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Abstract- In this study, a maximum likelihood supervised classification and post - classification change detection techniques were applied to Land Sat images acquired in 1986, 2002 and 2012 respectively to map Federal University of Technology (FUTA), Akure changes in Ondo state, Nigeria. The study employed surpervised digital image classification method using ILWIS 3.2, Arcview 3.1 GIS software and classified the Landuse into Built-up Area. Bareland. Dense forest, Exposed soils, Gallery Forest, Light Forest, Forest Reserve and Rock out crops. The results obtained shows that the Built-up area has been growing rapidly for the periods (1986-2012). The result also shows increase in the Bareland and Rock-outcrop between 2002 and 2012 while dense forest, forest reserves, Gallery forest and light forest decreased rapidly for the period (1986-2012). Adopting exponential growth formulae, the rate of change for projecting spatial expansion and landuse types and project the growth and landuse of Federal University of Technology (FUTA), Akure to year 2032. These results could help the city planners and policy makers to attain and sustain future urban and institutional development.

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I. INTRODUCTION

and cover is the combination of vegetation, soil, rock, water and human-made structures, which make up the earth's landscape, influencing the exchange of energy and matter in the climatic system and biogeochemical cycles (Chen et al., 1998). Land cover change is significant to a range of themes and issues central to the study of global environmental change has an important influence on hydrology. climate, global biogeochemical cycles and human activities (Flamm et al, 1991; Flamm, 1992; Kirchhof, 1995). These diverse roles have been recognized in a large number of research publications and international conferences, symposia, and workshops devoted to the subject over the past few years (e.g America Institute of Biological Sciences, 1994; Thom, 1994; Meyer and Turner 1994) as well as the United Nations' Agenda 21 (UNCED, 1992).

Land cover pattern of an area is an outcome of natural and socio–economic factors and their utilization by man in time and space. Information on spatial expansion/land cover (natural landscapes) and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. (Zubair, 2006). This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population. It is actually a fact, that rapid urbanization brings opportunities for new urban (land use) developments (Oyinloye, 2010).

Several studies have been conducted with the integration of remote sensing and geographic information systems to analyze and monitor land cover changes. Musaoglu, et al, (2002) merged the remotely sensed data with geocoded information. This was achieved by first classifying the images, applying 5*5 neighbor hood functions, then transforming the results into vector layers. The layers were imported into GIS environment for area analysis.

Similarly, Zhi-Yong Yin, et al (2005) used image processing and analysis in a GIS environment to access spatial changes in urban land use pattern and population distribution. Here, unsupervised classification 2014

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was used to classify the image into land use classes. With census data in a GIS, census polygon was constructed into various sets of units, and then comparison made with the classified image population in surface areas. In his studies carried out by 2004 in Shaoxing City in China using satellite imageries for the year 1984, 1997 and 2000, in which one of the goals of the study was to produce a landuse map of shaoxing city and its surroundings, the result shows that there are undoubtedly a lot of changes that occurred between 1984 and 1997 when compared with those of 2000, due to sufficient time gap. From the study, it was observed that residential area development was mainly at the expense of agriculture land use.

In the West African forest region, cities developed among the Yoruba, Fulani, and Hausa people as well as in the Ashanti and Benin kingdom. As well as being commercial and political centers they worked as spiritual centers. The Nigerian city of Lagos had 665000 inhabitants in 1963 (Rakodi, 1997) and 8.7 million in 2000 is expected to become the worlds' 11th biggest city by 2015 with 16 million inhabitants (UN, 2002). The urbanization of most of Africa countries is moving fast forward, especially south of the Sahara. As a country develops from primarily an agricultural to an industrial economy, large-scale migration of rural residents to towns and cities takes place.

