

Land Use Change Analyses in Lagos State From 1984 to 2005

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SUMMARY

The physical development in an urban community and the need to control such development for economic, socio-political and environmental reasons have necessitated the requirement for geographical and statistical information relating to the amount of land that has been used and that which is remaining. Growth and physical expansion of urban settlements has occurred significantly all over the world. This growth in recent time has taken on more dramatic momentum in those areas that have come to be regarded as the “third world”. The most notorious example of urban growth in Nigeria has undoubtedly been Lagos. Lagos has become legendary for its congestion and other urban problems. Determination of this growth and knowledge of the rate of growth is essential for adequate future planning.

In this work, we used ETM LandSat imagery (1984, 2001, and 2005), Lagos State administrative map, and Lagos State land use map (2007) to determine different land use uses in Lagos at different times. From this we obtain adequate information for the analysis of the changes in these areas over the years by overlapping series of classified satellite imageries. The changes observed for each year were analysed in a GIS environment. The result shows a change of other land use types to developed (built) land between 1984 and 2001. This pattern of change continued between 2001 and 2005. The result was discussed and recommendations were made on the impact of these observed changes in the local and global environment.

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1. INTRODUCTION

Earth surface is being significantly altered by man and this has had a profound effect upon the natural environment thus resulting into an observable pattern in the land use over time. Man continues to explore and exploit the natural resources in his environment and this has brought immense contribution to observable changes in land. "Land use involves both the manner in which the biophysical attributes of the land are manipulated and the intent underlying that manipulation – the purpose for which the land is used" (Turner et al. 1995). Land is the habitat of man and man uses land in a variety for his economic, social and environmental advancement. Land is the fundamental basis of all human activities, from it we obtain our food we eat, our shelter, our water, the space to work, the room to relax and lots more. The magnitude of land use change varies with the time being examined as well as with the geographical area. The assessment of these changes depends on the area, the land use types being considered, the spatial groupings, and the data sets used.

The landuse- land cover pattern of a region is the result of interplay of both natural and socio-economic factors. Issues of Land use-land cover and its effect on environmental sustainability and human welfare has become of great concern all over the world. Changes in land use patterns impact significantly local and global environmental conditions as well as economic and social welfare. An understanding of how these factors influence land use patterns would provide new dimensions to policy making and public policy evaluation (Chakir and Parent, 2008). Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times (Singh, 1989). Change detection is an important process in monitoring and managing natural resources and urban development because it provides quantitative analysis of the spatial distribution of the population of interest. Macleod and Congation (1998) identified four aspects of land use change detection that are important: (i) Detecting the changes that have occurred, (ii) Identifying the nature of the change, (iii) Measuring the area extent of the change and (iv) Assessing the spatial pattern of the change

Growth and physical expansion of urban settlements is a global phenomenon which has occurred significantly all over the world. This growth has been identified in recent time to have taken on more dramatic momentum in those areas that have come to be regarded as the “third world”. “In these regions contemporary urbanization has not only been extremely rapid in nature but also devastating in impact” (Aina, 1992). Nigeria since independence has become an increasingly urbanized and urban-oriented society. Because of the great influx of people into urban areas, the population of Nigerians living in urban cities has tremendously increased.

Lagos is undoubtedly the most notorious example of urban growth in Nigeria. Lagos is known today for its human and traffic congestion and other urban problems. As in other Nigerian cities, there is a constant problem of garbage and waste disposal. Scenes of Lagos city within a few years bears a remarkable difference which testifies to the fast rate of urban growth of Lagos. This growth is attested to in the United Nations report which predicted that Lagos will be the third most populous city in the world by 2015 after Tokyo and Bombay (UN, 1999). Many parts of Lagos especially the suburbs have witnessed great urban sprawl in recent times spreading fast into the neighbouring states. This development need to be adequately captured and analysed in order to understand the pattern of growth and possible checks in to avoid possible local and global negative results. Lagos is growing at an unprecedented rate that requires adequate monitoring from time to time.

Remote Sensing (RS) and Geographic Information System (GIS) are now providing new tools for advanced ecosystem management. Therefore, in this study imageries of Lagos for 1984, 2000 and 2005 were classified to identify changes in four classes of land use types: water bodies, vegetation, built up and undeveloped land. Analysis of the observed changes was carried out in a GIS environment and an attempt is made predict possible changes that might take place in the nearest future.

2. THE STUDY AREA

Lagos is located in the south –western part of Nigeria. It served the dual purpose of being the commercial and administrative headquarters of Nigeria until the mid 1990s when the administrative headquarters of Nigeria was moved to Abuja. Lagos is located at latitude $6^{\circ}27'$ N and Longitude $3^{\circ}24'E$. This falls just above the equator on Africa continent. The metropolitan Lagos has an area of 137,460 hectares and spreads over (3345 sq km/1292 sq mi). The islands are connected to each other and to the mainland by bridges and landfills. Lagos has a very diverse and fast-growing population, resulting from heavy and ongoing migration to the city from all parts of Nigeria as well as neighboring countries. According to Nigerian National Population Commission (NPC), its metropolitan area was about 9 million people in 2006.

