

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

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**Abstract:** *Since the creation of Ekiti State of Nigeria in 1996 with Ado-Ekiti as the state capital, the town has continued to grow significantly in size with the expanding population, land use, and infrastructure. Consequently, there was a need to assess the environmental impact of these developments in order to properly monitor and protect the environment; to continually obtain geospatial information on the Topography, Vegetation, Land use and Demography. In this paper, geospatial information on Topography, Thematic Maps and Satellite Imagery from 1956 to 2006 were reanalyzed to provide information on changes in the urban expansion of Ado-Ekiti. The area of the city increased from 2.5km<sup>2</sup> in 1956 to 6.9km<sup>2</sup> in 1966; 9.7km<sup>2</sup> in 1976; 13.3km<sup>2</sup> in 1986; 19.6 km<sup>2</sup> in 1996 and 36.9km<sup>2</sup> in 2006 being the span of five decades. The expansion of the city one decade after the creation of Ekiti State was 17.3km<sup>2</sup> which is equal to the expansion of the previous four decades-19.6km<sup>2</sup> of 1996 minus 2.5km<sup>2</sup> of 1956. The results show that the trends of expansion was 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.*

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### **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 areas by 2025 and eighty percent of these are expected to live in cities in developing countries (ITC, 2005). Urban expansion is one of the important areas of man's interaction with his environment with great impact on the natural land cover. The population of some urban centres in Nigeria has grown tremendously as a result of migration from rural to urban and urban to urban areas within the country. This has resulted in unplanned growth of the urban centres. The issue of Urban Sprawl is a growing problematic aspect of city growth and development in recent years at both local and metropolitan levels; hence, there is a 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 this status under different administrative structures such as Ekiti Central Local Government Headquarters, in the old Ondo State which was created February, 13<sup>th</sup> 1976. When Ekiti State was carved out in 1996, Ado-Ekiti became the State Capital. With the creation of states, many Civil Servants of Ekiti State or in hitherto resident in the part of old Ondo State which fell under the new Ondo State were transferred to Ekiti 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 migrated to Ado-Ekiti.

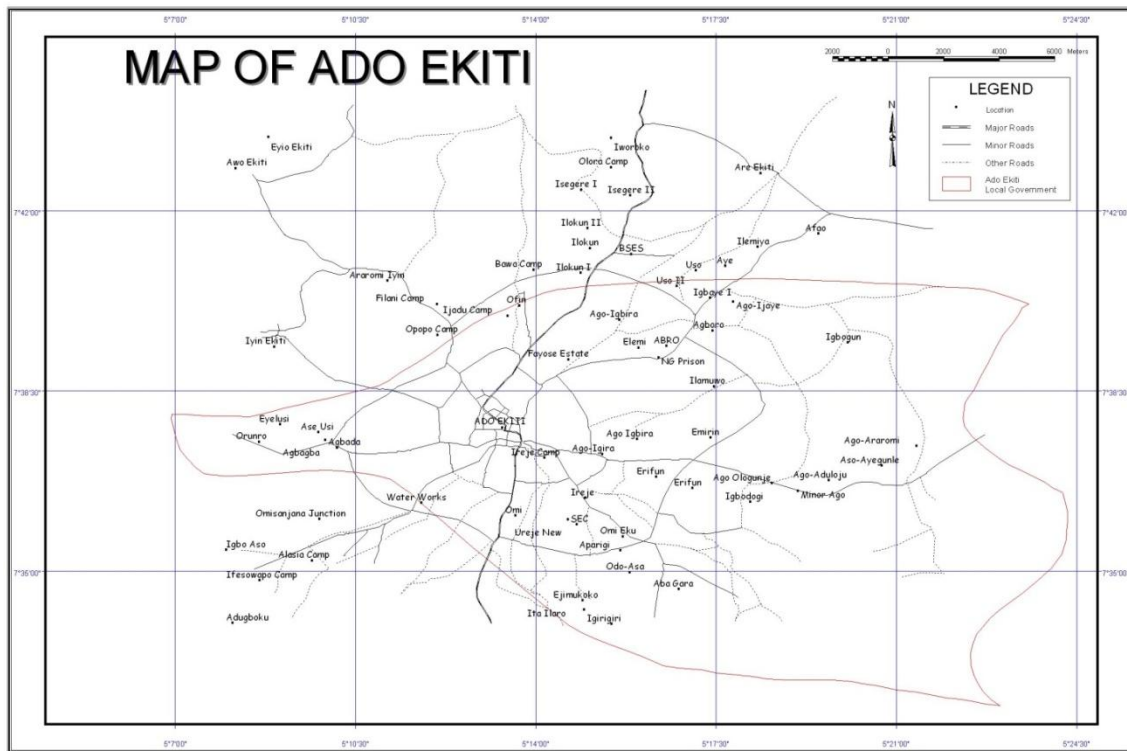


Figure 1: Map of Ado Ekiti:

