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Land use Change Detection: Management of Land using Remote Sensing and Geographiacal Information System: Rivers State

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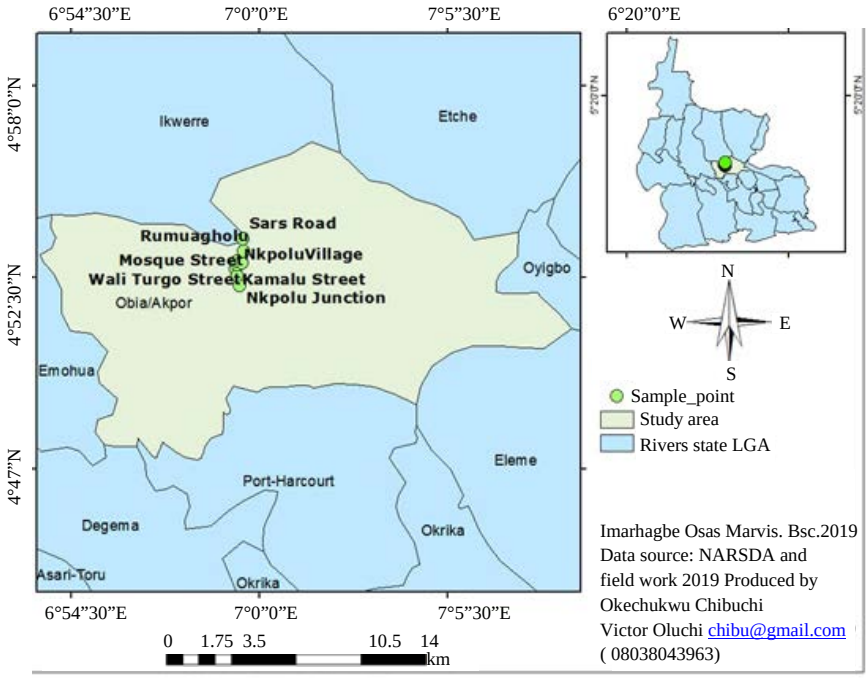
Abstract: The land use changes were detected using Remote sensing and GIS and this was very important in detecting the nature, rate and location of changes. Change detection of the study area was carried out for the years, 1994, 1999, 2000, 2004, 2005, 2009, 2010, 2014 and 2019. A land use classification scheme was developed for the area, There was a major decline in most of the land use in the study area. This was noted to majorily caused by mans activities. Water bodies also experienced a change within the periods worked on. Between 1994 and 1999 the water body area covered was 13576 m but decreased to 11784 m between 2000 and 2004, despite this fact the study area experienced a lot of flooding in few years past and this was deduced to be caused by illegal dredging activities and sand filling of river paths. Farm lands, built up areas all changed in dimension in different years and all these were attributed to mans activities. Land use change detection was able to help in determining and comparing the percentage changes as well of rate a of change and this could help in decision making.

INTRODUCTION

Land use involves the management and modification of natural environment or wilderness into built environment such as settlements and semi-natural habitats such as arable fields, pastures and managed woods. It also has been defined as "the total arrangements of activities, inputs that people undertake in a certain land cover type". Urban land cover types and their areal distribution are fundamental data required for a wide range of studies in the physical and social science as well as by municipalities for land planning purposes[1]. Land use change is a key driver of global change[2] and has significant implications for many international policy issues[3]. In particular, land use changes in tropical regions are of major concern due to the widespread and rapid changes in the distribution and characteristics of tropical forests.

According to Lillesand and Kiefer[4], remote sensing data has helped in the development of various environmental management methodologies. Some of the advantages that are synoptic view that facilitate the remote sensing to study the various between type of features of Earth's surface and the relation of the spatial. The accessibility of remote sensing data makes its possible to gather the information about areas that



Study area and sample ponits

Fig. 1: Map of rivers state showing study area; NASDAR (Abuja, Nigeria)

impossible to be accessible for ground surveys such as mountains or Foreign lands. Since, the information can be gathered quickly by using this method, these techniques are more save the time and the effort. Satellite imaginery has been used for measuring qualitative and quantitative terrestial land cover changes[5]. Qualitative changes in landscape occur either as natural phenomena or can be human induced (Fig. 1).

