Urban Growth Analysis In Akure Metropolis

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Abstract: Urban Land use changes, quantification and the analysis of rate and trend of growth would help in planning and resource management. Hence it will aid proper deployment and allocation of human resources geared towards sustainable development. This require spatio-temporal techniques which involved the use of Geographic Information Science and Remote Sensing. This research work is aimed at analyzing the spatiotemporal trends and urban growth patterns in Akure Metropolis. Three scenes of Landsat Images were implored which span across year 1986, 2000 and 2015 to study the rate and trend of growth in Akure metropolis. The images were pan-sharpened and subsequently, the bands of interest were layerstacked and re-sampled in Erdas 9.2. Maximum likelihood was used for classification and thus, map to map comparison was done to determine the changes in land use. Further analysis was done in ArcGIS 10.3 to determine and visualize the change dynamics of Akure metropolis. This research revealed that between 1986 and 2000 there is an increase of 1.1% change in built up, and between 2000 and 2015, an increase in growth of 7.8% was recorded. The degree of growth keeps increasing thus, Urbanization could strongly be an influencing factor to the growth process.

Keywords: Land use land cover, urban growth, spatio-temporal techniques, urbanization, GIS.

1 INTRODUCTION

Few decades ago, rapid urbanization and urban expansion, most especially in developing Nations like Nigeria, has seriously become one of the most important issues of global change driving the physical expansion of cities. This has brought about major changes in land cover patterns. According to [16], urban growth is defined as the relative or absolute increase in the number of people who live in towns and cities. The rate of urban population growth is a function of the natural increase of the populated area and the population gained by urban areas through the difference in rural-urban migration and the graduation of rural settlements into cities and towns. Migration to urban centers fostered by infrastructural development, employment opportunities and favorable conditions of living has become a norm. Being a huge center for commerce, trade, investment, infrastructure and other social amenities, urban areas have become the crowded populated areas on earth [16]. Urbanization could also be driven by population growth, migration and development of basic infrastructures leading to the growth of hamlet into villages; villages into towns; towns into cities and hence to mega cities. Urban growth identification, analysis, and the knowledge of extent and pattern of growth could help in regional planning and development with well planned infrastructure. This requires analyses of spatio-temporal data, which can be done with the aid of geospatial technologies such as Remote Sensing, Geographic Information System (GIS) and Global Positioning System (GPS). This research work aims at analyzing the spatiotemporal pattern of urban growth in Akure Metropolis.

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2.0 METHODS AND ANALYSIS

2.1 STUDY AREA

Akure metropolis is one of the fast growing towns in Southwestern Nigeria. It became the administrative capital of Ondo State in 1976. Akure is located between 5^0 5'11" E - 5^0 29'39" E and $7^0$3'40" N - 7^0 26'38" N and in 1991 and 2006 census, the provisional population was put at 316,925 and 484,798 respectively The metropolis occupies an area of about 530Km^2. It is made up of two Local Government Areas (LGA). These are Akure North and Akure South. The Climate of the Area is dominated by the Tropical wet and dry type with wet season lasting for 6 – 7 months (March to October).