Source: Author's Field Survey

## 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 subsequently, they have differing consequences. The process of urbanization is a universal phenomenon taking place all over the world where humans dwell. All countries are prone to this phenomenon chiefly due to the increase in population growth, economy and infrastructure initiatives. The extent of urbanization or the sprawl is one such phenomenon that drives the change in land use patterns. Urban sprawl or sub-urban sprawl is a multifaceted concept centered on the expansion of low-density development. Dimensions of urbanization/topics range from the outwards spreading of a city and its suburb to its logical limits, to low-density and auto-dependent development on rural land; examination of the impact of the segregation between residential and commercial uses, and analyses of various design features to determine car dependency ratio of the residents, (Oriye, 2008). Discussions 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 units per acre in a 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 does not necessarily increase traffic (Balogun et al., 2011). Consequently, the existing infrastructural facilities become grossly inadequate to meet the yearning need of the dense population. This then sets the stage for the eventual unprecedented expansion of the pattern of its town. Unfortunately, as the town continued to grow, visual representation of the pattern of its growth (in form of maps) were not given the desired priority attention by policymakers, hence, fifteen years after the creation of Ekiti state, there are no large-scale township maps of its capital 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 that occurs 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

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 forest land 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 a 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 the potential to indirectly reflect on weather parameters and eventually lead to local climate modification (Balogun et al., 2009; Akinbode et al., 2007; Kalnay and Cai 2003; Voogt and Oke, 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 roles of maps as data storage have been overtaken by databases. What remain are the visualized functions of maps. Akinyede and Boroff (2004) assert that databases are computerized digital (including computerized cartography products) data that can be expressed in both 2-dimensional (2D) and 3-dimensional (3D) forms and dynamic. Spatial databases store representation of spatial phenomena in the real world to be used in the geography information system (GIS) called GIS databases. Such spatial feature representations, unlike maps, are stored in scales and seamless manner with their world or geographic coordinates stored as variables whose scale can be chosen. The databases are easy to query and to combine data 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 at ten-year intervals of 1956, 1966, 1976, 1986, and 2006 spanning the period before and after the creation of Ekiti State. The information generated thereby becomes one of the input data in assessing 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 vast means of acquiring geo-spatial data and GIS can utilize Satellite Imagery to extract useful information and map large areas (Awoseyila, 2004). The applications of Remote Sensing and GIS in urban studies at 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 the study were adopted from some preceding works of Oriye (2008 and 2012). Data are collected first-hand by the researcher through the use of questionnaires, interviews, reconnaissance and ground-truthing, and personal observations. Also data were sourced from literature, especially the work of Ojo (1966) where the Ordinance Survey Maps of Ado-Ekiti (Sheet 244 SW & SE Topographical Map produced by the Federal Survey, Lagos in 1966) used in the study were obtained. Other relevant maps were sourced from LANDSAT MSS, Ministry of Forestry Abuja; SPOT XS, Federal Ministry of Forestry Abuja; and LANDSAT, UTM, RECTAS, 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 the scale of 1:50,000 covering the period of 1956-2006, a period of ten years growth intervals. These maps were enlarged or reduced as the case required to appropriate scales for uniformity's sake. The Figure 2 Map was extracted by digitizing Ado Ekiti Sheet 244 SW & SE Topographic map at scale 1:50 000 published in 1966 by federal surveys, Lagos. The area obtained was 6.9 km<sup>2</sup>. 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 areas obtained are 9.7, 13.3 and 19.6 km<sup>2</sup> respectively.

