Global Journal of Environmental Science and Technology: ISSN-2360-7955, Vol. 5(1): pp 423-431, February, 2017.

Full Length Research

The Dynamicity of Land Use in Ika Local Government Area of Akwa Ibom State, Nigeria

Okpiliya, F. I., (Assoc. Prof), Enyiekere, S. I., Inah Okon and Ajom, S. K.

Department of Geography and Environmental Science, University of Calabar, Nigeria.

Corresponding Author's E-mail: fetiongokpiliya@yahoo.com

Accepted 25th February, 2017.

Globally, land has significantly changed from one form to another in the past few decades. This dynamic nature of land varies between the developed and the developing nations. The objective of this study was to analyze the changes in landuse in Ika Local Government Area of Akwa Ibom State. A spectral image data covering 2003-2008 and projected to 2012 was acquired for this study. A topo sheet of 2003 derived from an aerial photo, was collected from Akwa Ibom State Ministry of Lands and Housing. Also LandSat Imagery at 30m resolution was collected. The image interpretatation processes were carried out using Erdas Imagery 9.2 software. The two-way analysis of variance was used to test the hypothesis which states that there is no significant variation in landuse change during the study period. The result of the study indicated that between 2003 and 2008, forest changed by 154.57km^2, bush fallow (257.84km^2); farmland (1106.63km^2) , compound farmland (406.86km^2) and built up area (1409.43km^2). Between 2008 and 2012, forest changed by (40.93km^2), bush fallow (471km^2), farmland (268.51km^2), compound farmland (315.2km^2) and built up area (562.13km^2). Also, the result of the two-way Anova analysis revealed that there was a significant difference in land use change during the study period since the calculated value of 37.91 was greater than the table value of 16.32 at 0.05 level of significance.

Keywords: Dynamicity, Landuse, Resources, Agriculture, Map, LandSat, Imagery

INTRODUCTION

Land can be conceptualized in different forms. It is seen as the solid part of the surface of the earth which corresponds to part of a celestial body. In another way round, it is a ground or soil of a specific situation, nature or quality. Some authors see land as a portion of the earth's solid surface distinguishable by boundaries or ownership. To the agriculturist, land is a rural area characterized by farming or ranching. To the spiritualist, land is a "realm" a domain. The word land originated from the German "Landt", Middle Irish lann.

Essentially, land could be seen from two major perspectives: firstly, in a general form, it is referred to as primary input and factor of production, which is not consumed but without which no production is possible. It is the resource that has no cost of production and although its usage can be switched from a less to more profitable one, its supply cannot be increased. The term "land" includes all physical elements in the wealth of a nation bestowed by nature, such as climate, environment, fields, forests, minerals, mountains, lakes, streams, seas and animals. As an asset, it includes something that has to do with the ground such as buildings, crops, fences, trees and water. Above the ground, any component of land includes air and space rights and under the ground, it has to do with minerals, and even down to the centre of the earth. Perhaps the oldest form of collateral, land is still very attractive to lenders because it cannot be destroyed, moved or stolen or wasted. All a lender needs is the borrower's clean title to it.

Secondly, in accounting perspective, land is something owned for productive use and which is referred to as fixed asset account (not subject to depreciation due to its un-wasting nature) and is listed under the equipment, land and plant sub leading in a balance sheet. It is recorded at its purchase price plus legal and development costs (such as surveying, draining, excavation, filling and grading). Land held for

investment is listed under investments; a real estate firm, however, may list it under inventory.

Land is the pivot man's absolute existence. Sheng (1989) stressed this by asserting that through the past, in the present, and through the foreseeable future, land continues to be the foundation of our food supply chain which is a vital recurrent and capital resource of any nation. However, Vink (1975) observed that in most cases, because of the temporary high economic gains, man may not care about the effect of the use of which land is subjected. The need for putting land to optimum use through adequate and effective planning has never been greatly felt than at present when rapid population growth and urban expansion are making available land scarce (Akinbola, 2003).

Land use is subjected to varied notions. Food and Agricultural Organization (FAO, 1995) conceives of land use as the purpose for which land is employed by the local population inhabiting it. This conceptualization regards land use as the utilization of physical territorial space by the human population inhabiting it. According to Meyer (cited in Briassoullis, 2000), land use is the way in which, and the purpose for which human beings employ the land and its resources. Meyer's notion emphasizes culture as an attribute that shapes land use. Culture necessarily varies among societies and communities. The variation in culture manifests in peculiar land use system which can be associated with different culture across the world. According to Ellis (2007) land use is a set of activities undertaken by man which modify land surface processes such as biogeochemistry, hydrology and biodiversity of flora and fauna of an area. He extends the notion to include social and economic contexts within which lands are managed. The context includes subsistence versus commercial agriculture, rented versus owned land and public versus private land.

