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REMOTE SENSING TECHNIQUES APPLIED TO TIME RELATED CHANGES IN THE LAND USE OF ABEOKUTA AND ITS ENVIRONS, SOUTH-WESTERN NIGERIA.

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ABSTRACT

The study looked at Abeokuta and its environs over a period of time with GIS as a tool. It recognised the various land use types, identified the various changes that have taken place and determine the area occupied by the changing land use types in quantitative terms. The observed changes were largely attributed to factors such as settlement expansion, growing population, the increasing demand for basic human needs which is provided from the limited natural resources. The trend it postulates may lead to environmental problems such as deforestation, global warming resulting from increasing atmospheric carbon dioxide level, soil erosion, and loss of biodiversity among others, the study postulated.

Keywords: Land-use, Change detection, Environmental degradation, Healthy City concept.

INTRODUCTION

The global pattern of urban development indicates a rapid urban growth in the developing countries including Nigeria (www.unhaitat). This trend is worrisome in view of the wide gaps which exist between facilities provision and skyrocketing area expansion. Most urban centres in this part of the world witness the coexistence of a modern sector, traditional sector and a shanty or slum area. Slums are largely occupied by new immigrants leaving villages to seek employment and means of lively hood in the cities. Slum areas in cities are largely unplanned. They are characterised by poor or inadequate transport network, absence of portable water supply, uncoordinated electricity network, lack of public hospitals, schools, security services, and generally derelict surrounding conditions. Land areas that should be left as green area (watershed), swamp and recreation spots are often occupied by low income and poor residents in the face of urban reality and high cost of living.

Remote sensing technique is a highly practical and unique method which has now revolutionized the collection of data on resources for planning, management and conservation in many parts of the world. The

development of any nation depends largely on prudent utilization of its natural resources which can only be guaranteed through proper, adequate and effective planning and management. This requires baseline information which is readily provided by remote sensing technology, in view of the economy and short time at which variety of information covering a large area is collected.

Abeokuta, as a state capital, has developed to a point in which rural people round it do move into the city in search of employment and also to enjoy the social amenities provided by the government. This has led to increased population and environmental degradation in the urban centre. The degradation features in form of high volume of run-off, flooding, rapid reduction in green area, shortage of water supply, increased waste generation, traffic congestion, housing problems and poverty. The continuous increase in population influx has led to overcrowding and the problems associated with uncontrolled urban development. The city witnessed a series of flooding in the year 2007 and has not fully recovered from the destructions that attended it.

It is this attendant problems that informed this study which was aimed at determining the changes in the land-use pattern of Abeokuta and its environs over time so as to identify better management option for an ecologically healthy city. In order to appreciate the significance of 'Healthy city' concept in the cities found in less developed countries, the land use pattern of such cities requires area analysis. Healthy city concept indicates that cities are expected to be clean and have good health and environmental services. In deed cities are not mere geographical location or simple collection of buildings, shops and streets (Khoseh-chashm, 1995; ICP/RUD, 1992). Change detection involves the analysis and comparison of imageries of different years with a view to detecting the changes that have taken place in the intermediate years.

Remote sensing technique offers an efficient method of discovering the development trends of a given region. This is because of the ability of the technique to monitor changes speedily and reliably. Monitoring technique is useful in geographically inaccessible areas where the conventional technique is inappropriate. It is a powerful tool that cannot be ignored because of its information potential and the logic implicit in the reasoning process employed to analyze remote sensing data. Because of its reliability, cost and time effectiveness, it has found application in virtually all fields. The method has been applied to study different urban and rural areas in the Nigeria (Adeniyi, 1980; Igbokwe, 1997; Ufoegbune, 2004; Mashi and Alhassan, 2004).

Study Area

Abeokuta is the capital of Ogun State which is situated at about 100 kilometres from Lagos (the commercial capital of Nigeria). Ogun state was carved out of the defunct Western state on February 3rd, 1976 by the then Federal Military Government of late General Murtala Muhammad. Ogun state lies within the tropics, and it is bounded in the west by Benin Republic, in the east by Ondo State, in the north by Oyo and Osun States and in the south by Lagos State and the Atlantic Ocean (Fig.1). It oc

occupies a total area of 16,409.26 square kilometres. Ogun state had a population of 2,338,570 in 1991 and its present population is above 4 million.