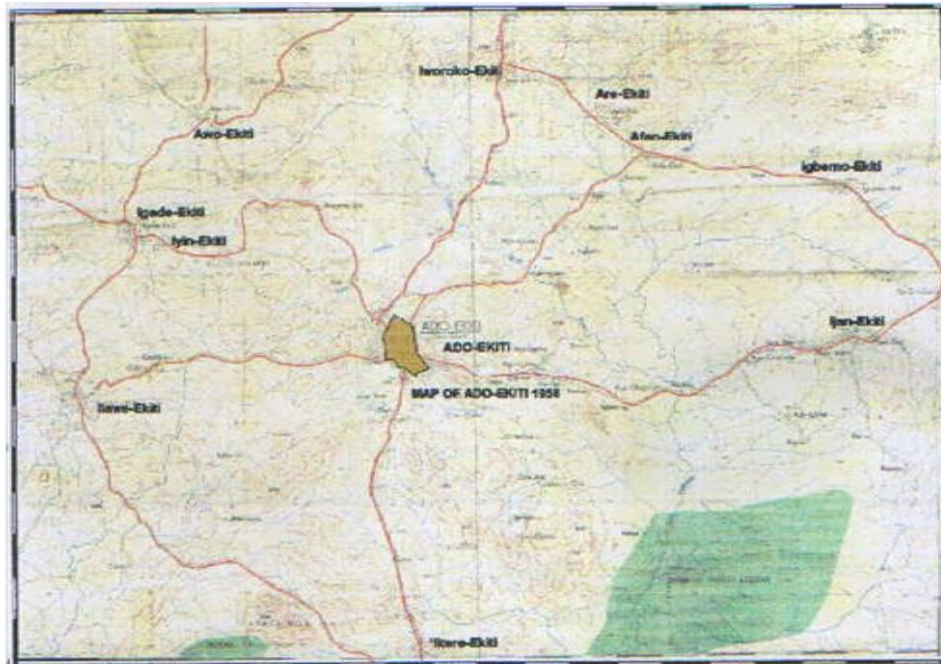
### **IV. Results and discussions**

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

#### **4.1 Identification of Spatial Extent of Ado-Ekiti**

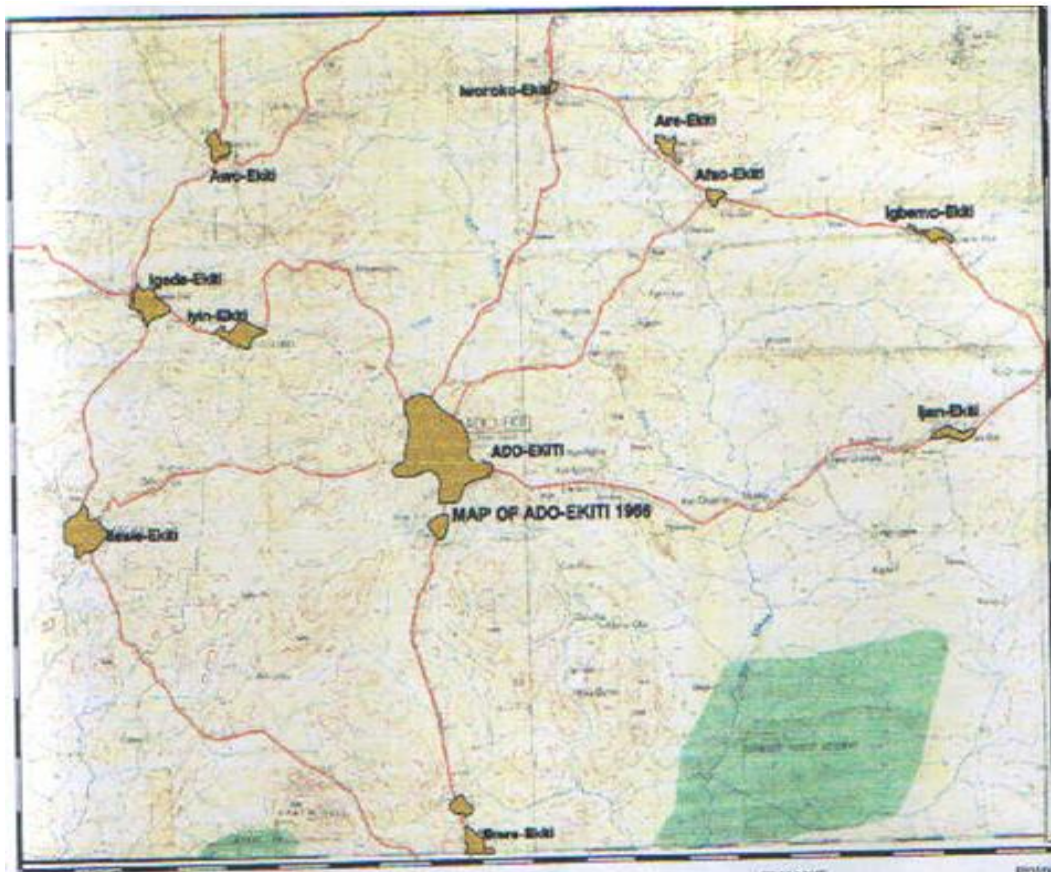
Over the past 50 years, the urban of Ado-Ekiti has increased up to 14.68 times in size. Most of the urban expansion occurred between 1996 and 2006. Due to the rapid population growth, the urban area of the city grew from 2.5 square kilometers in 1956 to 36.7 square kilometers in 2006.

