iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** VIII **Month of publication:** August 2018

DOI:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue VIII, August 2018- Available at www.ijraset.com

An Evaluation of Urban Landcover Dynamics using Remote Sensing: A Case Study of Ibadan, Oyo State, Nigeria

Fatunmibi Olugbenga[1], Ogunjobi Gregory .A[2], Akeredolu Richard[3]
[1, 2]*Department of surveying and Geoinformatics*
[3] *Regional Centre for Training in Aerospace Surveys, Obafemi Awolowo University Ile Ife*

Abstract: This study examines the use of GIS and Remote Sensing in evaluating Land Cover in Ibadan between 1972 and 2006 so as to detect the changes that has taken place in this status between these periods. Subsequently, a projection into 2072 was done using Marcov Chain Model, which is a projection mode. In achieving this, Land Consumption Rate, Overlay, Cross-tabulation operation were introduced to aid in the quantitative assessment of the change. The result of the of this study showed a rapid growth in Less dense built-up land between 1972 and 1984 while the periods between 1984 and 2000 Bare surface land Witnessed rapid growth in this class. It was also observed that changes follow this same trend till 2006. Marcov was used to projected 2006 for the purpose of validation. The projected was then compared with the 2006 LandSat Classified image. This model was then used in projecting till 2072. Suggestions were therefore made at the end of the study on ways to use the information as Contained therein optimally.
Keywords: Evaluation, Remote Sensing, GIS, Landuse/cover, and Marcov Chain Model

I. INTRODUCTION

Studies have shown that there remains only few landscapes on the Earth that are still in there natural state. Due to human impact on the environment, the Earth's surface is being significantly altered in some manner and man's presence on the Earth and his use of land has had a profound effect upon the natural environment. Thus this has caused an observable pattern variation in the land use/land cover over time [1]. The land use/land cover (LU/LC) pattern of a region is an outcome of natural and socio economic factors and their utilization by man in time and space [2] Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, information on LU/LC and possibilities for their optimal use is essential for the selection, planning and implementation due to increasing population. [3].

The driving forces behind the rapid urbanization in Africa today are the combination of rural-urban migration and natural increase within the towns and cities themselves. Ibadan is not in any way going contrary to this as the population has been more than tripled what it used to be before it became administrative headquarters of the state and local government. There is therefore an urgent need for accurate information on the trend of the changes in population growth over time. Remote sensing data, in conjunction with geographic information systems (GIS), have been recognized as an effective tool in quantitatively measuring of urban area and for modelling urban growth at a relatively large spatial scale, [4]. Lillesand et al 2004 [5] define Remote Sensing as the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area, or phenomenon under investigation.

Markov chain models have been used to model landscape changes in understanding and predicting the behaviour of complex systems [6, 7]

Every parcel of land on the Earth's surface is unique in the cover it possesses. Land use and land cover are distinct yet closely linked characteristics of the Earth's surface. The term land cover originally referred to the kind and state of vegetation, such as forest or grass cover but it has broadened in subsequent usage to include other things such as human structures, soil type, biodiversity, surface and ground water, [8].

It is however undeniable that theorizing and modelling urban land use greatly help in simplifying complex urban systems for easy understanding, interpretation, comprehension and therefore management. The three best known theories of urban land use structure are: i. the concentric zone theory,(which states that cities tend to expand radially from the centre to form a series of concentric zones), ii. the sector theory (shows that the different income groups or classes in a city tend to live in district areas describable in terms of sectors of a circle around a city centre) and iii. the multi-nuclei theory [9] further contested that Nigerian urban centres are rather multi- centric rather than monocentric, that is, cities often develop around several distinct nuclei rather than one centre of origin, but Fabiyi agreed that in Nigeria, all cities apart from Abuja are organic in their origin. [10].