From a resource perspective, Lambin, Geist and Lepers (2003) maintained that land use is defined by the purpose for which humans exploit land cover. From the same perspective, Barbier (2001) say, it is a series of operations and associated inputs on land, carried out by humans, with the purpose of obtaining products and benefits through using land resources. Land use is the end to which land is allocated, assuming a conscious decision to use it for a desired end. In the rural economy, land use patterns are governed mainly by the requirements of the agricultural industry which is important for the livelihood of the people. Human beings make use of land they inhabit to a degree unmatched by any other species.

Land use can be visualized as the various ways by which man utilizes the land resources at a given time period. In other words it has to do with series of operation on land carried out by humans with the intention to obtain product and benefits through using land resources. Land use generally is therefore, the primary indicator of the extent and degree to which man has made an impression on the earth surface. It reflects political, social and economic aspect of human culture and provides an index of the intensity of human lifestyle. (FAO, 2005; Meyer, 1995).

The land use and land cover of any particular region is an outcome of both natural and socio-economic factors and their utilization by man in time and space. Land is becoming a scares commodity due to immense demographic pressure and land use needs. Hence information on land use and land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use scheme to meet the increasing human population who depend on land for basic human needs and welfare (Zubair, 2006; Oyinloye and Kufoniyi, 2011). Land use is characterized by the arrangement, activities and input people undertake in a certain land cover type to produce change or maintain it (FAO, 2008).

According to Clawson (1965), landuse refers to man's activities on land which are directly related to the land. It describes how a portion of the earth's surface is used by man (such as for industry, habitation, agriculture etc). But Effiong-Fuller (2008) cited in Effiong (2011) defines land use in terms of syndromes of human activities such as agriculture, forestry and building construction that alter land surface processes including biogeochemistry, hydrology and biodiversity.

It has been discovered in recent past that land has continuously been dynamic in nature. That is, it has been subjected to changes from one form of use to another. It is based on this background that this study is undertaken in Ika Local Government Area so as to ascertain the nature of these changes in landuse in the area.

Objective of the Study

The aim of the study is to examine the effect of population growth on land use changes in Ika Local Government Area of Akwa Ibom State, Nigeria. Specifically, the objectives of the study include:

(i) To examine the relationship between population growth and land use change.

Study Area

Ika Local Government Area is an indigenous Local Government Area situated in Akwa Ibom State. It is bounded by Abia in the North, EtimEkpo Local Government Area in the South with Ukanafun in the East and EssienUdim Local Government Areas in the West. The area under study is located between longitudes 7^0 27' E and $7^0$37'E and Latitudes $4^0$56'Nand $5^0$05'N. Figures 1 and 2 present maps of Akwa Ibom State and Ika Local Government Area.