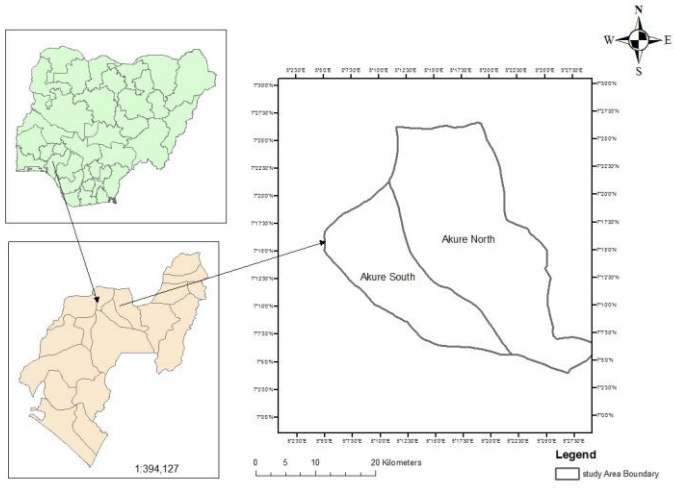


Fig. 1 *Study Area map*

2.2 DATA COLLECTION, PREPARATION AND ANALYSIS

This research work was conducted in three phases: Data Acquisition, Analysis and Post analysis phases respectively. The first phase is the information and data gathering phase. Here, important data required to carrying out the research which is mainly secondary data were collected. The success of using remotely sensed data for land-cover change detection depends on careful selection of the data source. The important attributes of remotely sensed data sources are spatial, temporal, spectral, and radiometric resolution [8, 14]. Remotely sensed Data; Landsat TM satellite images covering Akure Metropolis with 30m resolution, were used. Other

secondary data that were used include: topographic map, demographic data and administrative map. The details and characteristics of the above listed data are shown in table 1.1 and 1.2.

Table 1.1: *Characteristics of secondary data*

S/N	Type	Format	Scale Resolution	Data/Source
1	Topographic	Analogue	1:50,000	1964/OSGOF
2	Demographic Data	Analogue table		NPC
3	Ondo State Administrative map	Analogue		Ondo State Lands and survey

Table 1.2

S/N	TYPE	PATH/ ROW	RESOLUTION	Band Used	Year
1	Landsat TM	190/55	30m	1,2,3, 4,5 and 6	1986
2	Landsat TM	190/55	30m	1,2,3, 4	2000
3	Landsat TM	190/55	30m	1,2,3, and 4	2015
4	Google Earth extract				

Software Requirement

Considering the set objective of this work and the need to synthesize and integrate different datasets, different GIS and non-GIS software packages will be used, these will include: Erdas, ArcGIS, Microsoft Excel and Visio extension, the characteristics and uses of these software's are shown in Table 2.

Table 2: *Characteristics and uses of selected software.*

S/N	SOFTWARE	APPLICATION
1	Erdas 9.2	For image processing, classification.
2	ArcGIS 10.3	GIS analysis, thematic data integration, Geo-database creation, spatial query, visualization, weighted overlay operation
3	Microsoft Visio	Flowchart and Database schemer designing

2.3 Data Preparation

Using the Erdas version 9.2 software, the image was imported using the Geo-tiff format. Spectral sharpening technique was used to sharpen bands 4,3,2 and of the Landsat image, with 30m to 15m resolution using band 8 (15 m resolution). Subsequently, the bands of interest were selected and stacked. From the stacked bands, a colour composite of bands 4, 3 and 2 was generated and re-sampled in a new display. After the colour composite, the image subset was created using the Region of Interest (ROI) vector frame created in ArcGIS 10.3 from the study area map and imported into Erdas 9.2 environment as shape file. With this, the ROI of the study area was delineated from the satellite image scene. On the colour composite, band 4 of the Landsat image was loaded for red while bands 3 and 2 was loaded for green and blue respectively. This combination has been regarded as efficient and adequate when using Landsat image data for studying Landuse / Landcover especially with respect to vegetation, farmland, water body, wetland, bare surface and built-up area

2.4 Image Classification

One of the most important uses of land-cover data is for change analysis, and many different methods have been devised to assess change in the landscape [8, 9, 13]. Among these, the post-classification method is frequently used because of (1) the detailed information that can be gained from the produced change matrix, (2) the limited impact that image calibration and atmospheric and environmental differences will have on the multitemporal image comparison, and (3) its conventional method of interpretation as against the numerically based image analysis methods that need careful interpretation to assess what the identified changes mean [8]. The false colour composite images of 1986, 2000 and 2015 were respectively classified in Erdas software using maximum likelihood classification method and thus, post-classification was done to obtain the class statistics and built-up, area as vector layer.

2.5 Land-cover accuracy assessment

One of the first steps in making a land-cover product useful is to evaluate its quality. Data uncertainty is an inseparable companion of almost any type of land-cover product, and today there are many techniques to handle uncertainty representation and analysis for remote sensing and Geographic information system (GIS) [5, 17]. A standard method to describe thematic uncertainty in land-cover data is using an error or confusion matrix [2]. This matrix is used for many different measures of agreement between data estimates and ground truth conditions. In this research work, confusion matrix using ground truth data was used for accuracy assessment.

