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Detection of Land Use and Land Cover Change around Eti-Osa Coastal Zone, Lagos State, Nigeria using Remote Sensing and GIS

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Abstract

The study investigate land use and land cover change around Eti-Osa coastal zone area of Lagos State, Nigeria for the period of 30years, between 1984 and 2014 using satellite remote sensing (landsat) data to determine the changes that occur within this period and the impact of the changes over the area. The Landsat images reveals four type of classification; mangrove, built-up/bare land, water body and wetland. The built-up area significantly increased over the years, covering 3,870.63ha (13.34%) in 1984and 16,332.66ha (56.3%) in 2014 while percentage cover for Mangrove (vegetation) decreases from 13,729.9ha (49.98%) in 1984 to 2269.7ha (8.3%) in 2014. Water body shows only a marginal decrease of 1,692.18ha (4.8%) between the period of 30years examined while there is marginal increase of 690.39ha (3.9%) in wetland area.

Keywords: Land use, Land cover, Eti-Osa, Landsat, remote sensing.

Introduction

The term land use refers to human activity or modifications associated with a piece of land[1]. Changes in land cover / land use reveal the type of development that influenced a particular land application[2]. These changes reflect on the connection between climatic conditions, disaster vulnerability and environmental variations of an area. Several information can be acquired from land use and land cover. For example, detailed information obtained during ground surveys can be used by local planning agencies in their decision making. Also, interpretation of large-scale aerial photograph and remote sensing data has been widely used[3-6]. Sources of most present-day changes in the biosphere can be linked to human activities rather than natural phenomenon. Thus, understanding of these activities and forces that propel them is vital in understanding global environmental change and in predicting how to manage such change[3].

Recently, cities in the world have experienced rapid growth due to fast increase in world population and the irrevocable movement of people from rural are to urban cities. Many cities and larger towns of the developing world are therefore facing the challenge of unplanned settlement and housing scheme as a result of dense population in the urban areas[4]. In Nigeria especially in cities like Lagos (the study area), Abuja, Port-Harcourt and Kaduna, growth in population have increased rapid leading to more use of built-up area and having effect on other land use/land cover.

Study Area: The study area lies between latitudes 60^0 17'N and 60^0 17'N and longitudes 30^0 3'E and 30^0 35'E, located around Eti-Osa Local Government Area of Lagos State, Nigeria. It is bounded by Atlantic Ocean to the south, Ojo local government to the east, Lagos lagoon to the north and surrounded by Ibeju-Lekki local government to the west (Figure-1). The study area covers about 192.3km^2 including the Lagos lagoon and the beaches, stretching towards the Atlantic Ocean. The vegetation pattern is predominantly mangrove swamp trees which reveal the study area coastal location.

The study area falls within Benin Formation of Benin Basin, which is Miocene to Recent in age[7]. The geology of the formation consists of sediments deposited in fluvial, marine and lacustrine environment grading into one another with varying thickness and lateral extent[8]. The fluvial (alluvial) consist predominantly of sands deposit[9].

Methodology

Landsat ETM data for year 1984 and 2014 were processed using the ENVI Version 4.7 software and then ARCGIS 10. The images were sharpened after which bands of interest were selected and stacked. From the stacked image, a colour composite of band 4, 3 and 2 was generated and resampled newly display as red, green and blue respectively. The band combination has been regarded as efficient and adequate when using landsat image data to study landuse/landcover mostly because it reveals vegetation, farmland water, body, flood vulnerable areas, bear surface and built up area[10-11].

With ENVI 4.7 software, the image is classified using maximum likelihood classification, defined land use/land cover classes as shown in Table-1. After classification, different post

classification operation was carried out which included confusion matrix using ground truth ROI, sieve class, clump class, majority / minority analysis, segmentation and classification to vector. After the post classification processes the image was exported to ArcGIS10where it was vectorized and show the classified image.

Table-1
Table showing land use land cover classification for the study area

S/n	Class	Colour Code
1	Mangrove	Dark green
2	Built-up	Red
3	Water body	Blue
4	Wetland	Light green

Results and Discussion

Various processing techniques applied to the enhanced thematic mapping (ETM+) image datasets revealed the significant changes in land use that have occurred over the study area within the timeframe considered (Figure-2 and 3). Also, Table-2 showed the statistical results of the classification of the data set. A supervised classification was performed on these false colour composite (bands 4, 3 and 2) into the following land use classes built-up area, vegetation and water body. The classification results show remarkable differences as evidenced on Table-2.