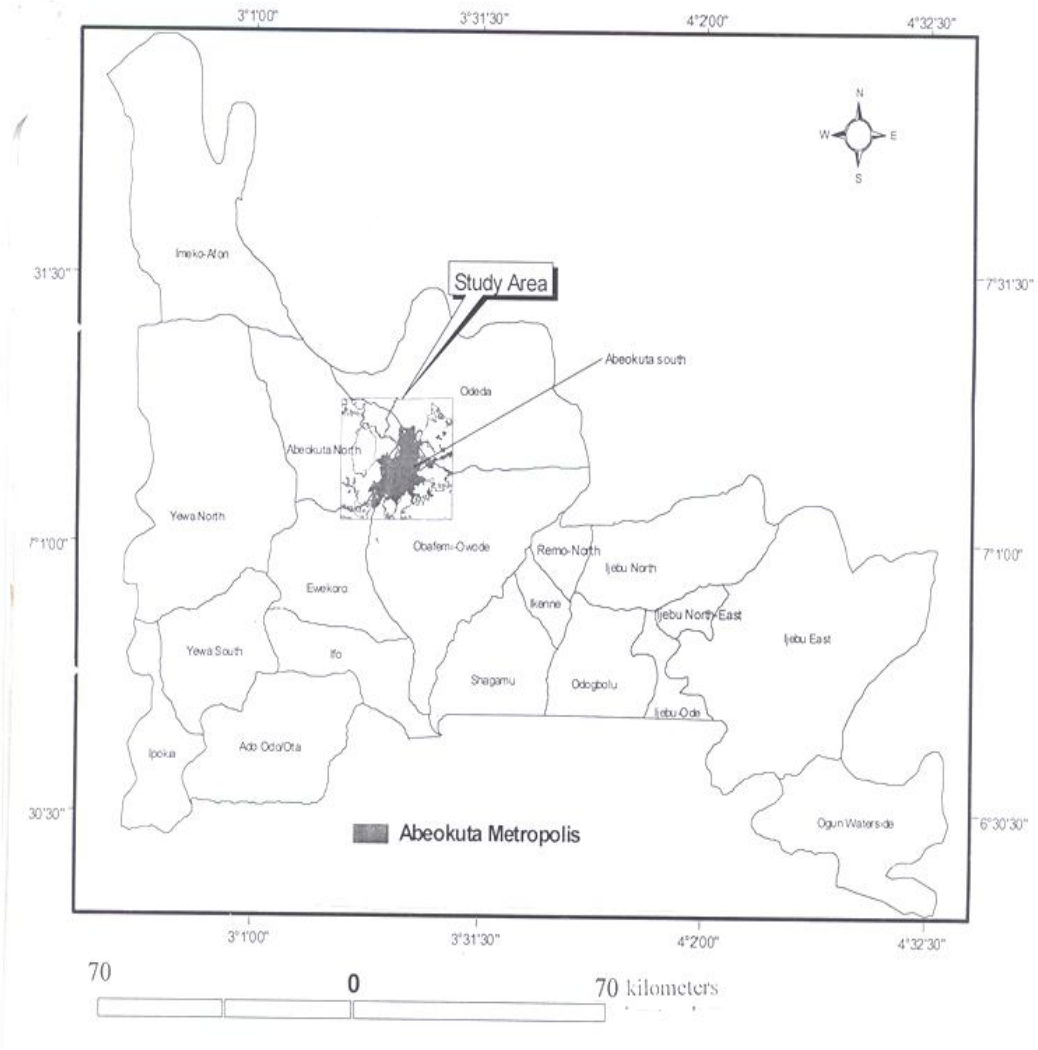

Figure 1. Ogun State showing the study Area.