Satellite remote sensing has been demonstrated as a useful tool to capture data that are relevant for the analysis of urban landuse patterns .A remote sensing device records response which is based on many characteristics of the land surface, including natural and artificial cover. It is accurate for mapping due to ease of interpretation, it uses the element of tone, texture, pattern, shape, size, shadow, site and association to derive information about land cover. It is often believed that no single classification could be used with all types of imagery and all scales [11]. Remote sensing provides tremendous means and ways of classifying landuse land cover change due to the synoptic and repetitive coverage capability that can be used to identify and monitor changes at regional and global scales [12]. Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times [13]. Change detection is an important process in monitoring and managing natural resources and urban development because it provides quantitative analysis of the spatial distribution. Early Markovian analysis is used as a descriptive tool to predict land use change on a local or regional scale [14]. Three different Markov process models were developed for prediction, firstly solely from the changed area, without giving consideration to the spatial information around it. Secondly, the spatial neighbourhood information were considered, but with different strategies, while the other one applies the four nearest neighbour consideration only to the pixels under boundary condition. [15; 7]. Therefore, this study uses Remote Sensing and GIS techniques for landcover evaluation of Ibadan and environs for proper facilitation of landcover and map landcover of Ibadan using Satellite images of 1972, 1984, 2000 and 2006; and determine the trend and rate of landcover changes within the period 1972 to 2006 and also to predict changes in landcover in the future.

II. STUDY AREA

Ibadan city is located approximately on latitude 7^0 $15^{'}$ 00"N, longitude 3^0 $45^{'}$ 00"E and latitude 7^0 $34^{'}$ 00", longitude 4^0 $05^{'}$00" E of the Greenwich Meridian. The name 'Ibadan' emanated from "Eba Odan" literarily meaning 'near the grassland' [16]. This reflects its location on the fringe of the forest zone near the savanna. The landform units of Ibadan consist of hills, plains and river valleys at South Western Nigeria. It is characterised by two climatic conditions the rainy and the dry season with a mean annual temperature of 26.6°C, estimated annual rainfall of about 1250 mm, elevation varies between 160 to 275 metres high which made the city easily defensible from the wars. Areola, 1994 [17] estimated the total area of the city to be approximately 103.8 kilometres square. Ibadan covers Eleven Local Govt. Area.

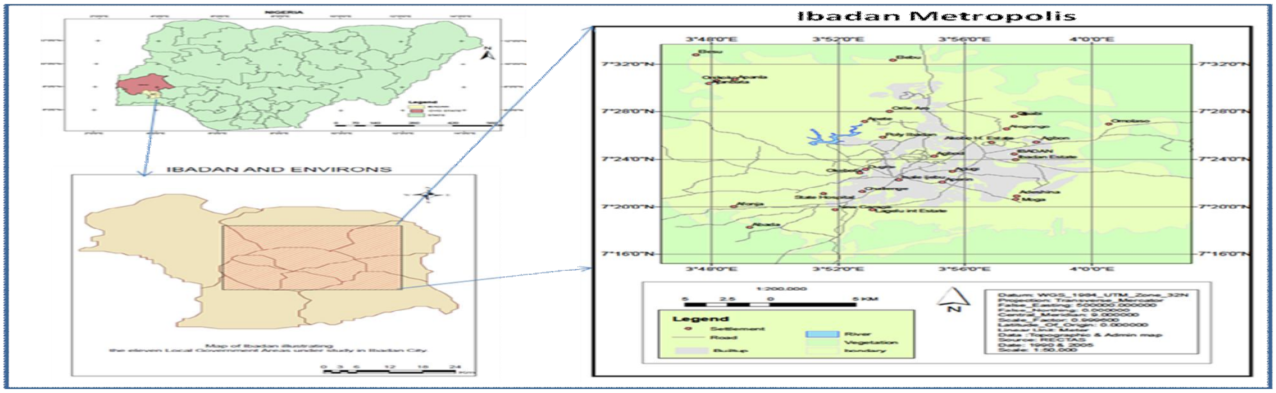

Fig. 1: Map showing the study area (Ibadan Metropolis)