In Federal University of Technology Akure, speedy urbanization took place in the last two decades due to population growth of students and staff which has been attributable to the increase in population of the host city of Akure and catchment areas and is still going on (Olisa, 2012). Spatial developments are no longer following a controlled and sustainable pattern due to lack of development plans. Meanwhile, the pressure of horizontal expansion that had started for years has continued to increase till this period in Federal University of technology Akure and its environs. This could sometimes be seen as socio-physical developments which consequently have effects on the natural landscapes. While these social issues affect the study area, their impact on vegetation distribution and composition are harder to estimate. The extent of this development is however deemed to be monitored in order to guide decision makers on the distribution of facilities/infrastructures and also to ensure that the growth is compatible with the concept that embraces Environmental Sustainability.

The aim of this paper therefore is to use the application of remote sensing and GIS approach to monitoring spatial expansion of Federal University of Technology, Akure with a view to determining the pattern of landuse/ landcover changes and its implications on the study area. The objectives are to;

i. identification of various landcover and landuse classes in remotely sensed data sources;

- ii. determine the spatial extent and the impact urban growth on the rural surroundings.
- iii. examine the major determinants of spatial expansion and land use types and the rate of urban growth in FUTA and its surrounding areas; and
- iv. examine relationship between urban (population) growth and spatial expansion / landuse type.
- v. adopt the exponential growth formulae;

Af = Ab(1+%/100) f-b, (where A is the future, b is the base year and % is the rate of change for projecting urban expansion and landuse type) to project the growth and landcover change of the study area to year 2032.

II. Study Area: Futa and Environs

Akure is the host town of the study area 'Federal University of Technology, Akure (FUTA)' a protected academic area. It is geographically geo-referenced on coordinate lines of 734393E, 808614N on the western flank and 737291E, 806714N on the Eastern flank of meridians. Down to the south is Aule Community; up in its north is Ipinsa Community Lands interpose by Akurellesa Express way, on the west Ilara and Ibule settlements while to the east is southern part of Akure Metropolis in Akure South Local Government Area in Ondo State, Nigeria; all these areas are made up of FUTA environs (see Figures 1 and 2).



Figure 1 : High Resolution of FUTA showing Landuse/ cover of the Study Area *Source : http://www.@googleearth.com*



Figure 2 : Satellite Imagery of FUTA and Its *Environment Source: http://www@googleearth.com*

III. DATA ACQUISITION AND METHOD

As a pre-processing step for both 1986 Thematic Mapper, 2002 Landsat ETM+ and 2012 Quick bird on Time Series images were geometrically corrected and ground control points obtained through intensive ground surveys permitted the co-registration of all images to a Universal Transverse Mercator (UTM). The satellite images: the Thematic Mapper (TM) of 1986, the Enhanced Thematic Mapper of 2002 (ETM⁺) and Quick Bird of 2012 were made to pass through process of image enhancement, geo referencing, resampling, image classification and digitizing.

Moreover, in order to produce landuse/land cover maps of 1986, 2002 and 2012, maximum likelihood supervised classification was performed on reflective bands (bands 4, 5 and 7) into the following 8 landuse/landcover classes; Urban (Built-up), Dense Forest, Bareland/Cultivation, Exposed Soil, Forest Reserve, Gallery Forest, Light Forest and Rock Outcrop. Information collected during the field surveys combined with the digital topographic map was used to assess the accuracy of the classification.

IV. Results and Discussions

Figures 3, 4 and 5 showed the results of the various processing itemized for the Landsat TM and Enhanced Thematic Mapping (ETM^+) data sets. Also, tables 1, 2 and 3 showed the statistical results of the classification of the data set.



Figure 3 : Classified Landuse Landcover Change Map of FUTA and Its Environs in 1986

Table 1 : Statistical Result of Landuse Landcover Map of FUTA and Its Environs in 1986





Figure 4 : Classified Landuse Landcover Change Map of FUTA and Its Environs in 2002

Table 2 : Statistical Result of Classified Landuse Landcover change map of FUTA and Its Environs in 2002



Figure 5 : Classified Landuse Landcover Change Map of FUTA and Its Environs in 2012

Table 3 : Statistical Result of Classified LanduseLandcover Change map of FUTA and Its Environs in2012



