cultural dimensions of the neighborhoods because it creates more pollution per person and more traffic fatalities. Sprawl is controversial, with supporters claiming that consumers prefer lower density neighborhoods and that sprawl will not necessarily increase traffic (Balogun et al., 2011). Consequently, the existing infrastructure facilities become grossly inadequate to meet the emerging need for the dense population. This is followed by the eventual unprec edented expansion of the pattern of towns. Unfortunately, the town continued to grow, visual representation of the pattern of growth (information on maps) were not given the desired priority attention by policymakers. Hence, fifteen years after the creation of Ekiti state, there are no large-scale townships map of the city, Ado-Ekiti, (Afolabi et al., 2006).

Land use changes arising from urbanization, agriculture, pasturing, and deforestation are some of the contributing factors to land cover changes in Akure. Land use change is the change in the apportioning of a piece of land to some use; for example, the conversion of agricultural land to educational institution contributing, whereas land cover change is the transformation in the cover of the land surface, say from soft cover (greenery and plantings) to hard cover (concrete, bitumen and such like). These changes in LULC are a reflection of the change in population growth, land consumption rate, and local climatic conditions. The

Figure 1: Map of Ado Ekiti:

Source: Author’s Field Survey

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expansion of Akure has resulted not only in depletion of natural resources, but deterioration of the environment. For example places like Okuta-Elerinla through Ilesa Garage to FUTA Junction which are part of the sprawl that occurred from the 1980s, where agriculturally productive land and forestland have been converted into residential and other uses, have not been well developed in terms of adequate functional road networks, paving, and other urban design and development parameters. The land use/land cover pattern of the region is an outcome of natural and socio-economic factors and their utilization by man in time and space.

The uncontrolled growth of urban development has adversely affected Akure’s ecosystem which has potential to directly reflect on weather parameters and eventually lead to local climate modification (Balogunetal, 2009; Akinbodeetal, 2007; KalnayandCai2003; VoogtandOke, 1997).

Maps are the best known conventional models of the real world used for many years to represent information about the real world. However, with the advent of highly optimized computer systems, the role of maps as data storage has been taken by databases. What remains are the visualized functions of maps. Akinyede and Boroffice (2004) assert that databases are computerized digital (including computerized cartography) data that can be expressed in both 2-dimensional (2D) and 3-dimensional (3D) forms and dynamics. Spatial databases store representation of spatial phenomena in the real world to use in geographical information systems (GIS) called GIS databases. Such spatial features representations, unlike maps, are stored in databases and can be easily queried and combined from different layers (Afolabi et al., 2006).

This study focuses on the collection of geo-spatial data on the expansion of Ado-Ekiti between 1956 and 2006 with year intervals of 1956, 1966, 1976, 1986, and 2006 spanning the period before and after the creation of Ekiti State. Therefore, information generated thereby becomes one of the input data assessed and/or monitoring environmental situation of the town at any point in time. For this purpose, Remote Sensing (RS) and GIS datasets were obtained applying different RS and GIS techniques. Remote Sensing remains a mean of acquiring geo-spatial data and GIS can utilize Satellite Imagery, in the remote sense, to examine information and map large areas (Awoseyla, 2004). The applications of Remote Sensing and GIS in urban studies in present in China, Israel, Malaysia and other countries highlight the importance of Remote Sensing and GIS applications in the dynamic monitoring of urban growth (Shimou, 1994; Afolabi et al., 2006).

III. Materials and Methods

Research methods used for this study were adopted from some preceding works of Orio (2008 and 2012). Data are collected first-hand by the researcher through the use of questionnaires, interviews, reconnaissance and ground surveys, and personal observations. Also, data were sourced from literature, especially the work of Ojo (1966) where the Ordinance Survey Map of Ado-Ekiti Sheet 244SW & SETopo graphical Map produced by the Federal Survey, Lagos (1996) used in this study were obtained. Other relevant maps were sourced from LANDSAT MSS, Ministry of Forestry, Abuja; SPOT XS, Federal Ministry of Forestry, Abuja; LANDSAT, UTM, RECTA, Obafemi Awolowo University, Ile-Ife. All the maps were formatted to a scale necessary for uniformity. Integrated Land and Water Information Systems (ILWIS), Remote Sensing and Geographic Information System techniques were applied for the analysis.