MATERIALS AND METHODS

Study area: This study was conducted at Nkpolu-Rumuigbo Axis of Rivers state. Nkpolu is located in the humid tropics of the southern part of Nigeria It lies between Latitude $04°52^{I}$ 14^{II} North and longitude $006°$ 58^{I} 86^{II} to the East. It lies in the North and is bordered by Rumuoghalu in the Southwest, Obik were to the East and Obiwalli to the Northwest, all in Obio/Akpor LGA. Figure 1 Map of Rivers state showing study area:

Maps and satellite images: Satellite images were used in the course of the study and were sourced from Departments of Geography and Environmental Management in University of Port Harcourt.

Land use change analysis: Landsat Satellite imageries of spatial resolution of 30 m (each pixel representing an area on the Earth surface of 30 by 30 m) with an altitude of 710 km were acquired. Landsat 7 imageries were used for years 1994-1999 and Landsat 8 imageries were used for years 2000-2019. Arc GIS 10.1 was used to perform analysis on the acquired satellite images.

RESULTS AND DISCUSSION

The land use changes were detected using Remote sensing and GIS. Comparision of the study area was done between the years 1994, 1999, 2000, 2004, 2005, 2009, 2010, 2014 and 2019. Land use types were delineated busing supervised classification (Table 1 and Fig. 2).

Vegetation was very prominent in the study area between the years 1994-1999. This was followed by farmlands which also covered significant areas in the study area. Water bodies were not so, prominent in the study area at that period.

And covered a small percent of the study area. The occupants of the study area were mostly farmers with an almost 0% presence of industrialization. The built areas occupied less space (Fig. 3 and Table 2 and 3).

Farmland size reduced between 2000 and 2005, this was due to an increase in mans activities (industrialization). These activities took over the spaces

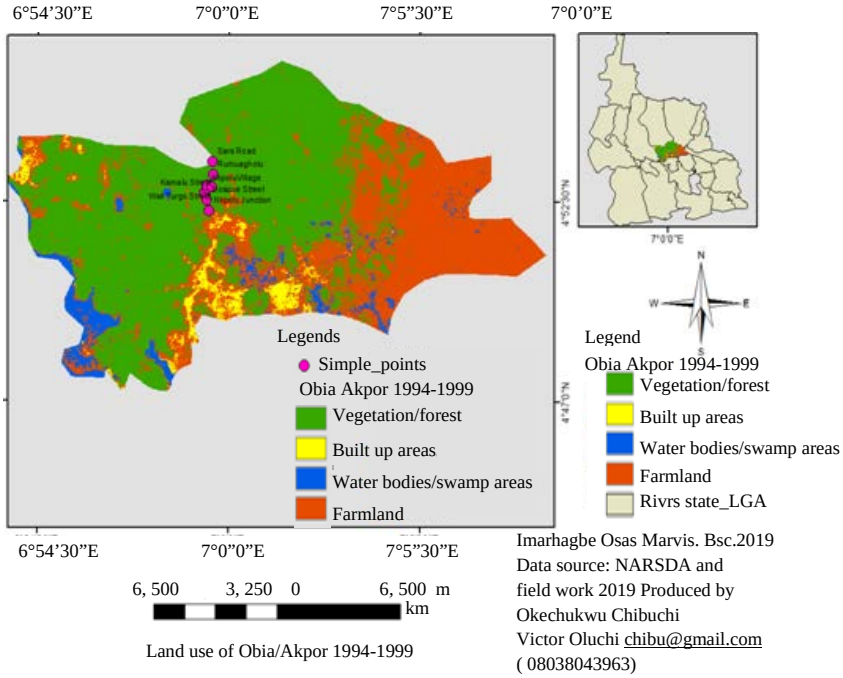


Fig. 2: Landuse change map of Obia/Akpor (1994-1999)