A supervised classification was performed on reflective bands (bands 4, 5 and 7) into the following 8 landuse/landcover classes; Urban (Built-up), Dense Forest, Bareland/Cultivation, Exposed Soil, Forest Reserve, Gallery Forest, Light Forest and Rock Outcrop. The classification results of Figures 3, 4 and 5 however showed remarkable differences as evidenced on Tables 1, 2 and 3. On comparing the figure 3 and table 1 it was observed that densed forest covers the largest land area of 13,540 hectares (55%) of the total land area of study. Bare land/Cultivation covers 4888.125 hectares (20%), while, built-up area was 1161.67995 hectares (4.79%) of the total land area of study in 1986. This information reveals that people had not tampered with vegetative covers in terms of agricultural landscapes and natural vegetation. Construction/land use development was bare minimum.

Figure 4 and table 2 shows that almost all classes are changing to one another but more built-up, significantly to light forest and bareland/cultivation followed by exposed soil. Forest reserve disappeared in after 16 years, having lost to light forest which has landcover increase of 457.07 hectares to compare to 1986 land cover figures. Bare land/Cultivation class has a short fall of 1836.76 hectares, while, built-up area class increased in landuse size to 2771.28 hectares (11.39%). This result indicates that green covers are gradually disappearing thus posing threat to biodiversity in 2002.

In 2012 expansive Built-Up area is more pronounced than what it was in 2002. Though, forest reserve had disappeared but light forest keeps increasing as dense forest is rapidly losing to light forest. In figure 5 and table 3, dense forest had decreased to 1102.41 hectares (4.47%), light forest 7259.35 hectares (29.41%), Bare land/Cultivation had increased to 9498.49 hectares (38.48%). This has been attributed to government intervention on campaign for agricultural practices such as Fadama programmes, campaign for tree planting across the world and particularly in Nigeria. Between 2002 and 2012, dense forest lost 88.96% of its land cover to light forest.

a) Percentage Ratio of Landuse/Landcovers of the Study Area

In order to determine the percentage ratio of the land use land cover of the area of study, all the 8 classes are grouped into two class categories. Built-up area, Exposed soil and Rock Outcrops are categorized as Landuse, while Bareland/Cultivation, dense forest, Forest reserved, gallery forest and Light forest are categorized as land covers.

Comparing the landcover areas to the landuse area ratio in percentage for each year 1986, 2002 and 2012 as shown in figure 6, it appears that large percentage of the area of study is still covered with green vegetation. As can be expected, the percentage of the forest cover declines with drier conditions and differences are quite obvious.





Hence, from figure 6, in 1986, 84.86 percent of the study area are forested in its tropical monsoon; in 2002, the vegetative area declines to 79.04 percent still in its tropical monsoon, while, in the year 2012, 73.12 percent is recorded for vegetation covers. In other word, the vegetation areas are becoming dry zones together as existed canopy and dense forests had gradually lost to Light and gallery forests. It is of note that light and gallery forest are also giving way for construction and other human activities while reclaiming land areas as substitutes from reserved and dense forest. The figure 6 indicates that as land cover decreases in percentage, landuse increases annually at 0.5% growth rate, implying an annual increase of 123.41 hectares of land gain to various urban landuse developments.

From the figure 7, the exponential function of Spatial (Built-Up) areas of the study area gives the following equation: Y=1E-16e0.0225x and $R^2=0.9952$

Within the 1986-2002, the increase in spatial expansion was 1425.45ha. (14254.5sqkm) that is 39% increase; the increase was 1534.2ha (15342.0sqkm) that is 30% landuse increase between 2002 and 2012. The percentage fall in this increase has been attributed to campaign on trees planting and promotion of agricultural production programmes such as FADAMA and landscape developmental crusade in Nigeria.



Figure 7: Exponential Function of Built-Up Areas of the study area from 1986 to 2012

b) Change Matrix

Change Matrix involves coding and assigning each landuse land cover type, overlay each other and subtract initial year landuse land cover data from land value of absolute year. Ko Ko Lwin, (1996).

i. Change Matrix from 1986 to 2012

An important aspect of change detection is to determine what is actually changing to what, that is, which landuse is changing to the other. Location of change can be accessed from the overlay map whereby both year of study's image were overlaid to see what has changed. Change matrix is a useful tool to vividly express the changes of a particular class and in what class the change absorption is taking place (Ko Ko Lwin, 1996).