METHOD

Landsat imagery in different bands were imputed and then principal component of the imagery was done which was followed by the standard false colour composite stacking of the images, that is, different colours are assigned to different features on the imagery. Features with similar colour were grouped together by digitizing them to identify the specific feature. In this study unsupervised classification was used, in which the image data was first classified by aggregating them into natural spectral grouping or clusters in the scene. To know what this natural spectral groupings or clusters represent, groundtruthing is carried out in which those places are visited and their coordinates taken using global positioning system (GPS) receiver. The data were imputed into the column provided to identify the training set of the imagery such that similar features grouped together are classified in reference to ground data collected. The data produced was then imputed in the Geographical Information System (GIS) software using, ArcView3.2a.

RESULT

From the grouping of similar features (land -use types) using the 1984 Landsat imagery, five classes emerged namely; Built-up area, Cultivated area, Disturbed forest, Grassland and Water bodies (Table 1). Also using the previous classification method, five land use types were identified for the Landsat 1993 imagery in Table 2. The same classification pattern was also used for the Landsat 2000 imagery and the result is given in Table 3.

Table 1: Pattern of land use as at 1984

Class	Area (KM2)	Percentage
Built-up area	62.2	8.65
Cultivated area	313.23	43.58
Disturbed forest	237.05	32.98
Grassland	89.42	12.44
Water bodies	16.90	2.35
Total	**718.8**	**100.00**

Table 2: Pattern of land use as at 1993

Class	Area (KM2)	Percentage
Built-up area	105.93	13.81
Cultivated area	403.42	60.13
Disturbed forest	34.31	5.11
Grassland	149.07	18.16
Water bodies	18.15	2.71
Total	**710.88**	**100.00**

Table 3: Pattern of land use as at 2000

Class	Area (KM2)	Percentage
Built-up area	230.04	32.43
Cultivated area	339.06	47.14
Disturbed forest	8.85	1.45
Grassland	3.03	0.49
Water bodies	17.74	2.91
Derived savannah	105.78	17.35
Riparian Forest	15.20	2.49
Total	**719.7**	**100.00**