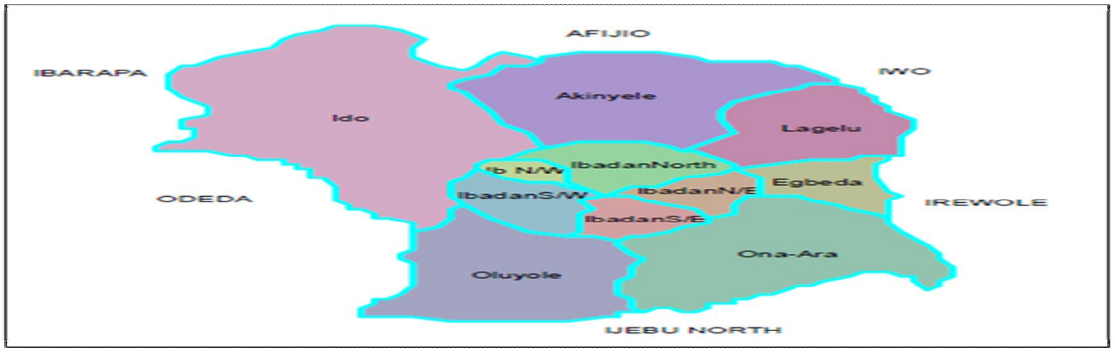

Fig 2: Showing the study area (Ibadan Metropolis).

III. METHODOLOGY

2006 satellite imagery was first mapped and analysed, and then (1972, 1984 & 2000) satellite imageries were evaluated for change detection. Other stages involved were Data preparation using ERDAS Imagine and IDRISI Software. The Landsat images (1972, 1984 & 2000) as well as the ETM (2006) image were geocorrected in ERDAS Imagine interface for radiometric correction of these images. Finally, maps showing landcover changes between 1972 to 1984 and 1984 to 2000 was also generated in ArcGIS software while Idrisi selva GIS software was used to generate the predictive map.

A. *Data acquisition*

Below describes the data that was acquired in the study

Table 1: showing data types and sources

Data	Source	Date	Resolution/ Scale	Relevance	Expected Result
Topo and Administrative map	RECTAS	1990	1:50,000	Base Map	Study Area Map
Landsat MSS TM,	GLCF	08/11/1972 18/12/1984	80m 30m	Land cover info	Land Cover Map
Landsat ETM+	USGS	02/06/2000 02/06/2006	30m	Land cover info	Land Cover Map

IV. RESULTS AND ANALYSIS

The objective of this study forms the basis of all the analysis carried out. The results are presented inform of maps, charts and statistical tables. Statistics assisted in identifying the percentage change, trend and rate of change between 1972and 2006. Percentage change can be calculated by dividing observed change by sum of changes multiplied by 100, base on classification, overlay operation and Markov chain analysis (when changes and processes in the landscape are difficult to describe)

$$\text{Trend or percentage change} = \frac{\text{observed change}}{\text{Sum of change}} * 100$$

In obtaining annual rate of change, the percentage change is divided by 100 and multiplied by the number of study year 1972– 1984 (12years) 1984 – 2000(14years)

All landscape spatial transition models can be expressed in a simple matrix equation as follows:

$$N_{t+1} = N \times P$$

Where Nt + 1 and Nt are vectors composed of the fractions of each landscape type at time t + 1 and time t, respectively; P is a square matrix, whose cell Pij is the transition probability from landscape i to j during times t and t + 1.

The transition probabilities P are derived from the landscape transitions occurring during some time interval.

A. *Discussion of result*

Table 2: showing Land Cover Distribution (1972, 1984, 2000 and 2006)

LU/LC Classes	1972 Area (km^2)	%	1984 Area (Km^2)	%	2000 Area (Km^2)	%	2006 Area (Km^2)	%
Vegetal Cover	1335.2090	93.05	951.3543	66.31	749.5677	52.24	544.6692	39.96
Water Body	7.1967	0.50	1.8073	0.13	1.9278	0.19	0.4392	3.02
Less Dense Built Up	81.5856	5.69	132.0320	9.20	220.7880	15.39	220.7880	15.39
High Dense Built Up	10.8061	0.78	12.2747	0.86	44.9100	3.13	67.2237	4.69
Bare Surface	-	0	335.4966	24.78	415.1619	28.94	598.3245	41.70
TOTAL	1434.7974	100	1434.7974	100	1434.7974	100	1434.7974	100

Statistics from the table above suggest that Ibadan city has a central growth and Less Dense built-up area, development fast springing up (5.69% to 15.39%) and spatial entities reducing vegetal cover(93% to 40%) between1972 to2006.