Results from the analysis reveals that built-up area covered 3,870.63Ha (5.48 %) in 1984 and increased to 16,332.66Ha (23.14%) in 2014. Mangrove decreased gradually from 13,729.95Ha (19.45%) in 1984 to 2,269.71Ha (3.22%) in 2014 which is mostly due to growth in built-up area. Water body shows only a marginal decrease from 35,476.83Ha (50.27%) in 1984 to 33,784.65Ha (47.87%) in 2014, this is because human activities and encroachment into the coastal area is limited in comparison to mangrove. Furthermore, there is slight increase in wetland class from 17,501.94Ha (24.80%) in 1984 to 18,192.33Ha (25.78%) in 2014. Table-2 was used to quantify and model the land cover change based on the land use classifications, while Figure-4 shows the pattern of change over the study area in chart format (histogram).

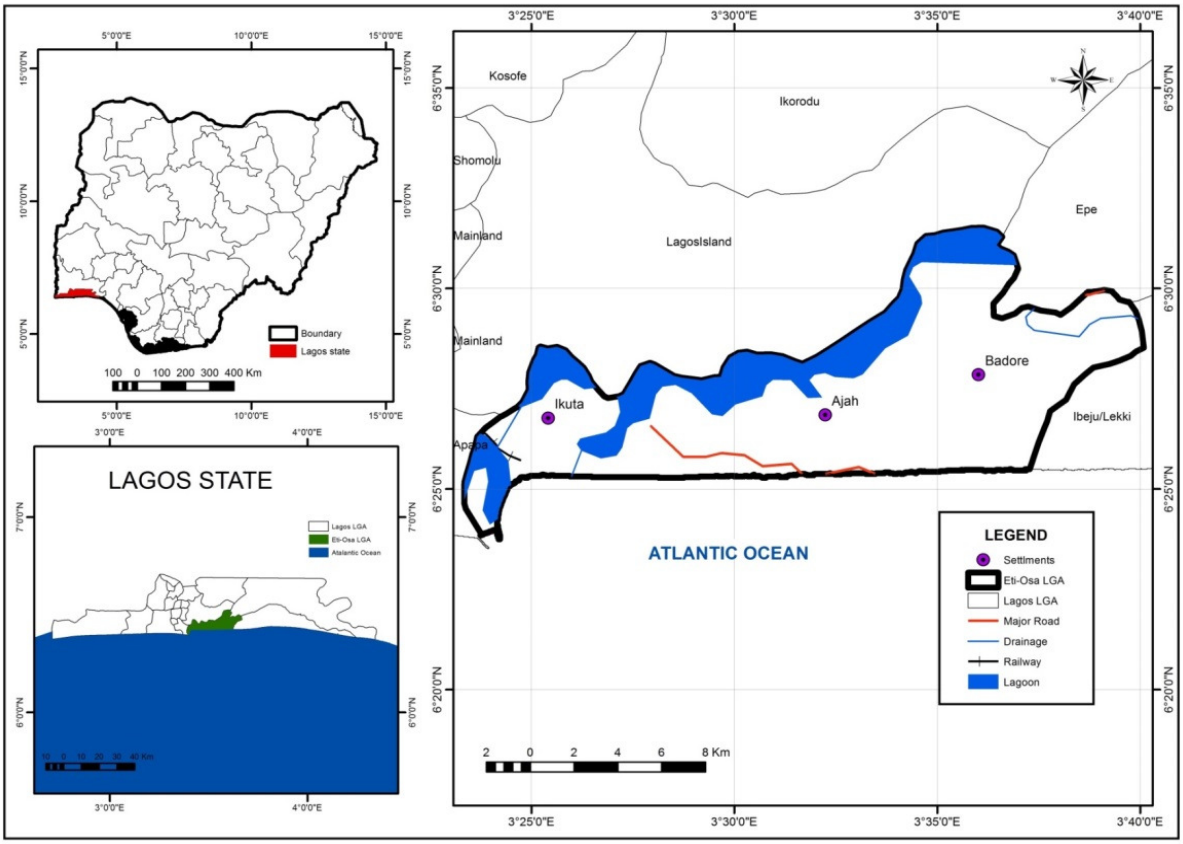


Figure-1
Map showing location of study area

Table 2
Table showing the changes that occurred between 1984 and 2014

Year 1984		
Classes	Area (Ha)	Percentage (%)
Mangrove	13,729.95	19.45
Built-up	3,870.63	5.48
Waterbody	35,476.83	50.27
Wetland	17,501.94	24.80
Total	70, 579.35	100.00
Year 2014		
Classes	Area (Ha)	Percentage (%)
Mangrove	2,269.71	3.22
Built-up	16,332.66	23.14
Waterbody	33,784.65	47.87
Wetland	18,192.33	25.78
Total	70, 579.35	100.00

