Effects of Urban land use change on Public Utilities for Sustainable Development in Akure, Nigeria

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Abstract

Urban landuse change is one of the main driving forces of global environmental change. It is central to the sustainable development debate. The aim of this research is to examine the effects of urban expansion and its impact on utility services in Akure with a view to improve strategies to protect these utilities for sustainable development. The research was conducted using remote sensing, Geographical information System and questionnaire to collect the required data for the purpose of fulfilling the objectives of this study. The study made use of satellite imageries of Landsat (MSS) images of 1972, 1986(TM), Landsat Enhanced Thematic Mappings (ETM^{+}) of 2002 and 2009. The study employed supervised digital image classification method using ILWIS 3.2 and ArcGIS 10.3 software to classify the landuse/ landcover into built-up area, vegetation, bare land, exposed rock, rock out-crops and water bodies. Digitized maps were carefully overlaid and calculated to get the different trend of changes and its impact on the utility services in the study area. The results of the analysis reveal that the built-up area has been growing rapidly for the periods (1972-2009). Findings also show increase in the bare land cultivation and exposed rock outcrops while vegetation decreases, the water bodies were stable between 1972, 1986 and 2002. Based on the GIS analysis, future prediction/ trend of the land use and its subsequent development were modeled between 2002 and 2022. Findings show that, housing provision (residential), business purpose (commercial), industrial and educational are the major causes of land use expansion in the study areas. To reduce the effect of land use expansion in the study areas, policy measures were recommended which include regulating the growth and spread of development, regional development programs. In our opinion, the information provided by these technologies could help city planners and policy makers to attain and sustain future urban development.

Keywords: landuse, public utilities, sustainable development, remote sensing, GIS, satellite imageries

Introduction

Land use refers to the activity, economic purpose, intended use and or management strategy placed on the land-cover type(s) by human agents or land managers. Land cover refers to the characteristics and surface cover of the earth surface as represented by vegetation, water, bare earth, impervious surface and other

physical features of the land (John et al. 2003). Land use change occurs when the use to which land is put in different from what it was in past. For instance, an open space or forested area could turn into a built – up area. Therefore, land use and landcover changes play an important role in local and regional environment condition of a particular territory and they are linked to global environmental change.(Adeboyejo and Abolade, 2006). In order to understand 'why' land use changes as well as 'how' the changes occur. It may be necessary to know what is currently going on and the pattern of these activities in general form (Hudson, 1980).

The patterns of land use within different urban areas have different forms due to the factors that are shaping this pattern. Such factors include topographical features, legislation and legal decision from the government, social and religious, even customs (land holding system), government policy on public utilities and social services supply (Adejola, 1992).

Several researchers have employed various methods or techniques for landuse and landcover change. In his studies carried out by 2004 in Shaoxing City in China, Peng and Howarth (2004) used Satellite imageries for the year 1984, 1997 and 2000; one of the goals of the study was to produce a land use map of Shaoxing City and its surroundings. The results show that there are undoubtedly a lot of changes that occurred between 1984 and 1997 when compared with those of 2000, due to the sufficient time gap.

Similarly, Zhi-Yong et al 2005 used image processing and analysis in a GIS environment to assess spatial change in urban land use patterns and population distributions. Here, unsupervised classification was used to classify the images into land use classes. With Census data in a GIS, census polygon was constructed into various sets of units, and then comparison made with the classified image by proportion in surface.

Elnazir *et al* (2004) analysed the nature, rate and location of urban landuse changes, urban built-up land was extracted from each of the images, overlaid on each other to obtain an urban expansion image. These extractions were done on layers in the vector GIS environment and the result used to identify urban land change to obtain real time information. Musaogwu *et al* (2002) incorporated remote sensing and GIS to create overlays of two or more independently produced classified images· It can be used to detect changes, trend, location and amount of changes that have occurred. Zubair (2006) examined the use of GIS and Remote Sensing in mapping landuse and landcover in Ilorin, Nigeria between 1972 and 2001 to detect the changes that has taken place in this status between these periods.

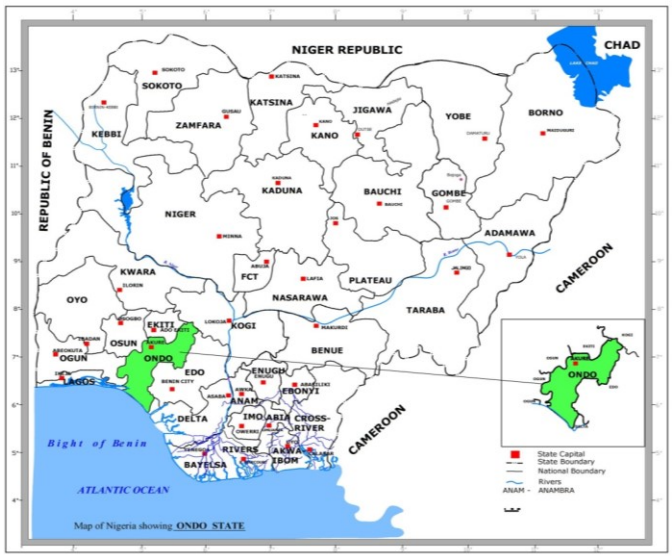
The objectives of this study include to:

(a) identify the land use types using remote sensing/ GIS in the study area.
(b) estimate the proportion of land use devoted to different urban land use types in the study area.