2.6 Urban change detection methods

There are two types of remote-sensing change detection: map-to-map comparison and image to image comparison [3, 6, 13]. In map-to-map comparison, individual land-cover maps were derived independently using different dates of imagery, and then the results were compared. The overall effectiveness of this approach depends on the classification accuracy of the images on two different dates. The actual differences in land cover can be influenced by many factors, including different classification systems and different mapping techniques [9, 10]. This research work focused on map to map comparison in order to determine changes in urban growth using dynamic overlay and comparison of later year to the recent year. Charts and maps were further used to buttress the change process.

3 RESULT AND DISCUSSION

3.1 LAND USE LAND COVER MAPS

Figure 2 and 3; a, b, and c respectively below show the result of the classified images for 1986, 2000 and 2015 satellite images respectively. The earth features were classified into six layers namely forest, degraded forest, rock out crop, Agriculture/ arable land, waterbody and settlement. The statistics shows continued and rapid growth in settlement which could be associated with urbanization and hence, there is speedy decline in forest cover fig.2.

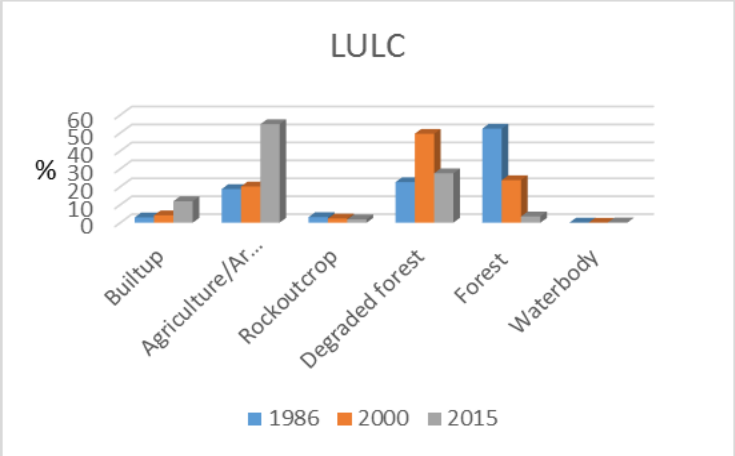
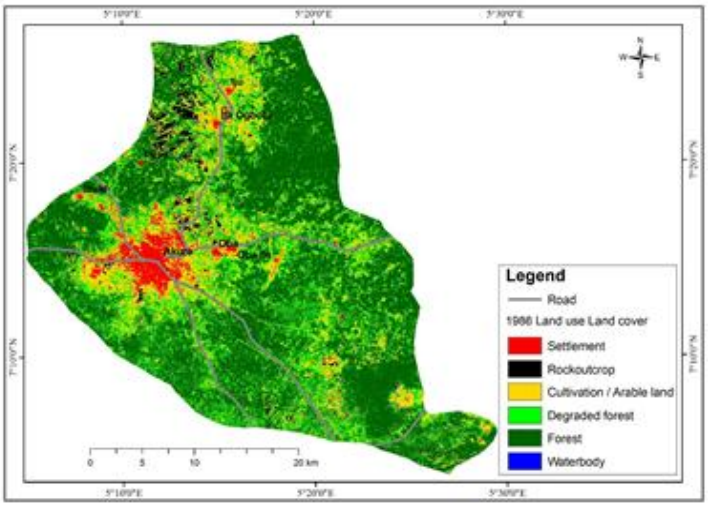
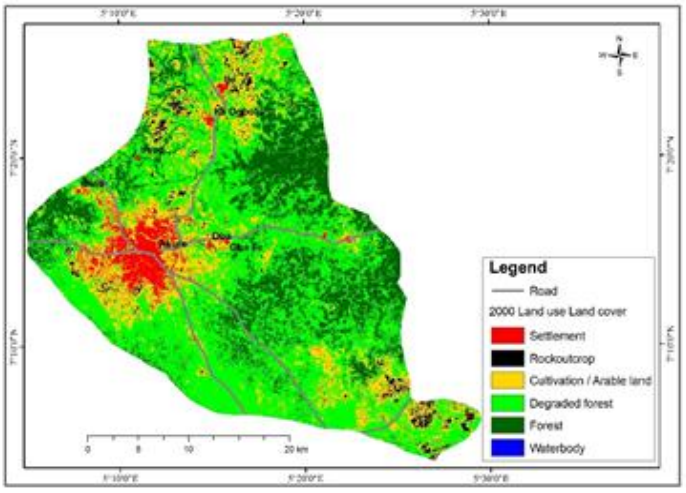