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



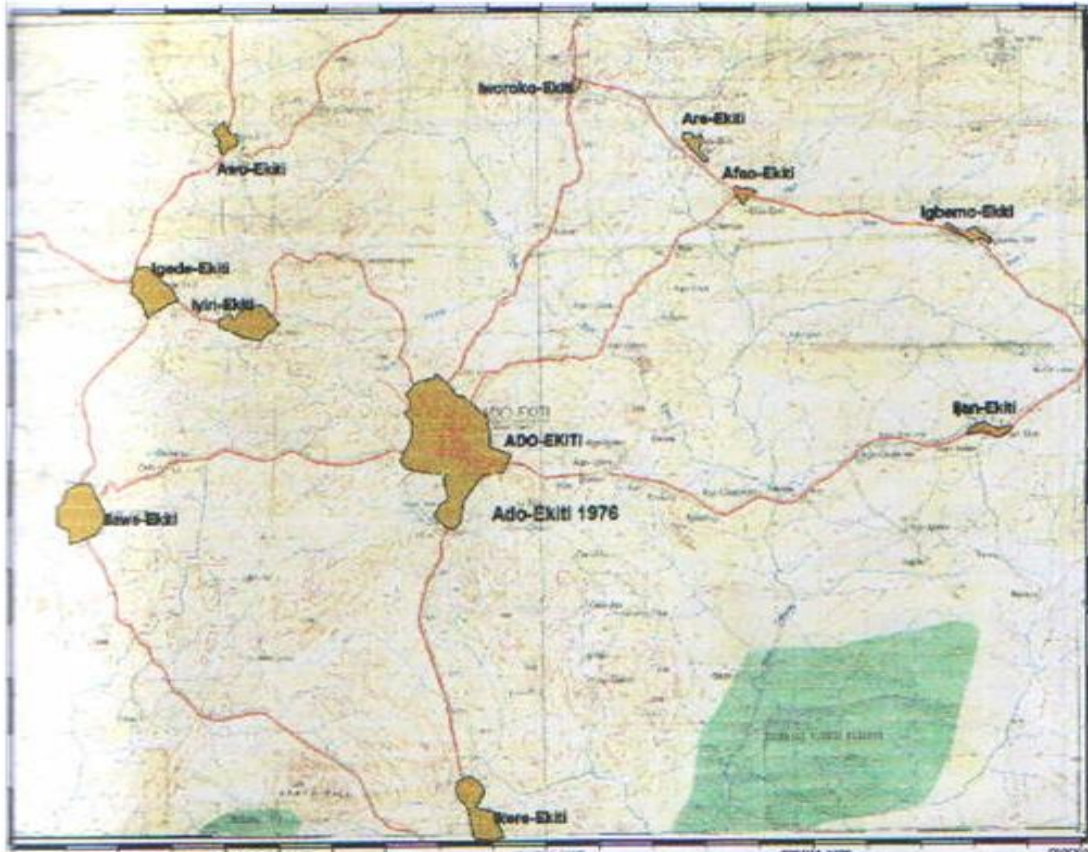
**Figure 2: Map of Ado-Ekiti in 1956 with Area-2.5 square Kilometers**

Source: (After Afolabi Ojo, (1956): Yoruba Palaces, pg.31)