This was generated at a scale of 1:50,000 covering the periode from 1956-2006, a period of twenty years growth intervals. These maps were enlarged to get the appropriate scale for the analysis. The Figure 2 shows a map that was extracted by digitizing Ado Ekiti Sheet 244 SW & SETopographic map at a scale of 1:50,000 published in 1966 by federal surveys, Lagos. The area obtained was 6.9km². The map of Ado Ekiti in 1976 and 1986 as shown in figure 3 and 4 were extracted by digitizing the Nigerian vegetation and Land use map. Akure Sheet base on LANDSAT MSS of path 204 row 5 acquired in 1976 and 1986 published by the Federal Department of Forestry, Abuja; while Ado Ekiti in 1996 (figure 5) was based on SPOT XS of path k70 row J334 in 1994 and published in 1996. The area obtained was 9.7, 13.3 and 19.6 km² respectively.

IV. Results and Discussion

Findings in this study are discussed under various sub-headings:

4.1 Identification of Spatial Extent of Ado-Ekiti

Over the past 50 years, the urban form of Ado-Ekiti has increased up to 14.68 times in size. Most of the urban expansion occurred between 1996 and 2006. Due to other population growth, the urban area of the city grew from 2.5 square kilometers in 1956 to 36.7 square kilometers in 2006.

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The map showing the expansion of Ado-Ekiti within the fifty years is analyzed below:

**Figure 2:** Map of Ado-Ekiti in 1956 with Area - 2.5 square Kilometers  
*Source:* (After Afolabi Ojo, 1956: Yoruba Palaces, pg. 31)

**Figure 3:** Map of Ado-Ekiti in 1966 with Area - 6.9 square Kilometers  
*Source:* Ado-Ekiti Sheet 244 SW & SETopographic Map Federal Surveys Lagos 1966
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Figure 4: Map of Ado-Ekiti in 1976 with Area 9.7 square Kilometers
Source: Akuresheet on LANDSAT MSS, Federal Ministry of Forestry, Abuja, 1976

Figure 5: Map of Ado-Ekiti in 1986 with Area 13.3 square Kilometers
Source: Akuresheet Map on LANDSAT MSS, Federal Ministry of Forestry, Abuja, 1986
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Figure 6: Map of Ado-Ekiti in 1996 with Area 19.6 square Kilometers
Source: Akuresheet Map on SPOT XS, Federal Ministry of Forestry Abuja, 1996

Figure 7: Map of Ado-Ekiti in 2006 with Area 36.7 square Kilometers
Source: Extracted from LANDSAT TM, RECTAS, Ile, 2006

Map of Ado-Ekiti in 2006, shown in Figure 7, was extracted from LANDSAT TM acquired 2004. The image was processed, geo-referenced, and the boundary of Ado-Ekiti was extracted by on-screen digitizing. The area obtained is 36.7 km².
Table 1: Area of Ado-Ekiti for every Decade

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AREA in km²?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>6.9</td>
</tr>
<tr>
<td>1976</td>
<td>9.7</td>
</tr>
<tr>
<td>1986</td>
<td>13.3</td>
</tr>
<tr>
<td>1996</td>
<td>19.6</td>
</tr>
<tr>
<td>2006</td>
<td>36.7</td>
</tr>
</tbody>
</table>

Source: Author’s Field Survey, 2008

Table 2: Increase in Area of Ado-Ekiti for each Decade

<table>
<thead>
<tr>
<th>DECADE</th>
<th>INCREASE IN AREA</th>
<th>PERCENTAGE GROWTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966-1976</td>
<td>2.8</td>
<td>9.4</td>
</tr>
<tr>
<td>1976-1986</td>
<td>3.6</td>
<td>12.1</td>
</tr>
<tr>
<td>1986-1996</td>
<td>6.3</td>
<td>21.15</td>
</tr>
<tr>
<td>1996-2006</td>
<td>17.1</td>
<td>57.4</td>
</tr>
</tbody>
</table>