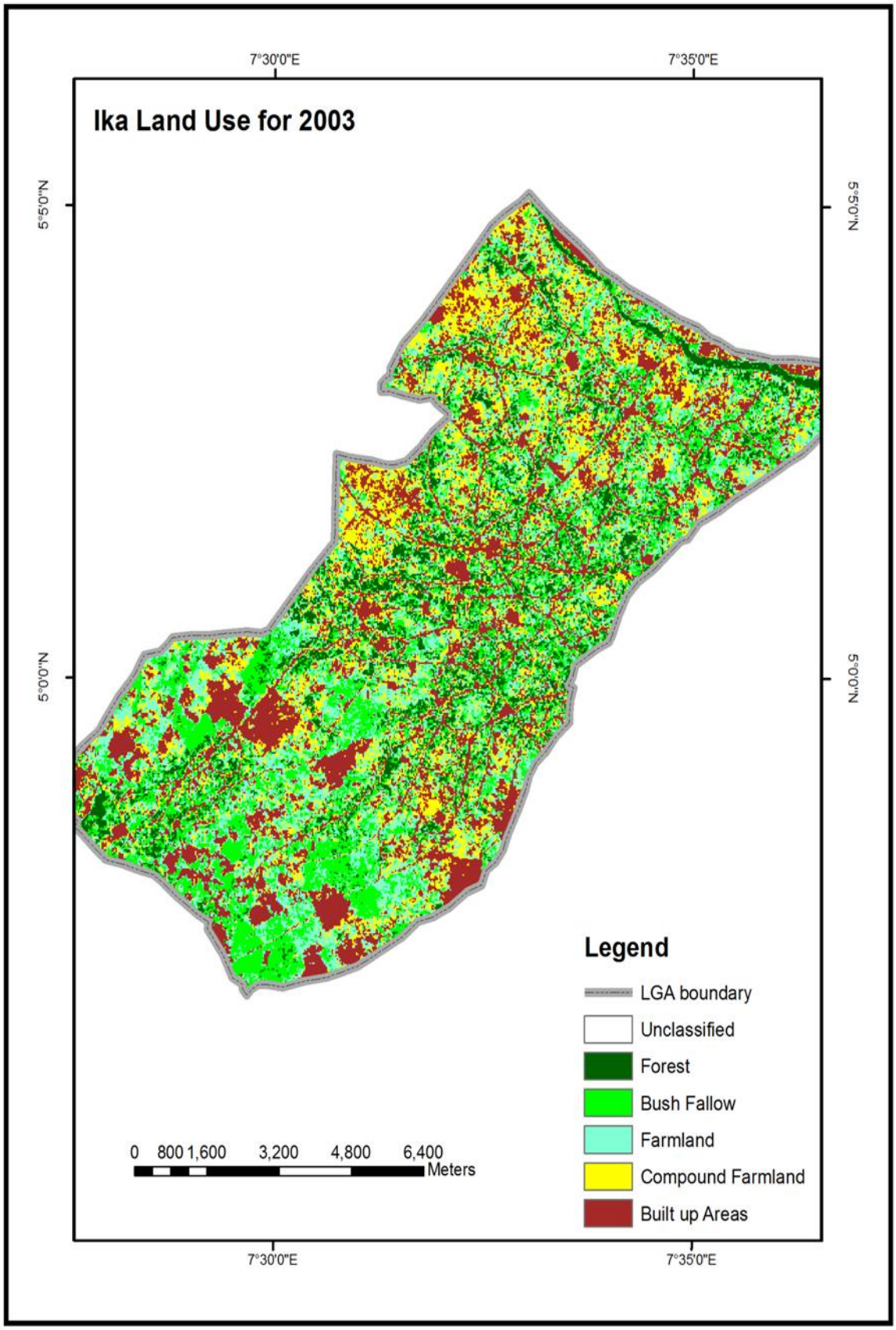

Figure 1: Map showing Ika Land Use for 2003

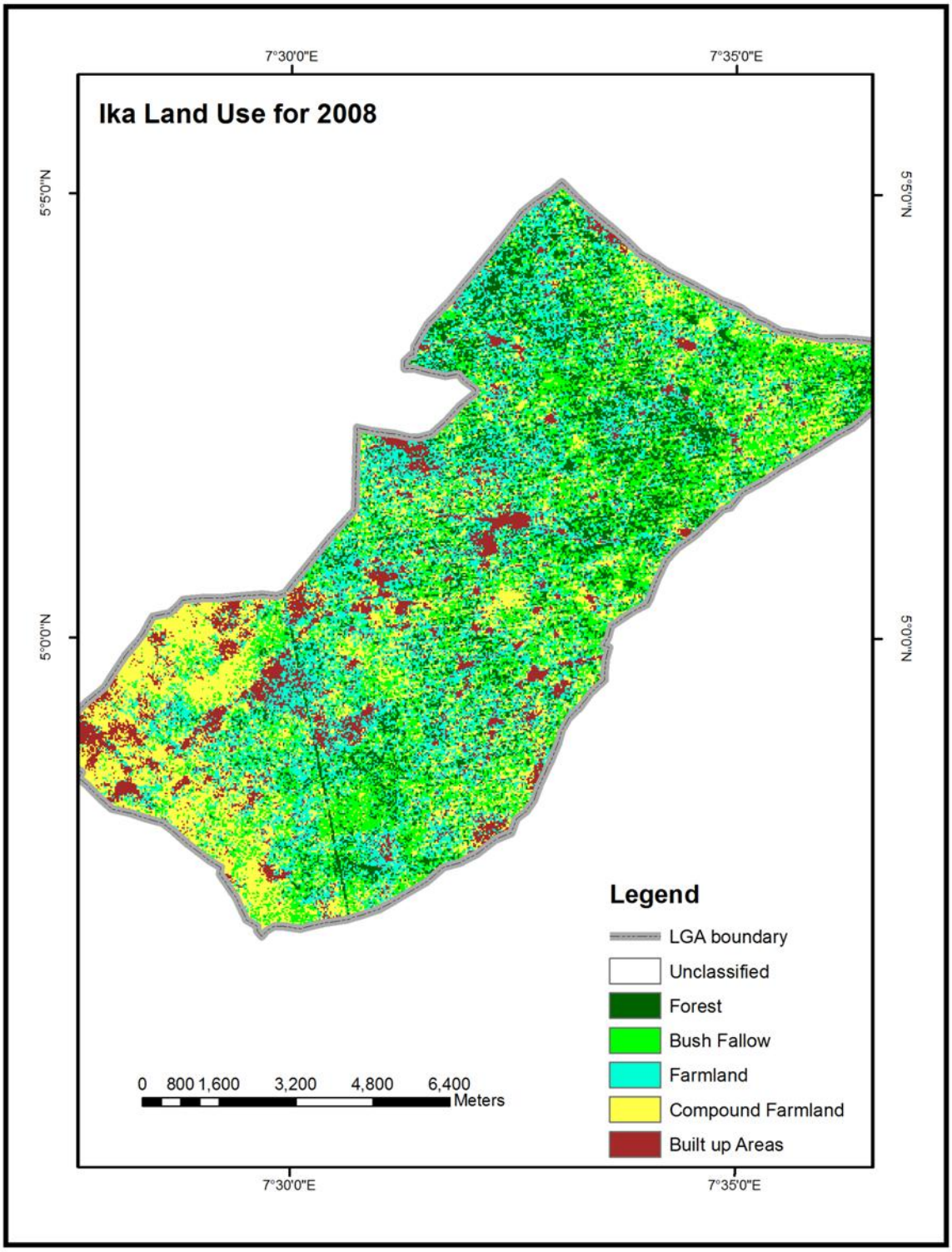

Figure 2: Map showing Ika Land Use 2008

Farming activities, hunting, and gathering of fruits is the mainstay of the people. The people of Ika Local Government Area practice shifting cultivation in a way that is quite typical for the indigenous people of the area (Johnson, 1983). Economic activities and food crops are cassava, banana, cocoyam, plantain, okra, yam, vegetables and palm plantations. Agricultural practice is dependently rain-fed in the entire area. Trading is another occupation of the people. The items engaged in the trade are mostly food items.

Ika Local Government Area of Akwa Ibom State is located within the sub-equatorial climate. This climate exhibits characteristic features of high temperature, rainfall and humidity because of regular sunshine. The hottest months of the year February to April coincide roughly with the passage of the overhead sun, with the coldest month, August having an average temperature of about 27^0C. The monthly distribution of rainfall shows April to July, interrupted by a short dry period in August and then another October. The rainfall variation is between 2500mm and 3000m (Akwa Ibom State Ministry of Agriculture Manual, 2004).

Ika Local Government Area has a total landmass of 113,600 square km, with estimated population of 45,414 in 1991 census (National Population Commission, 1991). In 2006, it increased to 72,772 a total of 36,996 were male and 35,776 were female in the entire local government area respectively (National Population Commission, 2007). Influx of migrants from other rural areas into Ika local Government Area and its environs is the major source of population increase posing serious changes on the landuse in the area.