NOTE**:** Tables 1, 2 and 3 further explained in the figures below

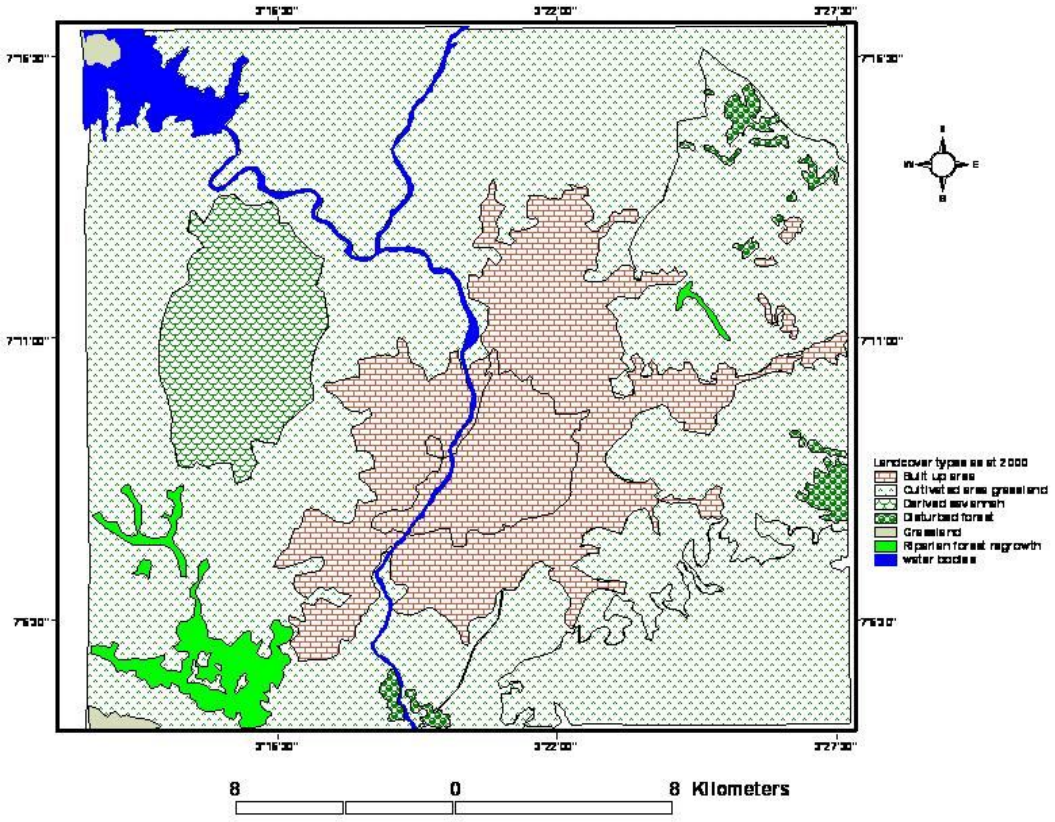

Figure 2: Landcover types of Abeokuta Environ as at December 2000

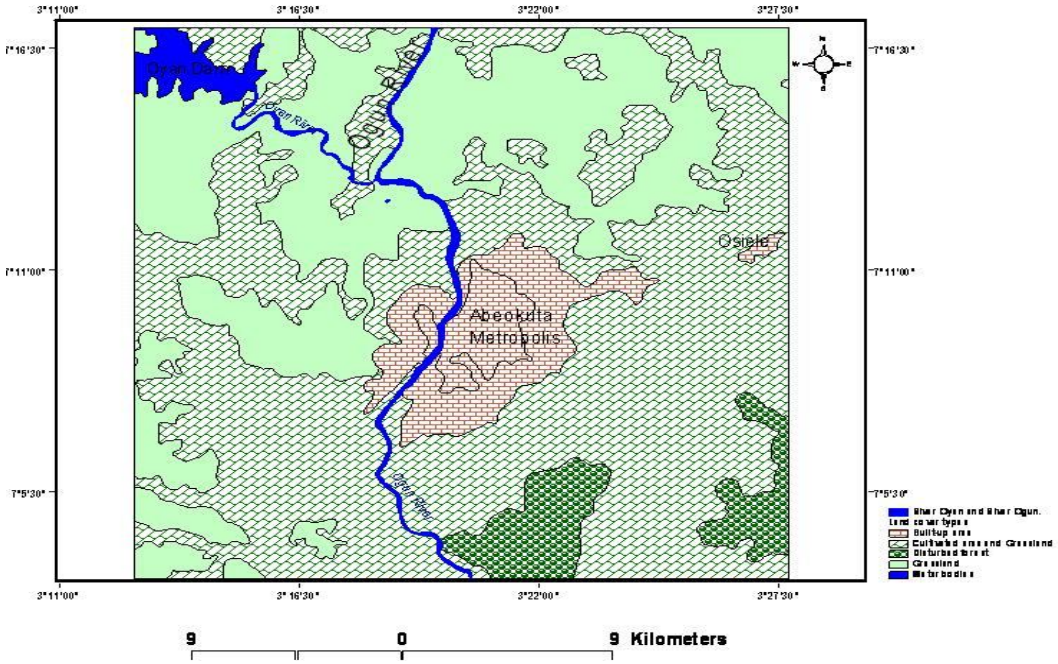

Figure 3: Landcover types of Abeokuta Environ as at January 1993

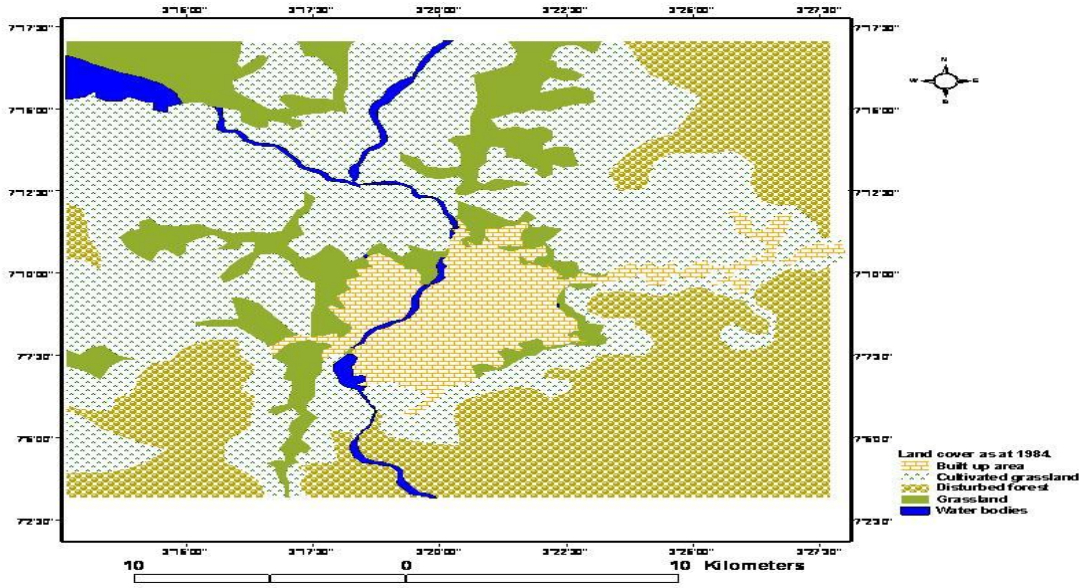

Figure 4: Landcover types of Abeokuta Environs as at 1984

Land use changes between 1984-1993

When the map produced from interpretation of 1984 imagery was compared with that produced from 1993 land use map, the following changes where evident (Table 4)

The most significant change was the increase in the grassland area, which maybe attributed to logging or lumbering activities caused by increased demand for land by the residents.

Another noticeable change was the increase in cultivated area implying an increase in farming activities to meet the need of the increasing population.
Also there was the decrease in forest area due to removal of the trees through slash and burn and lumbering activities.

Area occupied by water body increased from 1984 to1994. This may have been caused by silting in the lower course of the River Ogun that has lead to expansion in the upper course of the river.

Land use change between -2000

The most significant change during the time was the rapid expansion of the settlement which could be attributed to increased population.
There was the reduction in total area of the grassland; this may have resulted from settlement expansion caused by influx of people.

Another noticeable change was the rapid encroachment on forested area by the wood loggers, which resulted in a decrease in area covered by forest.