3. METHODOLOGY

3.1 Data Acquisition

In this study, we used three LANDSAT imageries. A regional map of Lagos was obtained from the Office of the Surveyor General of Lagos state to provide a priori information on the area under study.

Table 3.1 Data source

S/No	DATA	SOURCE
1.	Landsat Image 1984	Global Land Cover Facility, University of Maryland.
2.	Landsat Image 2000	
3	Landsat Image 2005	
4	Administrative and local government maps of Kwara state	Office of the Surveyor General of Lagos State

The satellite imageries in (digital format already) were directly imported into the ArcMap environment using the Add Tool. The images in the ArcMap environment were georeferenced. The geo-referenced images were vectorized (digitized) on the computer system. Based on prior knowledge of the study area for over 20 years and a reconnaissance survey using previous maps of the study area and additional information from previous research in the study area, a classification scheme was developed for the study area. The classification scheme developed gives a rather broad/general classification and four different classes were identified. They include are defined in the below:

Table 3.2 Land Use Classifications

S/N	Land Use Types	Definitions
1	Built-up area	Commercial, residential, industrial, government facilities, and settlements.
2	Water bodies	Lagoons, Creeks, rivers and waterlogged areas
3	Undeveloped areas	Open spaces, cleared and non vegetated land
4	Vegetation	All types of vegetation cover

The geo-referenced images were vectorized (digitized) on the computer system. Different layers were created for the various land use classes. Layers were created for the land use classes and these layers were grouped under the **built up areas, undeveloped areas or the open areas, water bodies, Lagos boundary and vegetation area**. In ArcMap this is done by creating Shape Files. The sketch tool on the editor toolbar in ArcMap was selected to trace the outline of these features. Upon closure of the sketch tool, the polygon was formed. The shapefiles were assigned to a projected coordinate system. UTM was used and WGS 1984(Zone 31N) was chosen. The shapefiles were then imported to ArcMap.