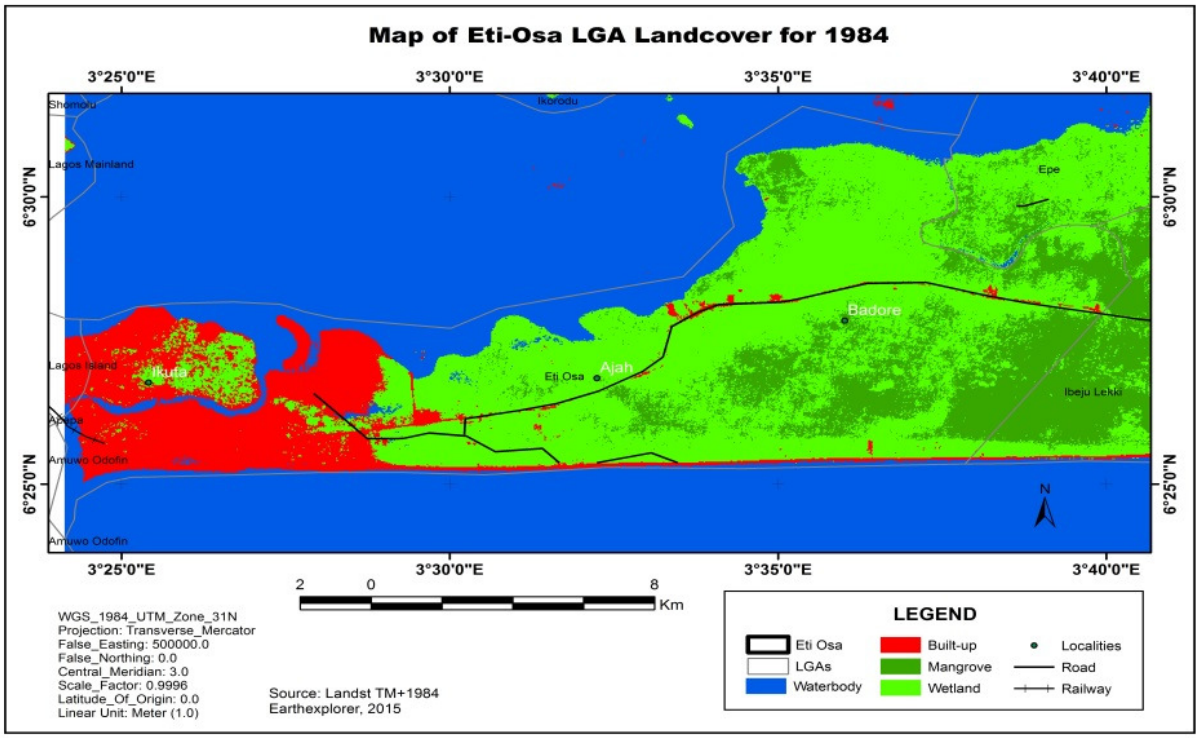


Figure-2
Map of Eti-osa showing LULC classification for year 1984

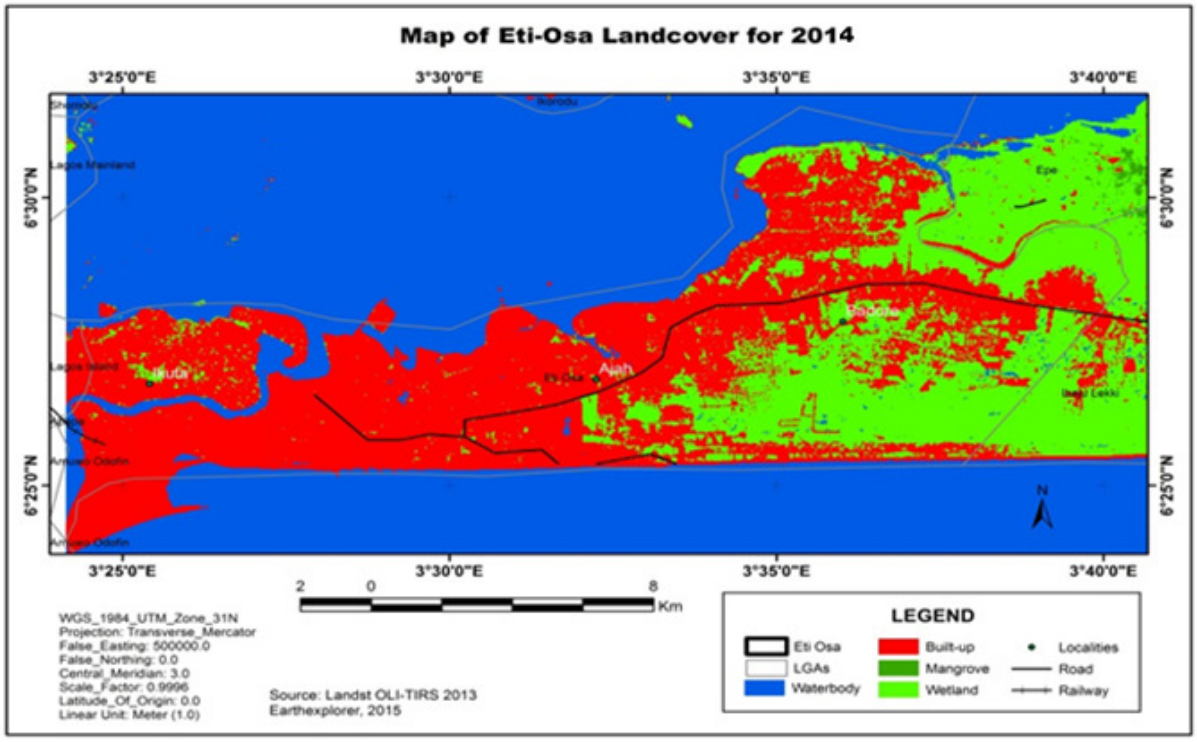
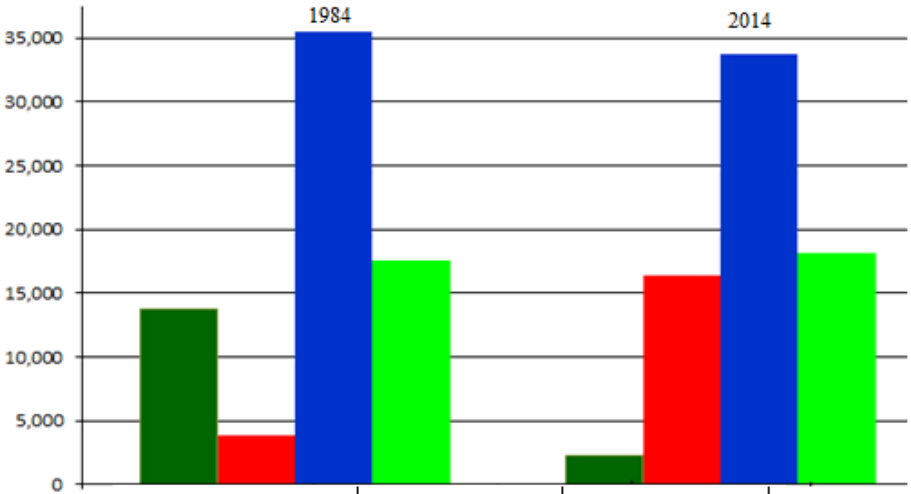


Figure-3
Map of Eti-Osa showing LULC classification for year 2014



	Area (Ha) 1984	Area (Ha) 2014
Mangrove	13,729.95	2,269.71
Built-up	3,870.63	16,332.66
Waterbody	35,476.83	33,784.65
Wetland	17,501.94	18,192.33
	70, 579.35	70, 579.35

Figure-4
Histogram showing changes pattern of study area between 1984 and 2014

Conclusion

The use of GIS techniques and remote sensing dataset with statistical calculations has proved significant in understanding the trend of land use land change (LULC) in Eti-Osa, Lagos State, Nigeria. It has established the usefulness of this approach in detecting LULC and evaluating the extent of urban growth without depending on ineffective and costly land surveys. The study revealed great increase in the urban/built-up area between 1984 and 2014. The urban growth or increase in built-up area is predicted to rise with more encroachment on mangrove area, unless a workable urban planning approach is developed and enforced. The study has therefore assisted in obtaining the necessary information about the existing LULC types which can be used by planning authorities in producing a detailed planning system for the growth of the study area.

From the assessment of the study, some suggestion can be useful in balancing and improving the built-up /urban environment and climate condition within Eti-Osa local government area of Lagos State. A serious approach should be implemented in order to increase the green cover in the area. This can be achieved with policy makers incorporating afforestation into the system, enforcing plantation of trees on sidewalks of housing areas, establishments of parks and green belts into the town planning schemes. This also requires community alertness on the adverse effect of inefficient urban arrangement / system and the significance of establishing a friendly environment. Finally, it is apparent that loss of vegetation cover to urban expansion cannot be completely stopped. However, proper planning and management will greatly assist in achieving a reliable and sustainable vegetation cover.

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