Area occupied by water bodies decreased in size due to increase in settlement expansion and silting in the lower course of the river.

Due to deforestation, derived savannah has replaced forest land in some places within the study area.

Table 6: Land use changes in Abeokuta Area 1993-2000.

Class	1993		2000		Change (KM2)
Landuse type	Km2	%	Km2	%	
Built up area	54.93	7.6	130.04	21.3	75.11
Cultivated area/grass land	403.42	56	329.06	54	-74.36
Derived savanna	-		105.78	17.3	-
Disturbed forest	34.31	4.8	8.85	1.5	-25.46
Grassland	207.07	29	3.03	0.5	-204.04
Riparian forest regrowth	-		15.20	2.4	
Water bodies	18.55	2.6	17.74	3	0.81

TABLE 4: Land use change in Abeokuta Area 1984-1993

Class	1984		1993		Change Km^2
Landuse type	Km^2	%	Km^2	%	
Built up area	62.20	8.7	105.93	7.6	70.27
Cultivated area	313.23	43.6	4.3.42	56	+90.9
Disturbed forest	237.05	33	34.31	4.8	-202.74
Grassland	89.42	12.4	209.07	29	+119.65
Water bodies	16.70	2.3	18.55	2.6	+1.85

TABLE 5: Land use changes in Abeokuta Area 1984-2000

Landuse type	Km^2	%	Km^2	%	(Km^2)
Built-up area	62.2	8.7	130.04	21.3	67.84
* C G	313.23	43.6	329.06	54	15.83
Derived savanna	-	-	105.78	17.3	-
Disturbed forest	237.05	33	8.85	1.5	228.2
Grassland	89.42	12.4	3.03	0.5	86.39
Water bodies	6.70	2.3	17.74	3	1.04

* C G = Cultivated area / grassland

Land use changes in Abeokuta between 1984 -2000

There was an increase in the built-up area (settlement expansion) caused by increased population. Cultivated area also increased which may be due to involvement of more people in urban farming to meet the need of the increasing population. There was a reduction in land area covered by grassland. Also observed was emergent of regrowth of trees in the hitherto forested land.