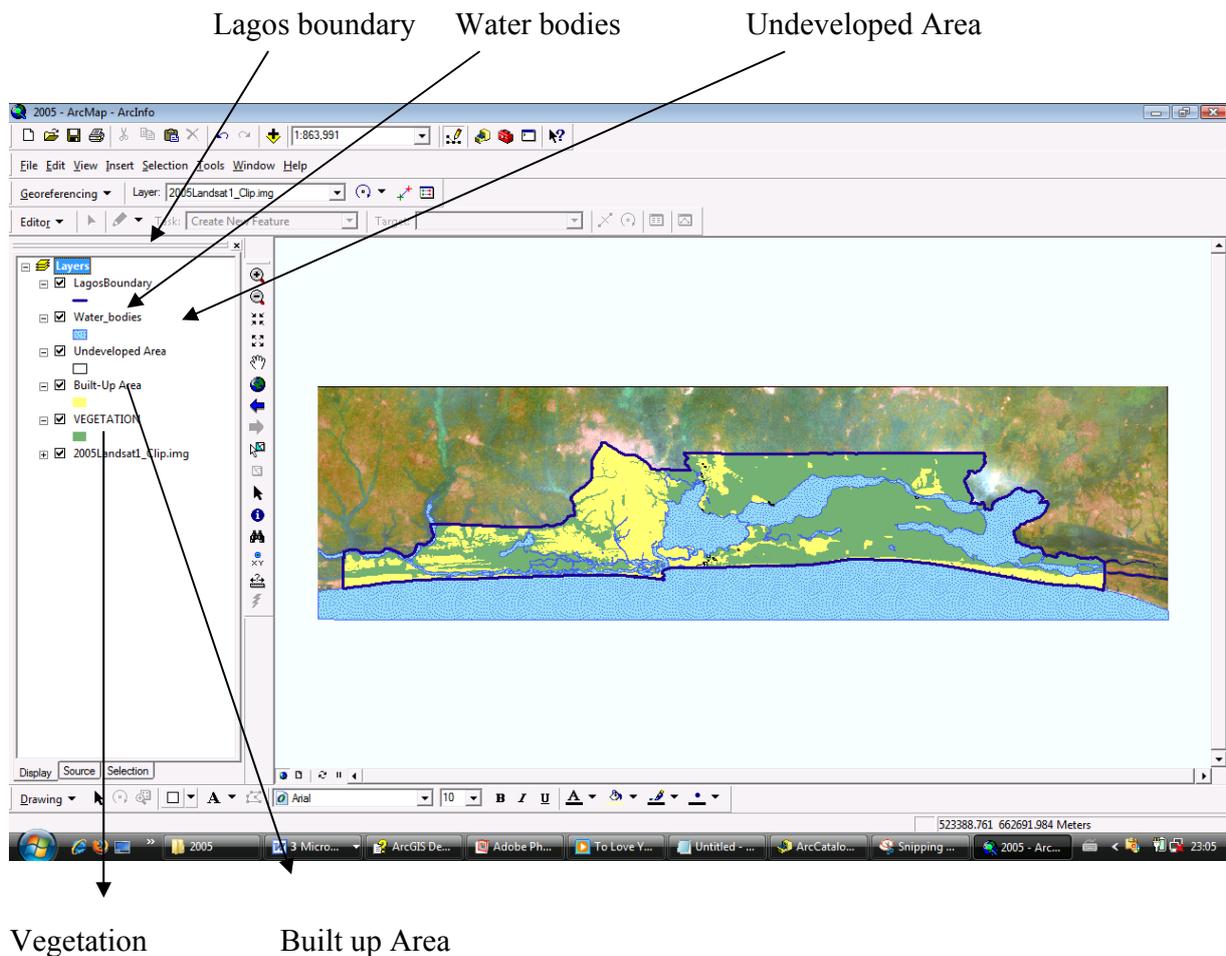


Fig. 3.1: The Various Classifications and Shape Files

4. RESULTS AND DATA ANALYSES

The area covered by the various classes which are the built up area, the vegetation, the undeveloped area as well as the water bodies for the different years were calculated using the calculate geometry in the ArcGIS 9.2 environment.

The results of the area occupied by each land use type are as shown in table 4.1 while the percentage coverage of each land use type is as shown in table 4.2

Table 4.1: Area coverage of each Land Use Types form 1984 to 2005

Land Use Type	1984 (m ²)	2001 (m ²)	2005 (m ²)
Water Bodies	2979359638.3447	2963818889.0796	2958065850.1011
Built-up Area	770613896.351887	942856236.890501	974725556.002479
Vegetation	1968779938.26496	1806364142.1974	1774934270.10664
Undeveloped	20936851.015917	47393000.653493	11643473.49959

Table 4.2: Table of the percentage coverage of Land use

Land Use Type	1984 (%)	2001 (%)	2005 (%)
Water Bodies	33.47	33.30	33.23
Built-up-Area	28.67	35.07	36.26
Vegetation	35.47	32.55	31.98
Undeveloped	26.18	59.26	14.56

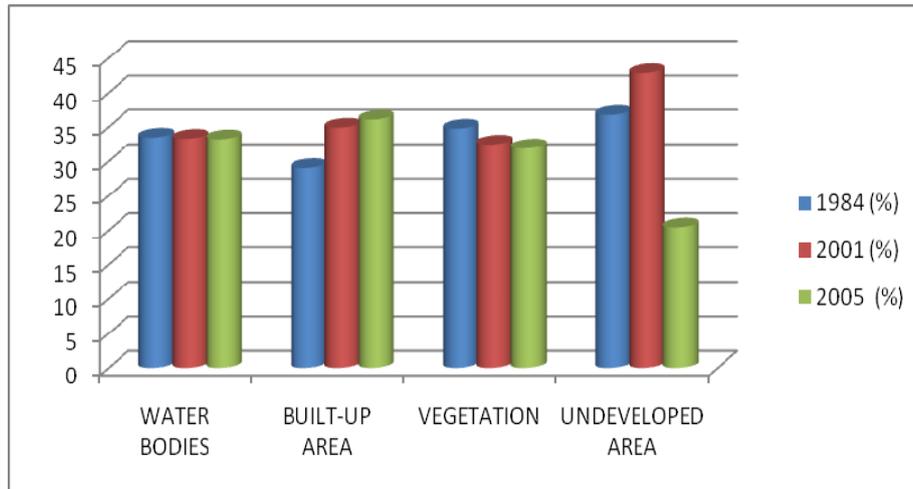


Figure 4.1: Chart of the percentage coverage of Land use

From the figure above, water body is relatively stable at the same level each year. There is an increase in the built up area. More between 1984 and 2001 than it was between 2001 and 2005. This can be justified because the variation in the duration of time under consideration. We can also see a reduction in the percentage of vegetation. Percentage of undeveloped area is more in 2001. Built-up area as expected increases from 28.67% in the year 1984 to 35.07% in the year 2001 and finally to 36.26% in the year 2005. Vegetation cover also decreases considerably from 35.47% in the year 1984 to 32.55 % in the year 2001 and finally to 31.98% in the year 2005. Undeveloped area shows an unpredictable % change over the years i.e. 26.18% in the year 1984 to 59.26% in the year 2001 and finally to 14.56% in the year 2005.