Source: Author’s Field Survey, 2008

Table 3: Area of Land and Population of Ado-Ekiti for every Decade

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Area in km²</th>
<th>Average Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>2.5</td>
<td>99,923</td>
</tr>
<tr>
<td>1966</td>
<td>6.9</td>
<td>120,855</td>
</tr>
<tr>
<td>1976</td>
<td>9.7</td>
<td>155,181</td>
</tr>
<tr>
<td>1986</td>
<td>13.3</td>
<td>204,300</td>
</tr>
<tr>
<td>1996</td>
<td>19.6</td>
<td>274,205</td>
</tr>
<tr>
<td>2006</td>
<td>36.7</td>
<td>409,065</td>
</tr>
</tbody>
</table>

Source: Author’s Field Survey, 2008

Figure 7: Map of Composite Expansion of Ado-Ekiti, 1956-2006

Source: Akuresheeton LANDSAT MSS, Federal Ministry of Forestry, Abuja, 2006
V. Discussions

Rapid urban development in increasing land use changes due to changing population and economic growth in Ado-Ekiti and landscape is being witnessed offlate. Agricultural lands being converted into urban purposes in and around the towns in Ekiti have shown typical urbanization because of the urgent need for improvement in information technology to help reduce problems in planning due to increasing pressure on land. Environment planners need to be well trained and in formation of a pan-information-related thesis aspect for perspective planning and management at the edge of Ado-Ekiti. Hence, there is a need to create an information system of Ado-Ekiti to retrieve, integrate, and create various planning scenarios for decision making. The Remote Sensing (RS) and Geographical Information System (GIS) are appropriate tools for creating such type of information system. There is a demand for constant monitoring such changes and understanding the processes for taking effective and corrective measures towards planned and healthy development of Ado-Ekiti.

Recently, GIS and RS data are being widely used for mapping and monitoring urban sprawl in small cities, especially in the case of Ado-Ekiti, Nigeria. Hence, the use of technology and data can be used for Ado-Ekiti to generate the spatial pattern of urban expansion over different time periods and can be systematically mapped, monitored, and accurately assessed from satellite data alone along with conventional ground data. The most productive farmland is losing its potential for expansion. The unchecked physical expansion and population growth in Ado-Ekiti have resulted in agricultural land around the town being used for various land use demands. Inondated meadows and crop failure, villages (Ilokom, Abakaliki) are annexed by the main city. This consumption of cultivated and vegetated lands of villages surrounded by Ado-Ekiti while the internal land structure of the town has also been changed. These changes in the city have not been planned resulting in building development without any set of rules and guidelines, leading to uncontrolled and unauthorized development. Urban development has taken place without having basic infrastructure with attendant effects on the health and environment. The area of the city experienced positive growth rate within the period of study. The area of the city increased from 6.9 to 36.7 square kilometers in the span of four decades. Surely, the city has encroached lots of precious agricultural land which were converted to other urban land uses during this period.

5.1 Suggested recommendations for policy guideline

Expansion of Ado-Ekiti brings with it a number of problems, particularly in the area of housing, infrastructure services, and loss of agricultural land use. One of the major issues is the depletion of agricultural land due to the physical expansion of Ado-Ekiti. Here, the growth is observed in smaller villages on the periphery of Ado-Ekiti, leading to uncontrolled and unauthorized urban development. Urban development has taken place without having basic infrastructure with attendant effects on the health and environment. The area of the city experienced positive growth rate within the period of study. The area of the city increased from 6.9 to 36.7 square kilometers in the span of four decades. Surely, the city has encroached lots of precious agricultural land which were converted to other urban land uses during this period.

1. There is a need to generate Digital Topographical DataBase for Ado-Ekiti, which will enhance the proper and effective monitoring of the growth;
2. The use of high-resolution data for planning and urban information generation, which can provide proper guidelines for policymakers and other stakeholders to facilitate their monitoring roles and responsibilities;
3. There is the urgent need to formulate a Master plan to go through the processes of approval and ensure the repositioning of the development control mechanisms to forestall the organic growth of the city;
4. Safeguarding fertile land around the city through maintenance of environmental quality and deliberate afforestation to minimize the urban sprawl;
5. Renewal of facilities in the city core and the provision of sufficient amenities on the edge of the city, particularly in the rural hinterlands so as to reduce the high rate of rural–urban migration;
6. Jurisdictional, legal limitations should be applied for encroachment of rural lands which should be strictly followed by stringent penalty on the offenders;
7. There is a need for research on encroachment of urban activities into rural land;
References


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