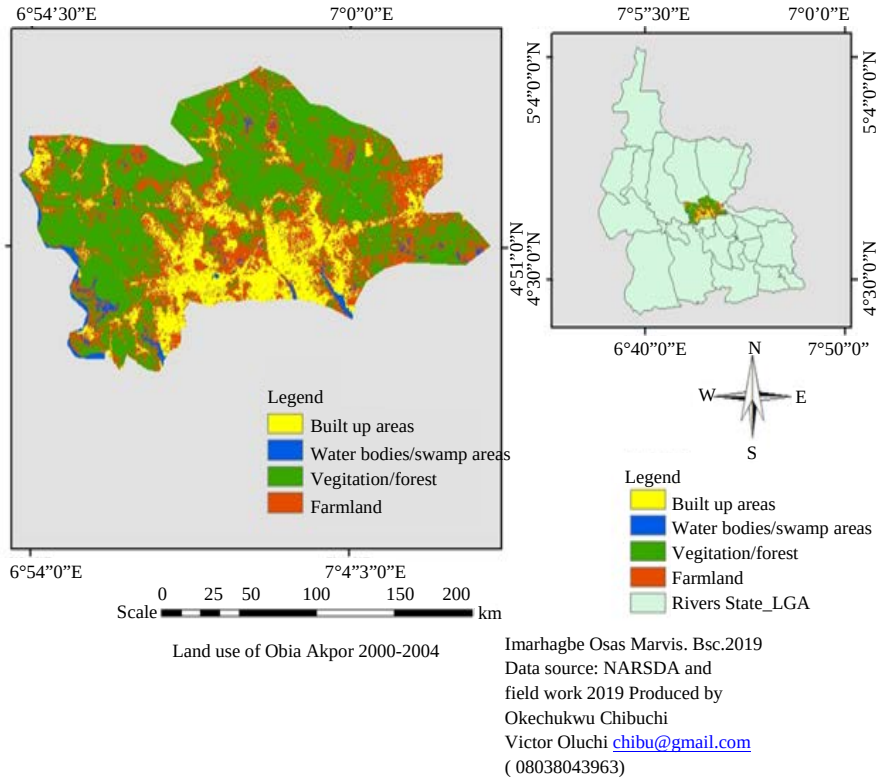


Fig. 3: Land use change map of study area 2000-2004

Table 1: Land use classification scheme

Variables	Parameters
Vegetation/forest	Lawns, shrubs, orchards or areas with evergreen growing naturally
Water bodies/swamp	River, permanent open water, lakes, ponds, canals, reservoirs and land that are water logged
Farmlands	Lands used mainly for growing crops. It includes crop field and fallow lands
Built areas	All residential, commercial and industrial areas, settlements and transportation infrastructure

Table 2: Area change in Land use distribution types (m)

Land use type	1994-1999 area (m^2)	2000-2004 area (m^2)	2005-2009 area (m^2)	2010-2015 area (m^2)	20150-2019 area (m^2)
Vegetation/ Foreat	164001	163267	147341	135230	124120
Water bodies/ Swamps	13576	11784	9822	9447	8354
Farm land	100503	23848	21975	14307	10432
Built up areas	8926	88107	107868	128022	144100
Total	287006	287006	287006	287006	287006

Researcher's Compilation in 2019

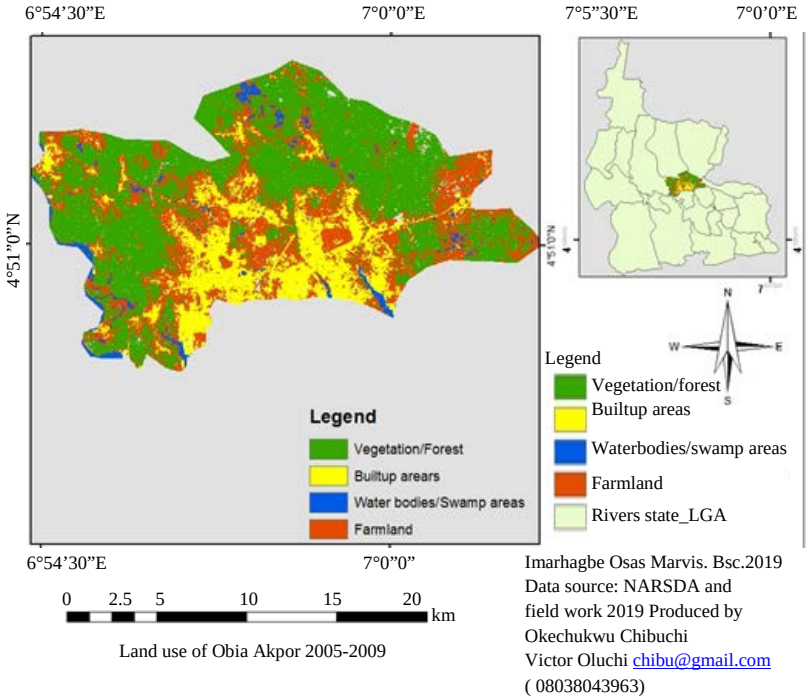


Fig. 4: Land use change map of the study area 2005-2009

formely occupied by farmlands. Also, most of the farmers left the farms in quest of white collar jobs (Fig. 4).