4.1 Detection of Land Use Change in Selected Areas of Lagos

Lagos State has undergone a series of changes in land use. Differences in changes from a selected area to another can be easily detected by creating grids on the digitized satellite imageries of the various years. The grids help to determine changes that have taken place in a particular location. In this work, we investigate changes in Ikeja and Ejigbo Local Government areas as compared with Amuwo-odofin local government area.

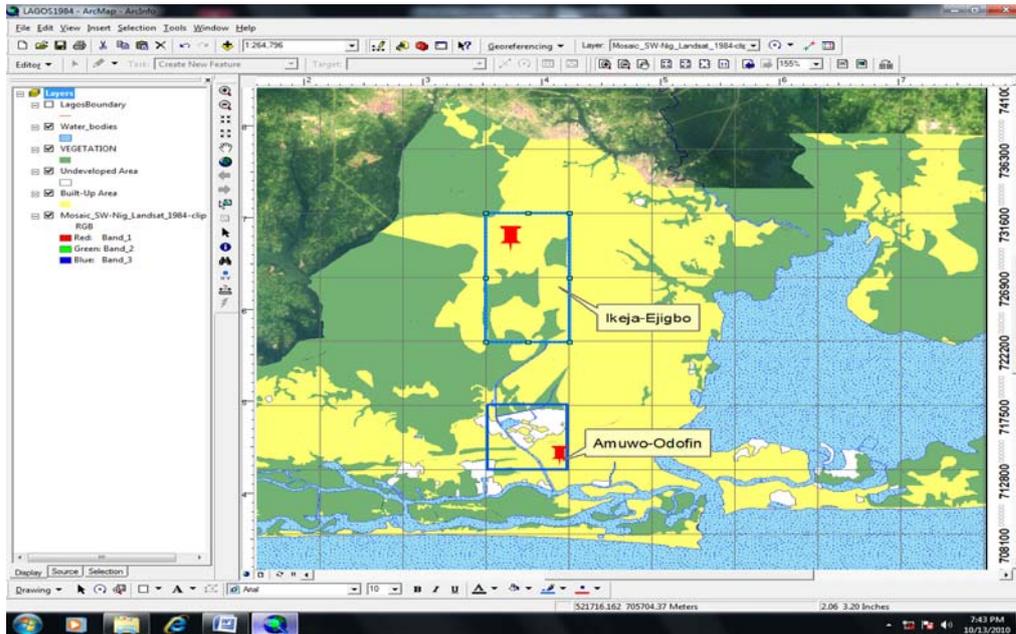


Figure 4.2: 1984 Lagos images with areas of interests indicated by red pins

Table 4.3: Table showing Land use change in Ikeja-Ejigbo from 1984-2005 in Hectares

Land Use Type	1984	2001	2005
Water Bodies	0.00	0.00	0.00
Built-up-Area	3375.78	3601.02	4,082.48
Vegetation	1223.76	936.58	230.16
Undeveloped	0.00	0.00	0.00

Table 4.4: Table showing Land use change in Amuwo-Odofin from 1984-2005 in Hectares

Land Use Type	1984	2001	2005
Water Bodies	213.90	254.474	176.116
Built-up-Area	1,057.39	1629.98	2,038.125
Vegetation	222.42	230.16	132.05
Undeveloped	726.64	0.00	0.00

From tables 4.3 and 4.4, it would be observed that the two areas under consideration are heavily built up. Water bodies and undeveloped land are absent in the areas considered in Ikeja-Ejibgo. There is reduction in the water body of the Amuwo-Odofin area and the large chunk of undeveloped land have been wiped off possibly converted to built up. Generally, the built up areas of the selected locations have tremendously increase while other land use types experienced sharp reduction.

5. CONCLUSION AND RECOMMENDATIONS

This part of our discussion focus on the conclusion arrived at and the various recommendations that have been inferred from the results of this project.

5.1 Conclusion

This research work demonstrates the ability of GIS and Remote Sensing in capturing, processing and analyzing spatial data. Attempt was made to capture as accurate as possible four land use land cover classes as they change through time. The four classes were distinctly produced for each study year. From this work we conclude as follows:

- Built-up-area in the entire Lagos and in the selected areas of interest experienced continuous growth from 1984 to 2005.
- Undeveloped land experienced a rapid growth in 2001 and then a sharp decline in 2005. Results of the two selected areas of interest shows that undeveloped areas in 1984 have all disappeared in 2001.
- Water bodies and vegetation both experience different degrees of reduction in the entire Lagos and in the areas of interest.

5.2 Recommendations

We make the following recommendations based on our results:

- A more detailed and regular analysis should be carried out to progressively study the rate and pattern of change.
- This project may be adopted and used as a source for planning and management in Lagos.
- Seminars and conferences should be organized locally to showcase the usefulness of studies such as this one and results and findings should be adopted as instruments for subsequent development and monitoring of activities within the study area.

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