The vegetation of Ika Local Government Area is basically that of the tropical rainforest zone, and thus consist forest vegetation. The soils in the area that is good for agricultural practices require adequate manure to provide good yield of crops.

The tropical rainforest is characterized by high species richness and diversity, though much of the original vegetation has been devastated by man for agriculture, housing, lumbering and for firewood. The vegetation is generally luxuriant due to abundant rainfall, sunshine and high relative humidity which promote perennial tree growth.

Within the forest are also plant species such as parasites, saprophytes, climbers and epiphytes. Where man has interfered heavily on the natural vegetation cover in the area, we find oil palm bushes and some forms of secondary succession plan plants replacing the original vegetation. Human activities have generally changed the original forest and most part of the forest areas are now undergoing secondary succession. The cultivation of trees crops such as oil palm, leak and Gmelina plantations has in some areas replaced the original vegetation and these now form a major part of the vegetation of the area. Trees are always relied upon to rebuild soils damaged and degraded by man's activities.

The physical relief of Ika Local Government Area is basically flat. However, there are places in Ito Clan and Odoro and Achan Clan that makes the entire Ika Local Government Area where the topography of the land is undulating with some areas as high as 200 feet above sea level. While in some areas are valleys, marshes and swamps.

In the coastal areas of Ika is very wide continental shelf extending some 200 nautical miles into the Atlantic Ocean. The area falls within four geological formations about four kilometers north of Ika Local Government linking Abia state and covering their entire north-western aspect of the local government area in the tertiary shales of Abia, River States and EssienUdim Local Government Area respectively.