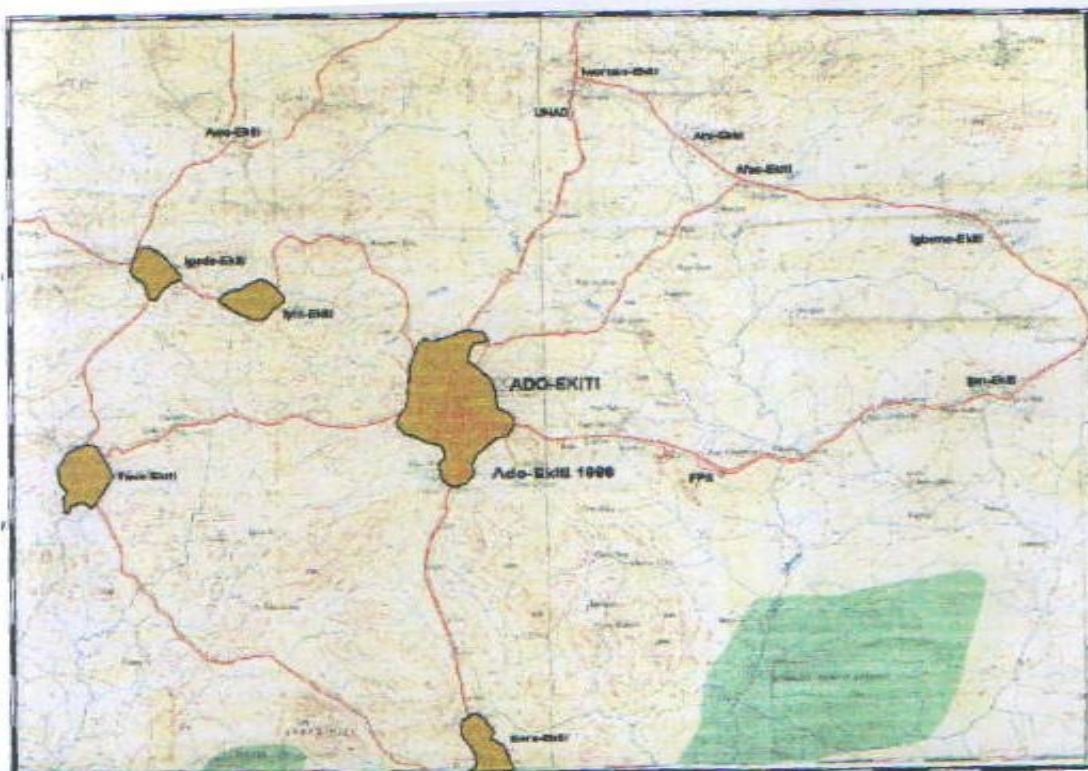
**Figure 3: Map of Ado-Ekiti in 1966 with Area-6.9 square Kilometers**

Source: Ado-Ekiti Sheet 244SW & SETopographic Map Federal Surveys Lagos 1966



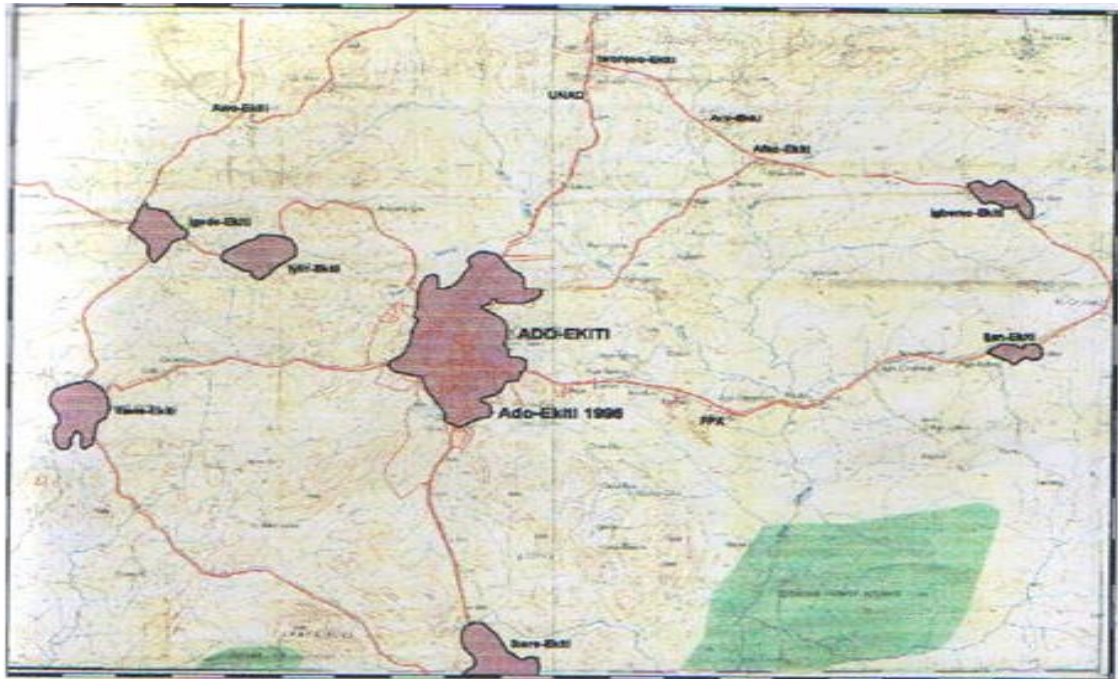
**Figure4:MapAdo-Ekitiin1976 with Area-9.7 square Kilometers**