Another important change was a reduction in the land area covered by forest that could be attributed to increased demand for land and fuel wood which the urban poor largely depend on since the cost of alternatives such as kerosene appears too expensive.

Finally, there was a notable increase in the area of Ogun River.

DISCUSSION

The result of this study was based on the interpretation of imagery covering the entire study area. The land use changes identified on the maps are a clear reflection of the impact of human activities especially settlement development on the area under study within a period of 16 years.

The Changing Land Use

The term landuse relates to the various uses to which a given piece of land is subjected to due to human activities and it is dynamic. Its dynamicity in the study area is an indication of pressure on the limited land resources due to increase in population between 1984 -2000. An appreciable change observed as regards farmland area showed that there was an increase in area of land under cultivation. This could be an effort to meet the needs of the teaming population and also an increase in the numbers of urban farmers. Those areas formerly occupied by various vegetation types, notable among them are disturbed forest and grassland, were encroached upon and used as farmland.

Effects of Land Use Changes on the Environments

The role of forest trees as well as land resources can not be overemphasized. For example; it is a known fact that forest trees act as 'sink' for carbon dioxide and this may reduce the level of carbon dioxide concentration in the atmosphere. However, continual removal of forest cover without appropriate replacement reduces the effect of forest to act as 'sink' for carbon dioxide and could eventually contribute to global warming. Continued removal of trees and forest could also result in microclimate change. This is because trees are known to have a variety of effects on microclimate of an area by their influence on climate parameters such as humidity, temperature, precipitation among others. According to Adeyoju and Enabor (1973), trees enhance availability of soil moisture in their immediate vicinity. The precipitation reaching the soil in the forest during rain is ameliorated by tree canopies thereby inhibiting soil erosion. Soil erosion resulting from deforestation may affect extensive agricultural land by way of diminishing crop yields with the overall threat of food security. In sparsely populated area, the conventional farming system sustains food production as this allows for fallow long enough to restore soil fertility through nutrient recycling. However, as population increases beyond the carrying capacity of land, fallow period becomes shorter with grave consequences for soil fertility status. This may lead to impoverishment of soil, poor crop yield, continuous cultivation without appropriate soil conservation strategies and consequently land degradation.

CONCLUSION

The analysis of land use changes in Abeokuta and its environs was studied over a period of time and the results clearly depict that there has been a lot of changes in terms of different land use types in the study area. It was possible to recognise the various land use types, identify the various changes that have taken place and determine the area occupied by the changing land use types in quantitative terms. The observed changes were largely attributed to factors such as settlement expansion, growing population, the increasing demand for basic human needs which are provided from the limited natural resources. This

trend may consequently lead to environmental problems such as deforestation, global warming resulting from increasing atmospheric carbon dioxide level, soil erosion, and loss of biodiversity among others.

RECOMMENDATIONS

The absence of remote sensing imageries at suitable working scales, and where present, the high cost of procuring them for individual use, constitute a major constraint to the assessment of land use and other renewable natural resources by remote sensing techniques. The acquisition and proper storage of Landsat imageries and other remote sensing imageries covering the entire nation at regular interval of, say, five years by the appropriate governmental agency will be appropriate for ensuring economic and technological advancement in the country. Stringent measures aimed at prohibiting indiscriminate removal of plants through illegal felling of trees and exploitation of trees for fire wood, bush and forest burning should be formulated and enforced. It is expected that the result of these exercise will ensure effective resource conservation, land use planning and the selection of necessary aforestation location in the area of study. There is urgent need for comprehensive town-planning for all cities in Nigeria. Such planning within the context of ecologically healthy city, should such consider cities as organic units with functional sub systems. Adequate area such be committed to green cover, river courses should be left without human interference while water shed within cities such be protected. Residence should be mandated to plant trees round the homes while some portions of land area around homes are to be left unpaved to enhance infiltration. This is crucial because recent flooding experiences have showed that rainfall in cities yield high volume of run of since infiltration is minimal. City administrators should equally set aside certain areas of the city for green-belts, especially hill slopes and river plains

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