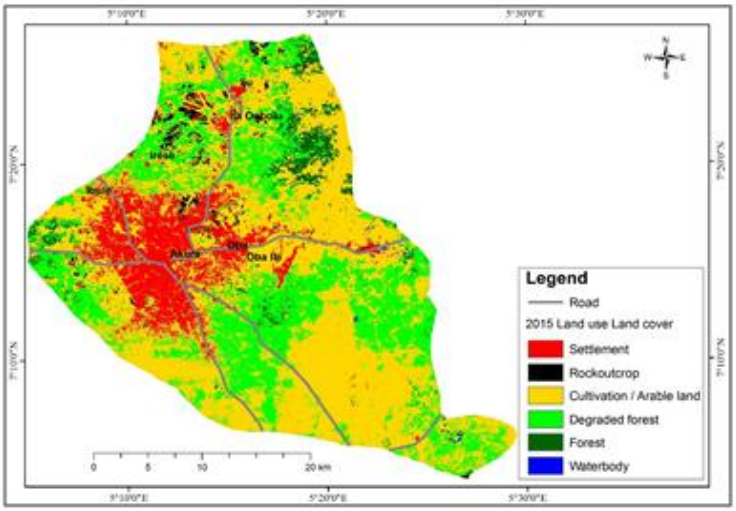
Fig. 2 *land use land cover plot*



a. lulc map for year 1986



b. lulc map for year 2000



c. lulc map for year 2015

Figure 3: *land-use land cover (lulc) map of the study area*

3.2. PERCENTAGE CHANGE IN LAND-USE LAND-COVER PATTERN

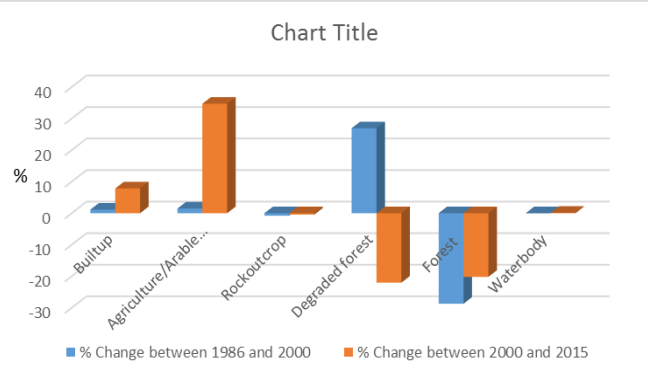
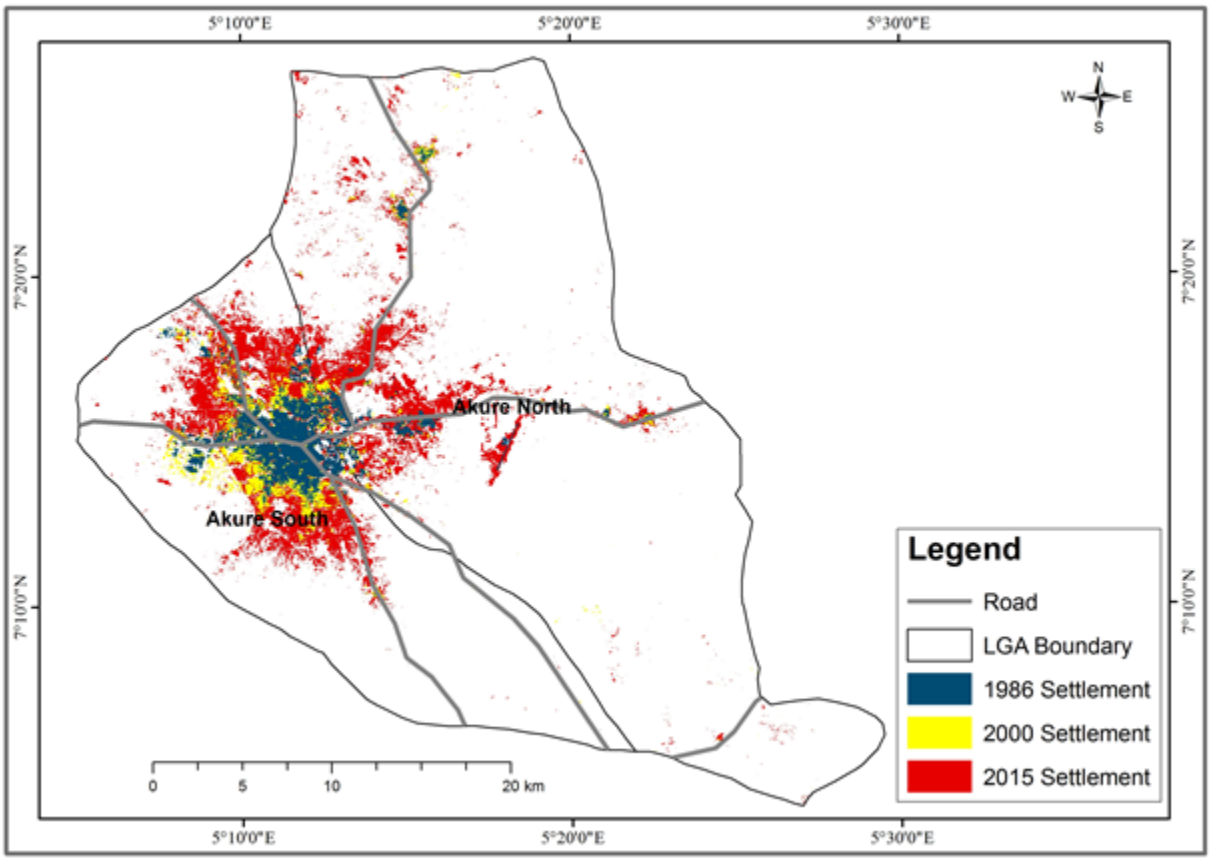


Fig.4. *percentage change in lulc*

The percentage change in settlement between 1986 and 2000 is about 1.1% while a significant positive change in urban growth was observed between 2000 and 2015 as it was found to be 7.8%. Agricultural/ arable land is on increase; this could be as a result of encroachment into other land use and land cover features. It was observed that large percentage of the agricultural/arable land are left fallow.



3.3 SETTLEMENT PATTERN OVERLAY

The settlement pattern in Akure metropolis showed a significant growth between the 1986, 2000 and 2015, however, GIS and Remote sensing techniques has been able to depict the land use changes across these years. It was noted that within year 1986 to year 2000, the forest has decreased because the land has been used for other purposes like the more cultivation, the forest was degraded and the settlement increased. In the year 2015, the margin was so vast as the cultivation has spread, increased settlement and increased degraded forest as well were observed. The forest area was very little due to obvious reasons. Hence, the urban growth in Akure metropolis is increasing as validated by the National Population Commission [11]. This growth can be attributed to the influx of people (migration from rural areas into the state capital for commercial activities).

4. Conclusion

The research investigates the urban growth phenomenon occurring in Akure metropolis between the year 1986, 2000 and 2015; and found out that there has been a significant growth in Akure town over these years. This is in-line with the result from the National Population Commission Census of 2006 which recorded increased population which eventually led to the loss of agricultural land to settlement.. This growth can be attributed to the influx of people (migration) from rural

areas into the state capital for commercial activities. This study demonstrates that GIS and remote sensing coupled with statistical report is an efficient tool to study urban growth.

ACKNOWLEDGMENT

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