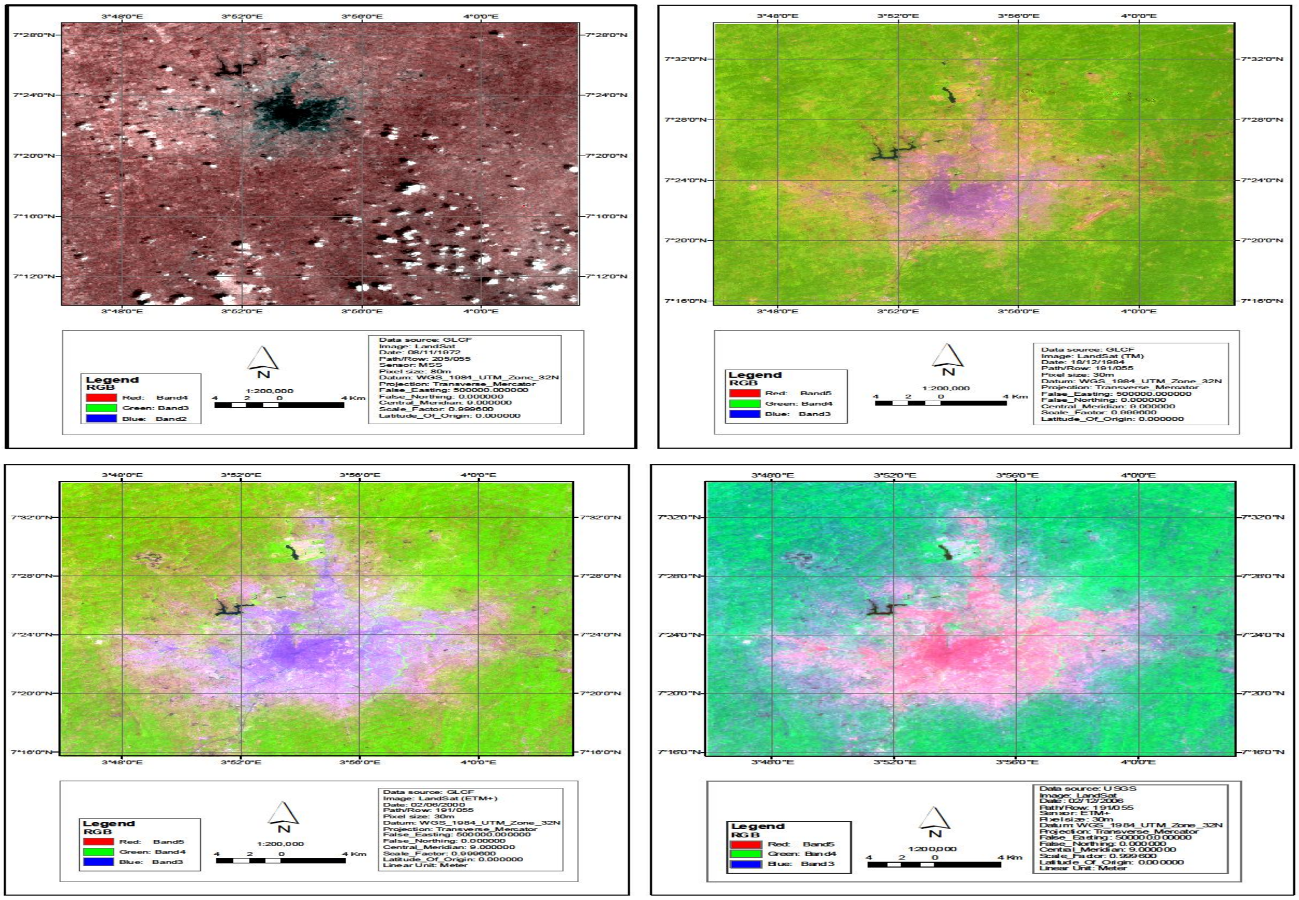

Fig. 3: showing subset (colour composite) of Landsat MSS 1972, 1984, 2000 & 2006 imagery