(c) determine the planning implications of the urban land use change on these public utilities in the study area

The Study Area

The study area is Akure, the administrative capital of Ondo State. The city is located within Ondo State in the South Western part of Nigeria (see figure1). It lies approximately on latitude 7^0 15^1 North of the Equator and longitude 5^0 15^1 East of the Greenwich Meridian. Akure is a medium- sized urban centre and became the provincial headquarter of Ondo province in 1939. It also became the capital city of Ondo State and a Local Government headquarters in 1976 (see figures 2 and 3). The city's morphology has changed over time to assume its present status with its attendant land use problems, as experienced in similar medium sized urban centres in Nigeria. Akure is located approximately 700 kilometers South West of Abuja, the Federal Capital of Nigeria and about 350 kilometers to Lagos the former capital of Nigeria. The annual average temperatures range between 21.4 and 31.1^{o}C, and its mean annual relative humidity is about 77.1%. It is located within the tropical rain forest region of Nigeria where rainfall is high throughout the year. In 1963, Akure had a population of 71,106 which increased to 109,253 by 1976 (Olotu, 2005). The rapidity of its development within forty two years stemmed from the political status of the city which was initially a provincial headquarters later a state capital thus servicing as the seat of both local and state governments ever since; this accounted for the influx of people into the city for employment. In 1991, the population had risen to 239,124 and by 2006 the population was put at 340,021 (NPC, 2006).