As shown Figure 5 almost all classes are changing to one another but more significantly to builtup, followed by light forest and Bareland/Cultivation.

Table 4 : Coded Landuse Land cover type in two
classification images

1986 classified Image	Code	2012 Classified Image	Code
Bareland/Cultivation	20	Bareland/Cultivation	39
Built-Up Area (Landuses)	5	Built-Up Area (Landuses)	16
Dense Forest	56	Dense Forest	5
Exposed Soil	0	Exposed Soil	2
Forest Reserve	3	Forest Reserve	0
Gallery Forest	5	Gallery Forest	1
Light Forest	2	Light Forest	29
Rock Outcrop	10	Rock Outcrop	10

The output values are between -55 to 56 according to their change categories are shown in table 4.

æ	2012 LAND USE LAND COVER CHANGE MAP								
YEA	CLASS	Bareland/ Cultivation	Built-Up Area (Landuses)	Dense Forest	Exposed Soil	Forest Reserve	Gallery Forest	Light Forest	Rock Outcrop
Æ	Bareland/ Cultivation	19	-4	-15	-18	20	-19	9	-10
AND COVE	Built-Up Area (Landuses)	34	11	0	-3	5	-4	24	-5
	Dense Forest	-17	40	51	-54	56	-55	-27	-46
ISE I NGE	Exposed Soil	39	16	5	2	0	-1	29	10
U CHA CHA	Forest Reserve	36	13	2	-1	3	-2	26	-7
° LA	Gallery Forest	34	11	0	-3	5	-4	24	-5
198	Light Forest	-37	14	3	0	2	-1	27	8
	Rock Outcrop	29	6	-5	-8	10	-9	19	0

Table 5 : Change Matrix from 1986 to 2012

Note : the minus (-) signs indicate cell where class changes has taken place to another class type while positive sign indicates no change events.

The change categories are as follow,

- 1. Forest reserve reductions are: (Reserve forest to Light forest, Bareland/Cultivation, Built-up area)
- 2. forested Area (Dense forest to light Forest, Bareland/Cultivation to Forest)
- 3. Change to light forest (Every land cover type changed to light forest except gallery forest)
- 4. Change to Gallery forest (No land Cover type change to gallery forest but losing to built-up area)
- Change to Bareland/cultivation (Every land cover type changed to Bareland/cultivation except densed forest)
- 6. Change to Built-up area (Urban) (Every land cover type changed to built-up area except Bareland/cultivation)

- 7. Change to Exposed soil (No land type changed to exposed soil except light forest)
- 8. Change to Rock Outcrop (No land type changed to exposed soil except light forest)

For each sample, a change matrix has been produced from the interdependent interpretation of two satellite images; the historical image acquired in year 1986 and the recent one acquired this year 2012.

The table below shows spatial prediction of 20 years taking cognizance of the exponential functions. Recalling the formulae:

$$Af = Ab (1 + \%/100) f-b).$$

Area HaY0	Perc	2032	Comments/Hemarks
9498.49	21.13	49639.11	40140.62 hectares gain from dense forest, light forest and Gallery forest
3844.79	3.83	6789.90	2945.11hectares gain precisely from Bareland/ Cultivation class
1102.41	-8.89	-3062.50	Dense forest has completely lost to light, then to Bareland/Cultivation with negative sign equivalent to nothing but zero.
446.91	83.34	7896.00	7449.09hectares of land has been exposed due to construction, quarry, mining and other physical developments
0	0	0	Zero forest reserved is experienced.
188.72	7.84	-484.63	There is tendency that the gallery forest would have
			totally given way for Cultivation /farming activities like FADAMA Projects.
7259.35	3.65	7260.35	Light forest almost disappearing.
2342.17	0.27	2468.65	Rock Outcrop remains slightly unchanged due to low rate of industrial exploitation and mining.
	Area HaY0 9498.49 3844.79 1102.41 446.91 0 188.72 7259.35 2342.17	Area HaY0 Grow Perc 9498.49 21.13 3844.79 3.83 1102.41 -8.89 446.91 83.34 0 0 188.72 7.84 7259.35 3.65 2342.17 0.27	Area HaYO Grow Perc AreaHaY2O 2032 9498.49 21.13 49639.11 3844.79 3.83 6789.90 1102.41 -8.89 -3062.50 446.91 83.34 7896.00 0 0 0 188.72 7.84 -484.63 7259.35 3.65 7260.35 2342.17 0.27 2468.65