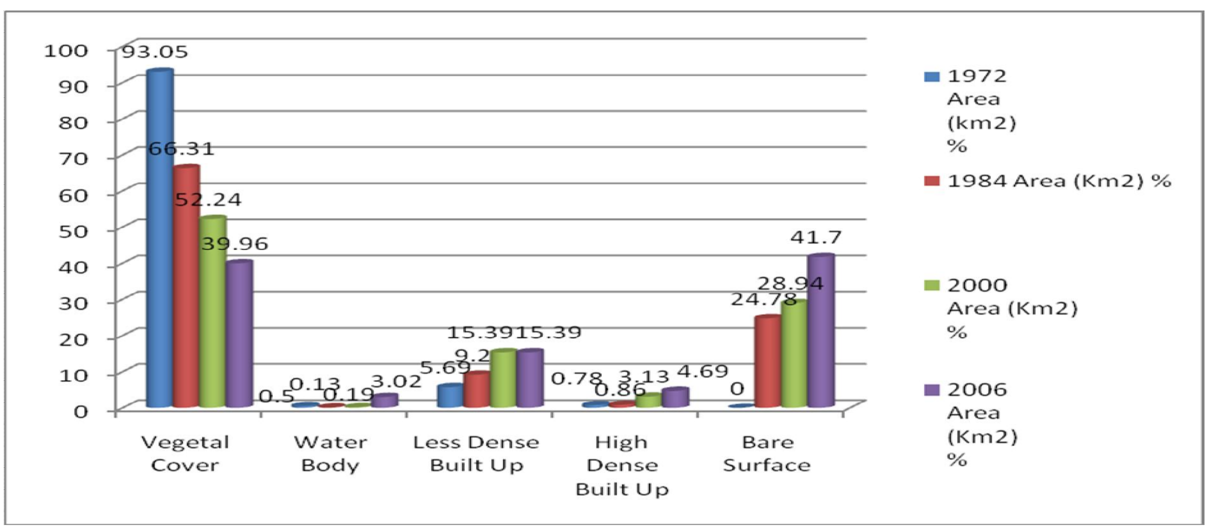

Fig 4: Showing Landcover bar chart from 1972 to 2006

Indeed, between the period of 1984 and 2000, there has been a reduction in the water body, compared with1972 and 1984. In 2006 the water body pick up again, therefore water body is not stable. This therefore suggest that the city has to be police against any indiscriminate development to avoid flooding

Table 3: showing Land Cover Projection Distribution (2010 to 2072)

LU/LC Classes	2010 Area(km^2)	2020 Area(km^2)	2030 Area(km^2)	2040 Area(km^2)	2050 Area(km)	2060 Area(km)	2072 Area(km^2)
Vegetal Cover	764.0847	778.6017	793.1187	807.6357	822.1527	836.6697	851.1867
Water Body	2.0232	2.1186	2.2140	2.3094	2.4048	2.5002	2.5956
Less Dense Built Up	217.3383	213.8886	210.4389	206.9892	203.5395	200.0898	196.6401
High Dense Built Up	44.4078	44.4078	43.4034	42.9012	42.3990	41.8968	41.3946
Bare Surface	404.5014	393.8409	383.1804	372.5199	361.8594	351.1989	340.5384
TOTAL	1432.3554	1432.3554	1432.3554	1432.3554	1432.3554	1432.3554	1432.3554

There is likely going to be crowdedness brought by compactness in Ibadan come 2020. This situation will have negative implications because of the associated problems of crowdedness like crime and easy spread of diseases. It is therefore suggested that there is need for proper planning so that Development will continuing outwardly without hampering. After the initial reduction in Bare surface land between 1972 and 1984, it may continue in this trend in till 2072. For this projection, it suggested here that a deliberate attempt should be made by the State government to achieve food security. The result also showed that the Provision of incentives and forces of attraction that are available at the city centre should be made available at outskirt of Ibadan because Less dense developed fast than High Dense build-up area.