Source:AkuresheetonLANDSATMSS,FederalMinistryofForestryAbuja,1976



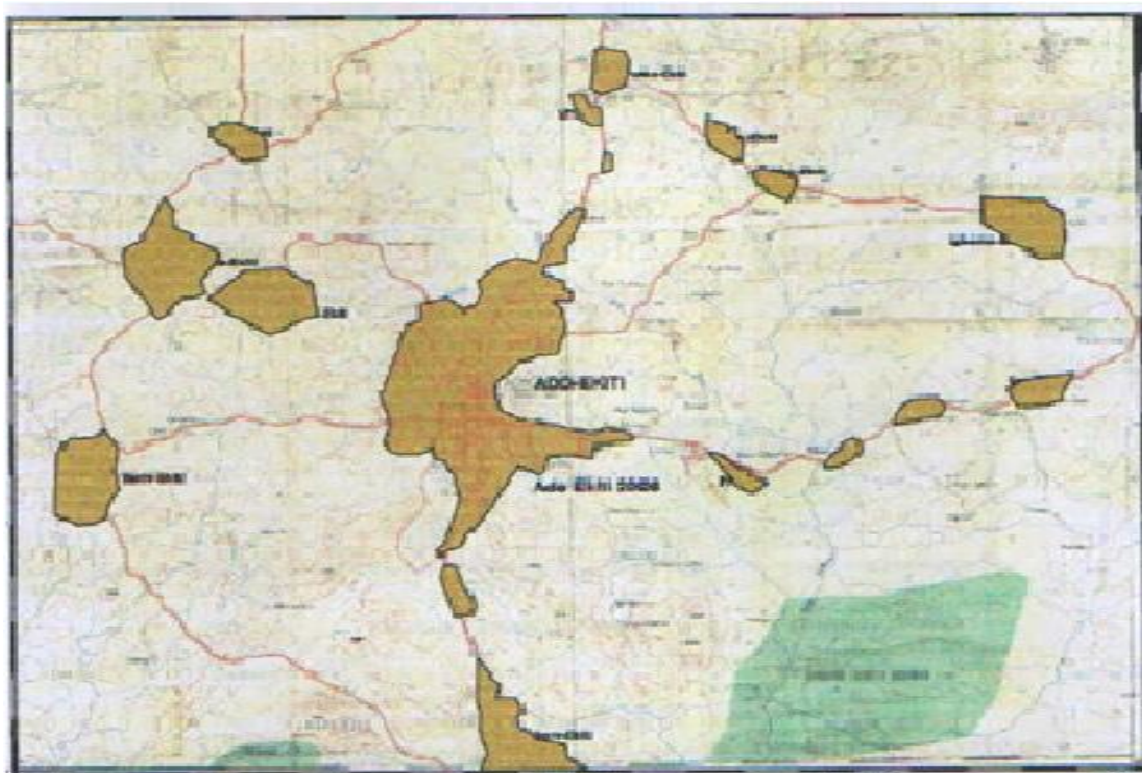
**Figure5:MapofAdo-Ekitiin1986 with Area-13.3 square Kilometers**

Source:AkuresheetMaponLANDSATMSS,FederalMinistryofForestryAbuja,1986



**Figure6:MapofAdo-Ekitiin1996with Area-19.6 square Kilometers**

**Source:**AkuresheetMaponSPOTXS,FederalMinistryofForestryAbuja,1996



**Figure7:MapofAdo-Ekitiin2006with Area-36.7 square Kilometers**

**Source:**ExtractedFromLANDSATM,RECTAS,Ife;2006

MapofAdoEkitiin2006,showninFigure7,wasextractedfromaLANDSATM acquired2004.Theimagewasprocessed ,geo-referencedandtheboundaryofAdo-Ekitiwasextractedbyon-screen digitizing.Theareaobtainedis36.7km<sup>2</sup>.

