Analysis of Landuse Change and Land Surface Temperature in Ifo Local Government area of Ogun State, Nigeria

[+] D.N. Olayinka, [+]P.C. Nwilo, *A.S. Adefarati, [+]A.E. Adzandeh, and [+]A. Atagbaza

Abstract

Huge population from Lagos is migrating to Ifo Local Government Area (LGA), Ogun State due to its nearness to Lagos. This situation has left the area unplanned and ill-coordinated without provision of necessary infrastructure. This study attempts to determine and model the landuse/land cover change that occurred in the area over a period of twenty-two years. Landsat TM (1984) and Landsat ETM+ (2002 and 2006) satellite imageries were used as dataset. The area of interest was enhanced and classified in ENVI 4.5 into bare soil, built-up area, vegetation, water body and wetland. Ogun State Administrative map and topographic map were used as base maps to delineate Ifo LGA. The results indicate that built-up areas increased by 50% between 1984 and 2006. Within the same period, vegetation decreased by 21.50%, water bodies by 0.125%, wetland by 28.228% and bare soil by 0.147%. Transition Probability Matrix of Markov Chain was employed to model and predict the future land use extent of urban growth pattern from 2006 to 2015. Land Consumption Rate (LCR) and Land Absorption Coefficient (LAC) were used to determine the quantitative assessment of the growth. The rapid urbanization in the area from 1984 to 2006 with increased deforestation and impervious surfaces is believed to be responsible for the temperature change scenario by almost 2.18°C.

Keywords: Landuse, carbon sequestration, Land Consumption Rate, Land Absorption Coefficient, Transition Probability Matrix, Land Surface Temperature

1.0 Introduction

Land can be regarded as a solid part of the earth's surface that is not covered by a water body or sea. It is a vital medium that man requires in order to make his existence on the earth meaningful and useful. Land is used to enhance its development for industrialization, sheltering in form of residential buildings, agricultural purposes, infrastructural development, mineral exploration and exploitation.

* +Department of Surveying & Geoinformatics, University of Lagos, Lagos, Nigeria
* Office of the Surveyor–General of the Federation, Abuja, Nigeria
E-mail: dsaka@unilag.edu.ng

In ancient times, our forefathers employed the land mainly for habitation, farming and plantation, while the greater part which consists of vegetation (forest) was used for accommodating all animal creatures. But as man began to advance in knowledge and wisdom, industrialization paved the way for manufacturing and alternative employment. Land was divided for residential, industrial, recreational and agricultural purposes.

Landuse or landuse growth can be defined as the function or purpose for which land is used by the local human population and also as the human activities which are directly related to land, making use of its resources or having an impact on them (Foley et al, 2005). The use, growth or expansion, of land over time as both natural and artificial environments, impacts and is influenced by the pressures associated with the processes of development. The demand for land for new residential housing and industrial activities has been a great challenge in recent years for governments striving to protect greenfield sites across the world.

Landuse growth models help us to understand the complexities and interdependencies of the components that constitute spatial systems and can provide valuable insights into possible landuse configurations in the future. Models of landuse progress incorporate a vast amount of knowledge from a wide range of disciplines.

With rapid economic growth and high demand for land, a large portion of agricultural and forest lands in Ifo LGA has been converted to residential use. These surfaces of the earth absorb heat and increase the temperature comparatively to the surrounding area-urban heat island (Ahmad and Hashim, 2011). (Steffen, et al, 1992 and Foley et al, 2005) listed some of the induced environmental problems that are associated with urbanization as declining biodiversity, actual and potential primary productivity, poor water and soil quality, increased surface runoff and sedimentation rates, global carbon cycle transformation, hydrologic cycle and climate change. The rate at which population growth expands has great impact on landuse change.

The effects of human-induced landuse progress in the urban environment are: variation in thermal properties of the built-up area land surfaces, soil moisture and impervious surfaces which occur as solar energy is stored, and emitted greenhouse gases through heat sensation [land surface temperature (LST)]. These thermal differences from greenhouse gases are contributing to the development of a micro-climatic condition, otherwise referred to as the urban heat island (Ahmad and Hashim, 2011).

2.0 Justification for this Study

An aerial view of Ifo Local Government Area (LGA) of Ogun State depicts it as part of Lagos megacity because development and built-up area has had overtaken the boundary lines demarcating the two states. Lagos is regarded as one of the fastest growing urban agglomerations in the world (Millington et al, 2006). This study is necessary to ascertain the rate of depletion of Landuse/Landcover of farmlands, vegetation, cash crop farm and wetland which have been replaced by residential buildings, industrialization and recreational centres and the extent of urban sprawl.