Further, changes occurred between the years 2005-2009. Extreme changes, caused by an increase in mans activities in the study area (industrialization, oil and gas exploration). There was increased flooding in the study area due to blocking of canals and river beds by mans activities (Fig. 5).

Between 2010 and 2014, there was a notable increase in built up areas as much of the forested areas and farmlands were destroyed to give way for industrialization (Fig. 6).

At this period of the study, there was obviously an absence of most of the vegetal cover in the study area farmlands and forest). These had all been wiped of due to mans activities. Very few farmlands were in existence in the study area.

As can be seen from Table 4, there was a constant reduction in the land use types of the study area. Vegetation reduced from 164001-124120 m. While water bodies recorded a decrease of 13576-8354 m in 2019. Farmlands also suffered the same fate from 100503 m to 10432 m. The built up area was the only land use type that had an upsurge of 8926-144100 m, this is completely due to mans activities as well as industrialization and oil and gas exploration in the study area.

From the above table of percentage change, it shows that vegetation decreased drastically from

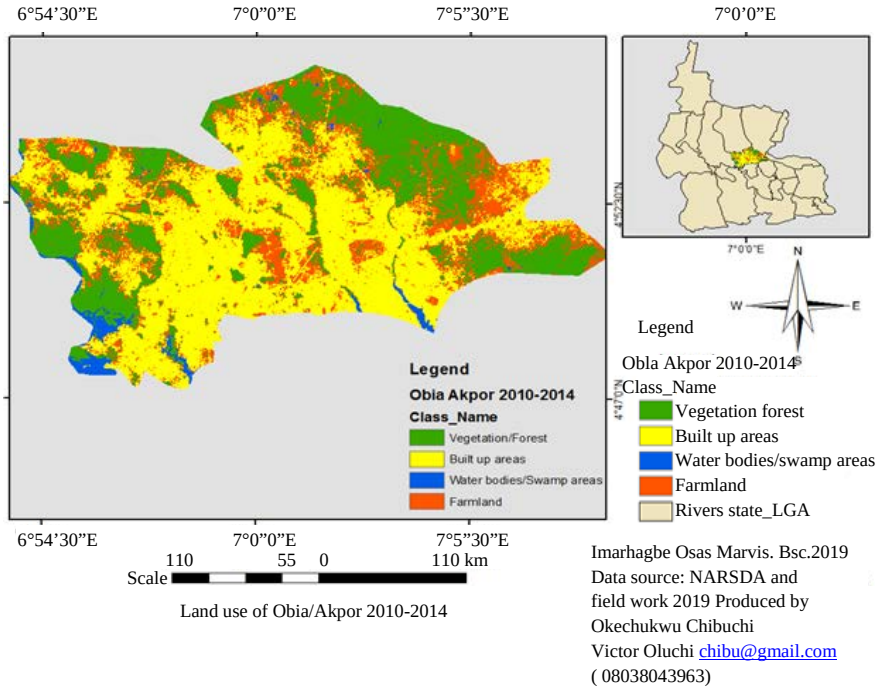


Fig. 5: Land use change map of the study area 2010-2014

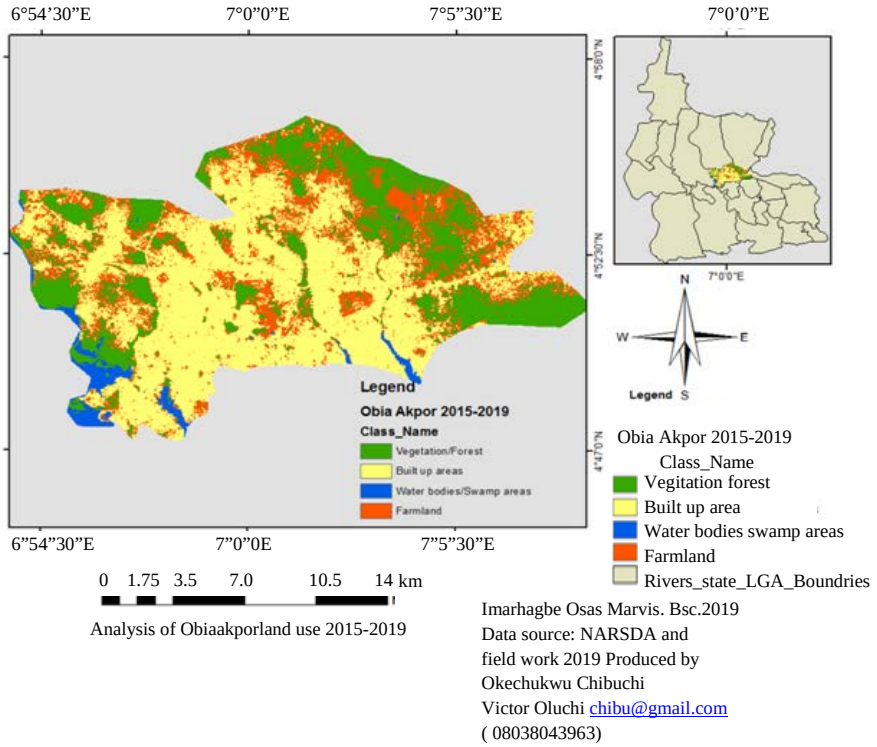


Fig. 6: Landuse change of the study area 2015-2019

58.4% t while water bodies frightenely reduces in area space from 4.7-2.95 in a 24 year stretch. This very sad decrease was also noted on the farmland land use type which decreased from

Table 3: Land use change in percentage