V. CONCLUSION

This study predicts the future growth and examines the spatial pattern of urban landcover changes in Ibadan region using remotely sensed data and GIS techniques. With analysis, it is can be seen that many new developments had taken place, enabling the changes in the landcover to be dynamic and to generate outward growth of the city in all direction.

VI. RECOMMENDATION

Based on this study it is recommended that further studies make use of quantitative data (i.e. census data) instead qualitative data used. This will help provide insight to other various factors that have caused the landuse/landcover consumption

REFERENCES

[1] Zubair , Ayodeji Opeyemi, unpublished Research, change detection in land use and land cover using Remote sensing data and GIS, Pp1-2.Ilorin Nigeria, 2006
[2] N. K . Ndukwe, Principles of Environmental Remote Sensing and Photo Interpretation New Concept Publishers Enugu., 1997
[3] F. A. Adesina, W. O. Siyanbola, F. O. Okelola, D. A. Pelemo, L. O. Ojo, and A. O. Adegbulugbe, Potentials of agroforestry for climate change mitigation in Nigeria, some preliminary estimates. Glob. Ecol. Biogeogr. Lett., 8: 163-173, 1999
[4] M. M. Yagoub, Monitoring of urban growth of a desert city through remote sensing: Al-Ain, UAE, between 1976 and 2000. International Journal of Remote Sensing, 25, pp. 1063–1076, 2004
[5] T. M. Lillesand, R. W. Kiefer and J. W. Chipman, Remote Sensing and Image Interpretation. Fifth Edition. John Wiley & Sons Inc., New York, 2004
[6] W. L. Baker, A review of models of landscape change. Landscape Ecology, 2, pp. 111–133, 1989
[7] Q. Weng, Landuse Change Analysis in the Zhujiang Delta of China using Satellite Remote Sensing, GIS and Stochastic Modeling. A paper published in Journal of Environmental Management (2002) 64, 273–284. http://www.idealibrary.com (Last Accessed 06/04/2012, 2002
[8] Meyer, W.B. (1995). Past and Present Land-use and Land-cover in the U.S.A. Consequences. p.24-33, 1968
[9] A. L. Mabogunje, Urbanization in Nigeria.. University of London Press, Londo, 1968
[10] O. Fabiyi, Colonial and post colonial architecture and urbanism in Nigerian urban history, past and present. Edited by Ibikunle H. University Press of America, pp: 141-164, 2005
[11] J. B. Campbel, Introduction to Remote Sensing. 3rd Edition. The Guildford Press.New York. London, 2002 311–316, 1974
[12] H. Briassoulis, Analysis of Land Use Change: Theoretical and Modeling Approaches. The Web Book of Regional Science. www.rri.wvu.edu/WebBook/ Briassoulis/chapter4 (models6).htm -109k (last accessed 01/07/2012)., 2000
[13] A. Singh, Digital Change Detection Techniques Using Remotely Sensed Data. International Journal of Remote Sensing. Vol. 10, No. 6, p. 989- 1003, 1989
[14] E. J. Bell, Markov analysis of land use change: an application of stochastic processes to remotely sensed data. Socio-Economic Planning Sciences, 8, pp., 1974
[15] M. R. Muller, J. Middleton, A Markov model of land-use change dynamics in the Niagara Region, Ontario, Canada. Landscape Ecology, 9, pp. 151–157, 1994
[16] C. O. Ikporukpo, Perspective on Ibadan Region: An Overview. Department of Geography, University of Ibadan, Nigeria. Rex Charles Publication Ibadan. , 1994
[17] O. Areola, The Spatial Growth of Ibadan City and its Impact on the Rural Hinterland Rex Charles Publication. Ibadan, 1994