Many research work

3.0 The Study Area

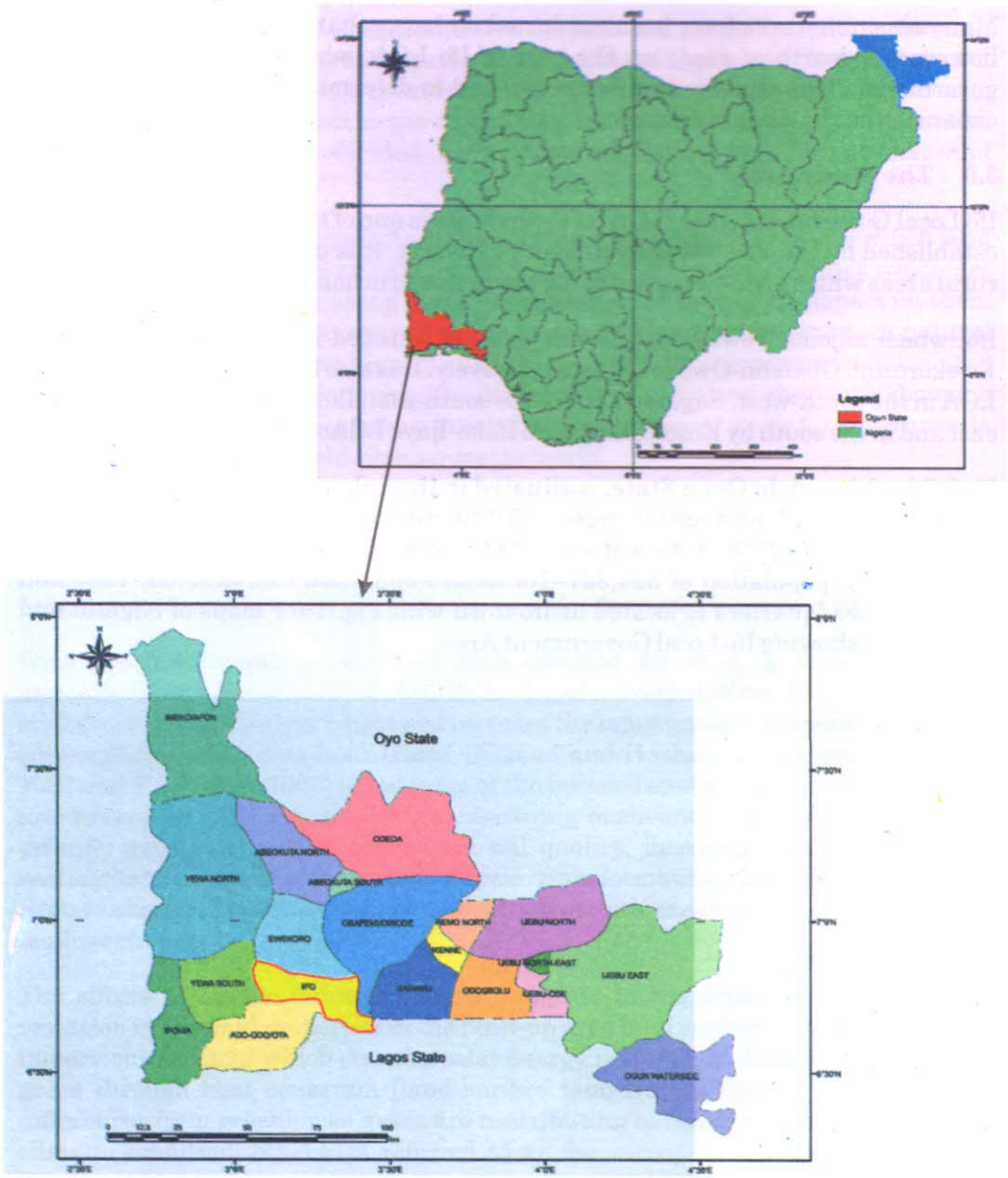

Fig. 1: Location of Study Area. Ifo LGA is highlighted in red

4 .0 Materials and Methods

This study is focused on modelling landuse expansion and its effect on climate change. The methods involved the use of maps, satellite imageries, population census figures, GPS device, ENVI 4.5, ArcGIS 9.3 and IDRISI Andes (R15) software.

4.1 Materials

An administrative map of Ogun State at the scale of 1:250,000 and topographic maps of different parts of Ifo LGA at scale of 1:25,000 were sourced from Ogun State

Ministry of Works and Housing, Survey Division, Abeokuta and Office of the Surveyor-General of the Federation respectively. Landsat imageries at 30m resolution for December 1984 (TM Dec), 2002 (ETM) and 2006 (ETM) from USGS were also used. The population census data of Ogun State for 1991 and 2006 were obtained from the National Population Commission, Abeokuta.

4.2 Methods

A handheld GPS receiver (Garmin GPS MAP 76CSX) was employed to obtain locations of features such as markets, hotels, schools, health centres, hospitals and police stations. The administrative and topographic maps were geo-referenced and the study area carved out from satellite images in the ArcGIS environment. In the ENVI 4.5 environment, a supervised means of classification was used to cluster pixels in the dataset with the help of training classes and adopting the parallelepiped technique, as well as the vectorization of the Landuse/Landcover (LU/LC) categories. For the LST, Landsat thermal bands 6 (TM) and 6_1 (ETM) of the same period as the landuse classification were subjected under ENVI software analysis to particularly determine changes in temperature in the environment.

4.2.1 Editing

The spectral signatures of unedited feature classes in ENVI 4.5 were added as data to the ArcGIS environment for proper editing. The feature was overlaid on original Landsat image to ascertain the proper positioning, and also corresponding attribute data was obtained in the field using GPS. This activity assisted in processing spatial data, queries and analysis of the change detection that occur in spatial-temporal stages.

4.2.2 Ground Truthing

The study area was visited to verify and validate the features classified in the satellite images and administrative maps. Five categories of classification schemes were employed with remotely sensed data modified to suit the above classification scheme (Table 1), produced by overlay operation and correlating 1984, 2002 and 2006 epochs.

Table 1: Land Use/Cover Classification Scheme

Landuse/CoverClasses	Description
Bare soil	All agricultural and uncultivated lands
Built-up Area	Parcels of land developed for dwelling purposes (residential), commercial, markets, schools, hospitals, banks, churches, mosques, informal settlements, roads and railroads.
Water (Drainage)	Streams, rivers and inland waters
Vegetation	All vegetation types
Wetland	All marshlands, areas liable to flood, mangrove, swamp, dam

Source: [2]. (USGS classification scheme)