Land use change	1994-1999 (%)	2000-2004 (%)	2005-2009 (%)	2010-2014 (%)	2015-2019 (%)
Vegetation/forest	58.4	56.9	51.3	47.1	43.2
Water bodies	4.7	4.1	3.4	3.3	2.9
Farm land	35	8.3	7.6	4.9	3.6
Built up areas	3.1	30.7	37.6	44.6	50.2

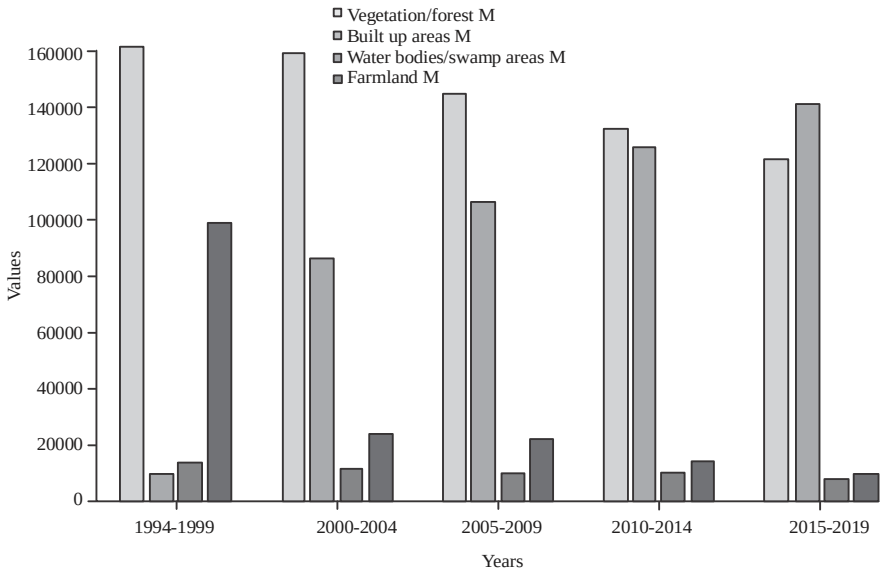


Fig. 7: Land use dynamics 1994-2019 (M); Analysis of the year

35-3.6% in the study area. Built up areas maintained a constant increase from 3.1-50.2% all through the years studied.

CONCLUSION

The anthropogenic activities of man have led to the reduction of the studied land use types. This decrease is mainly due to the continuous increase in population and diversification of humans activities and these activities can cause negative impairment such as environmental pollution, land degradation, loss of soil nutrient if not properly managed or controlled in time.

It has also been shown that the use of remote sensing and Geographical Information System (GIS) in the classification of land use changes can not be overemphasized as seen in this using the technology using Landsat 7 and 8 with a resolution of 30×30 m and arc GIS 10.1 giving a clear differentiable change of the different classes of land use changes.

RECOMMENDATIONS

There is the need for ecosystems restoration in the study area. The population must be educated on the implication of the existing situation. Legislations compelling environmental protection, restoration and remediation need to be enforced. There is urgent need for the governments through appropriate land use planners to embark on data gathering on critical environmental variables using Remote sensing and GIS techniques as well as in-situ and field measurements.

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