**Table1:AreaofAdoEkitiforeveryDecade**

YEAR	AREAINKm <sup>2</sup>
1966	6.9
1976	9.7
1986	13.3
1996	19.6
2006	36.7

Source: Author's Field Survey, 2008

**Table2:increaseinareaofAdoEkitiforeachdecade**

DECADE	INCREASEINAREA	PERCENTAGE GROWTH
1966-1976	2.8	9.4
1976-1986	3.6	12.1
1986-1996	6.3	21.15
1996-2006	17.1	57.4

Source: Author's Field Survey, 2008

**Table3:Areaof Land and Population ofAdoEkitiforeveryDecade**

Year	Area in Km <sup>2</sup>	Average Population
1956	2.5	99,923
1966	6.9	120,855
1976	9.7	155,181
1986	13.3	204,300
1996	19.6	274,205
2006	36.7	409,065

Source: Author's Field Survey, 2008



**Figure7:MapofCompositeExpansionofAdo-Ekiti,1956-2006**

Source: Akuresheet on LANDSAT MSS, Federal Ministry of Forestry Abuja, 2006

## V. Discussions

Rapid urban development and increasing land use changes due to changing population and economic growth in Ado-Ekiti landscape is being witnessed of late. Agricultural land is being converted into urban purposes in all around the town since Ado-Ekiti has shown atypical urbanization there is an urgent need for the improvement in information technology to help reduce problems in planning due to increasing pressure on land. Environment planners need the whole data and information of a map and information related to this aspect for perspective planning and management at the edge of Ado-Ekiti. Hence, there is need to create an information system of Ado-Ekiti 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 to constantly monitor such changes and understanding the process for taking effective and corrective measures towards a planned and healthy development of Ado-Ekiti.

Recently, GIS and RS data are being widely used for mapping and monitoring a urban spread especially in some major cities in Nigeria. Hence, the same 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 along with conventional ground data. The most productive farmland is being lost by urban encroachments into rural lands in the past thirty years. The unchecked physical expansion and population of Ado-Ekiti has resulted in agricultural land loss around the town and space is limited inside the city but there are always multi-faceted demands for space due to various land-use demands. In order to meet the space requirement, village lands (Ilokun, Aba Igbira) are annexed by the main city. This consumed the 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 haphazard development which in turn yielding problem for the proper functioning of the city. This exhibits problems in varying degrees, ranging from inadequate housing, economic decline, poverty, slums, overcrowding, ill health, social polarization, traffic congestion and environmental pollution.

The growth of any city is a good sign of development, but the way the expansion takes place calls for concern in the context of urban land use. One of the land use issues, which has become of prime importance is the depletion of agricultural land due to the physical expansion of Ado-Ekiti where the growth is absorbing small villages on the periphery gulping fertile agricultural lands. Uncontrolled and unauthorized urban developments have also taken place without having basic infrastructure with attendant effects on the host environment. The area of the city experienced the positive growth rate within the period. 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 land used for agricultural land which were converted to other urban land uses during the study period.

### 5.1 Suggested recommendations for policy guideline

Expansion of Ado-Ekiti brings a number of problems, particularly in the area of housing, infrastructure services and loss of agricultural land use. These problems demand the immediate attention of planners and administrator. However, the following are the suggested measures aiming at monitoring the sustainable growth of the city, being a rapidly urbanizing city in the south-western Nigeria:

- ① There is need to generate Digital Topographical Data Base for Ado-Ekiti which will enhance the proper and effective monitoring of the growth;
- ① 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.
- ① There is the urgent need to formulate a Masterplan to go through the processes of approval and ensure the repositioning of the development control mechanisms to forestall the organic growth of the city.
- ① Safeguarding of fertile land around the city through maintenance of environmental quality and deliberate afforestation to minimize the rampart abuse;
- ① Renewal of facilities in the city core and the provision of sufficient amenities at the edge of the city, particularly in the rural hinterlands so as to reduce the high rate of rural-urban influx into the city;
- ① Jurisdictional, legal limitations should be applied for encroachment of rural lands which should be strictly followed by stringent penalty on the offenders;
- ① There is need for research on encroachment of urban activities into rural lands;



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