Map of Nigeria showing Ondo State

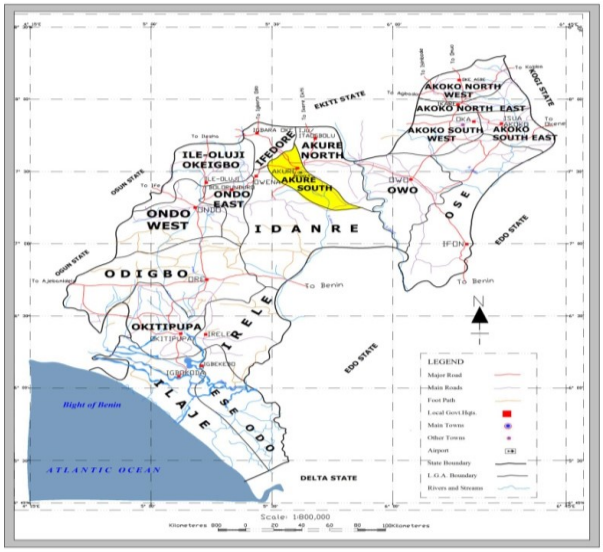


Figure 2: Map of Ondo State showing Akure South Local Government

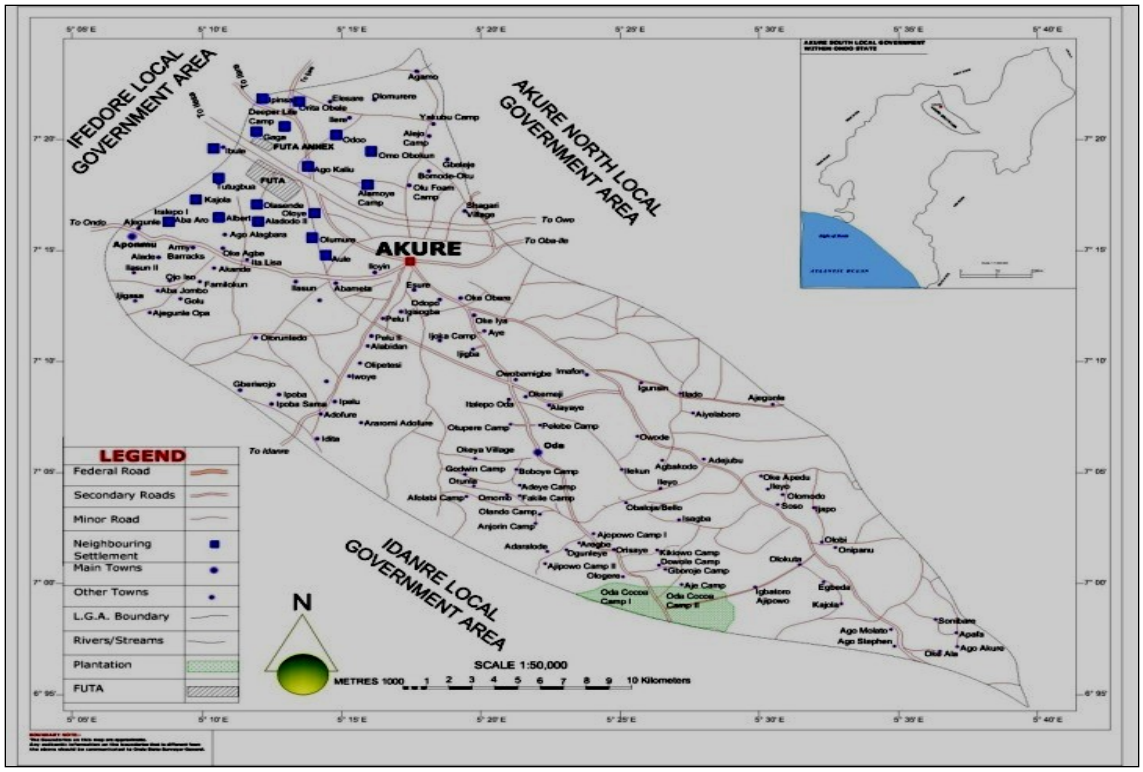


Fig. 3: Map Showing the Location of the Study Area

Data Acquisition and Method

This study was interested in the effect of urban land use change on public utilities in Akure. It also seeks to use the capabilities of Geographical Information System and remote sensing techniques to determine the rate of land use change on these utilities in the study area. The basic data acquisition include topographic map of the study area at a scale of 1:50,000 published in 1967 by the Federal Survey Department, Lagos. LandSat satellite images of the study area were acquired for three years: Landsat Multispectral Scanner (MSS) of 1972, Thematic Mapper (TM) of 1986 and Enhanced Thematic Mapper (ETM^{+}) of 2002 while satellite image of Akure of 2009 was captured from Google website (http://www.googleearth.com). This satellite image of Akure as posted online on this website was imported Into GIS environment. These images were geometrically corrected and ground control points obtained through intensive ground surveys permitted the co-registration of all images to a Universal Transverse Mercator (UTM). All the images were made to pass through processes of image enhancement, georeferencing, re sampling, image classification and digitizing. A supervised classification was performed on false colour composites (band 4, 5 and7) into the following landuse/landcover classes: Built-up area, dense vegetation, rock-outcrop, bareland/cultivation land and water bodies. The training sites selected was then used for the image classification procedure using the Maximum Likelihood Algorithm.

The Maximum Likelihood classification assumes that spectral values of training pixels are statistically distributed according to a 'multi-variate normal (Gaussian) probability density function' and is suitable for distinguishing features present in our tropical environment for best result in order to achieve the aim of the project. Therefore, Maximum Likelihood Algorithm was used to classify the images and identify changes that have taken place in the study area. Information collected during the field surveys was combined with the digital topographic map produced from aerial photograph of April 1963 and January 1965.

The questionnaire method was used to generate attribute data to further enhance our information on the study. For the purpose of this study, Akure was sub-divided into 20 residential neighborhoods namely Ilesha Road/Alaba Layout Residential Area, Okuta-Elerinla Residential Area, Akure High School/Kajola Residential Area, Ijapo Residential Area, Alagbaka Residential Area, Ala River Residential Area, Federal Housing Estate (Shagari Village) Residential Area, Oba-Ile Residential Area, Fanibi Layout/Lafe Residential Area, Oke-igan/Eruoba Residential Area, Isinkan/Ondo Road Residential Area, Oshinle Residential Area, Ijoka/Sijuwade Residential Area, Araromi/Isolo Residential Area, Oke-jebu Residential Area, Idi-agba Ijanikan Residential Area, Erekesan/Erekefa Residential Area, Ijomu Ilisa Residential Area [15]. Four (4) residential areas were then selected randomly from the 20 residential areas and each was further sampled on street basis. These four (4) residential areas are Erekesan/Erekefa, Ijoka/Sijuwade, Isinkan/Ondo Road, and Federal Housing Estate (Shagari Village) (see fig. 2). The questionnaires were allotted based on the number of buildings in the selected streets in each area and these were further shared between the streets

References

[8] N. Musaogwu, S. Kaya, D.Z. Seker, C. Goksel, A case study of using Remote Sensing Data and GIS for Land Management. Catalca Region. FIG XX II International Congress USA, Washington, D.C. U.S.A., April 19 – 26; 2002.

[13] R.E. Elnazir, F. Xue-zhi, C. Zheng, Satellite Remote Sensing for Urban Growth Assessment in Snaoxing City, Zhegiang Province. *J. Zhegiang Univ. Sci.* 2004 5(9), 1095 – 1101.