Table 6 : Exponential prediction of land use land cover change for 20 years

Where:

- Column AreaHaY0 contains the areas in hectares for each land use/land cover class in year 0.
- Column GrowPerc contains growth rates per year.
- Column AreaHaY20 contains the areas of the land use/land cover classes after 20 years

V. Implications of Spatial Expansion in Federal University of Technology (Futa), Akure

Indeed, between the period of 2002 and 2012, there has been rapid increment in the spatial expansion of the study area compared to the period between 1986 and 2002. There is a possibility of continual increment in this area over the next 20year. This may therefore suggest that land covers are continually disappearing in the study area. This would have impacts on a wide range of environmental and landscape attributes including the quality of water, land and air resources, ecosystem processes and function, and the climate system itself through greenhouse gas fluxes and surface albedo effects (Goodchild (2002). Continuous global warming and destruction of bio-diversities in the ecosystem will definitely become the order of the day.

There have been several house owners who have converted their residential units to student hostels without considering regular space standards. Open space and setbacks to road have been considered good areas to build more hostels and commercial shops. The result of this is upsurge of urban slum around a protected academic area.

There is likely going to be over crowdedness brought by compactness in and around FUTA come year 2032. This situation will have negative implications in the area because of the associated problems of complexity of urban land use such as crowdedness like crime, poor housing, poor socio-economy and easy spread of diseases. Surrounding areas of FUTA will contain the poorest segment of the urban population, notably first generation immigrants living in the lowest housing conditions.

VI. Conclusions

This paper employed the use of remote sensing, Geographic Information System and Spatial Statistics in monitoring spatial expansion of Federal University of Akure (FUTA). Attempt was made to capture as accurate as possible eight land use/ land cover classes as they change through time, the eight classes were distinctly produced for each study year but with more emphasis on built-up land as it is a combination of anthropogenic activities that make up this class; and indeed, it is one that affects the other classes. In achieving this, Land Consumption Rate, Land Absorption Coefficient and Change Matrix were introduced into the work.

However, the result of the work shows a rapid growth in built-up land between 1986 and 2002 while the periods between 2002 and 2012 also witnessed a reduction in this class. After the initial reduction in farm land between 1986 and 2002, the study area has witnessed a steady growth of land use development culminating to great decrease in farmlands, forest reserve and dense forest. In 2012, the result showed that there was great loss of agricultural lands, and it may continue in this trend in 2012 to 2032 all things being equal. Therefore in order to enhance the functionality of the institution and to reduce its social problems, the following recommendations should be given attentionthere is need to encourage urban agriculture to create a sustainable environment. maintain quality of environment, create employment, and provide much food and aesthetics to serve as additional economic nutritional base. It becomes imperative for the institution and Federal government to make sure that farming and urban agriculture are encouraged since this will lead to food security and more importantly, it will be a source of revenue to the institution. Forest land has been steady in reduction between 1986 and 2002, thus signifying a desirable change and indeed; if this moderate change reduction in forest land observed in-between 1986 and 2002 is upheld to be for next 20 years, effects of global warming on our environment will be negligible. Securing plan approval will reduce uncoordinated building arrangement in our environment and reduce slums. Emerging development taking place around Federal University of Technology Akure 'a protected academic environment' can be checked with this measure. There need to generate digital database is for landuse/landcover spatial change. Geographic information on spatial change and other geographic data can be stored and accessed for policy decision making. This will serve as a brain box for policy makers not only in physical and urban planning but for other professions.

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