However, there is coal measure that is hardly 1.3km^2 in the area. It is believe that more than 80% of the geological formation in the Ika Local Government Area is of the coastal plain sand.

Agriculture is the mainstay of the economy of Ika people. The people engage in subsistence agriculture, they cultivate both food crops and tree crops such as oil palm and cola nut and so on. Part of the land is forested and constitutes a source of timber for the area, and so lumbering is another economic activities. Most of the crops grown are food crops which are either grown for subsistence or for internal exchange. The crops are grown for local markets. The crops include yam, cocoyam, plantain, banana and cassava. Maize is widespread grains in the area and can be grown twice a year especially in fairly drained wet land area.

Oil palm and kola nut form the major cash crops of the area. These cash crops are sold within to the indigenous people who trade on them in small quantities and later processed them for export and these cash crops are owned by individual and once owned by the communities.

METHODS

A multi temporal image data covering (2003 – 2008) and projected to 2012 was acquired. Also a Topo Sheet (1989) derived from an aerial Photo, land landsat imagery at 30m resolution was collected within this period. These data sets were geo-referenced into a common framework in a GIS environment after being digitized and delineated into different landuse classes. Intersection operations of the above imagery were carried out to determine the changes in land use over the period of the study.

An existing land use/cover map of the area was also acquired from the Cross River Basin Development Authority. Large-scale aerial photographs of 2003 were also acquired from Akwa Ibom State Ministry of Lands and Housing.

Ika LGA, Akwa Ibom State is a part of the Cross River Basin located within the freshwater swamp forest belt of southern Nigeria. Extensive land use and vegetation mapping had previously been undertaken by the Cross River Basin Development Authority (CRBDA). In this work, reference was made to the land use and vegetation classification scheme which the Authority used when mapping the area in 1987. This scheme has been modified and simplified for the purposes of this study into five landuse/cover classes. They include compound farmland with trees, bush fallow, farmland, forest and built up areas.

All the image interpretation processes were carried out using Erdas Imagery 9.2 software, while change detection aspects were completed using the image Minus Algorithm of the mathematical Toolbox of the Spatial Analyst extension within ArcGIS 9.2 software. The mapping of the different land uses were completed exploiting the robust mapping capabilities of the same software. Erdas imagine was used due to its robust and advance image analysis functionalities, while the use of ArcGIS was prompted by its flexibility in spatial data handling and analysis (Ituen, 2008).

As a matter of fact, supervised signature extraction was adopted in conjunction with a maximum likelihood algorithm to derive classes from the images. Bands 4-3-2, which were found to be very useful in discriminating the land use classes, were combined for this purpose. Also, two forms of spatial analysis were undertaken: area calculation of the land use/cover for each year and post-classification change detection. While the former involves comparison of the LUC statistics derived from the classified images, the latter is an area-specific change detection procedure (point-by-point). With these two techniques, information on the nature, location, magnitude, trend and rate of change were highlighted. Weismiller (1977) considers this point-by-point method superior to other change detection techniques within image analysis systems. It also helps to maintain a finder control over the data sets (Jakubauskas, 1990), and offers greater flexibility in generating related classes of change (Adeniyi and Omojola, 1999 in Ituen, 2008).

After the images were classified the actual cartographic production of the land use/cover maps and generation of statistics for inventory was completed using ArcGIS 9.2. This also aids ease integration of data from many other sources.

To test hypothesis one, which states that there is no significant variation in landuse type in the study area over the years, the analysis of variance was used.

It has the form:

TSS = BSS + WSS

The model is given by

$$\sum_{j=j=i}^{Kn}\sum(xij - x)^2 = \sum\sum ni(xi - x)^2 + \sum\sum 1(xij)$$

Where = number of clans

n = number of observations in the samples

xij = value of the group on the observation

x = means for the sample

$\sum\sum$ = sum of all items in the matrix

$$F = \frac{MBS}{MWS}$$

Where

F = Sneadecor's Variable ratio

Degree of freedom for BSS, dFB = k – 1

Degree of freedom for WSS, dFW = n – k

$$MBS = \frac{BSS}{DF_B} \text{ or } \frac{BSS}{K-1}$$

$$MWS = \frac{WSS}{df_w} \text{ or } \frac{WSS}{n-k}$$

RESULTS AND DISCUSSION OF FINDINGS

From Table 1, it could be inferred that the total area of Ika is 11293.3km^2. Out of this, farmland occupied the highest area of 4045.65km^2, followed by compound land (2579.23km^2), bush fallow (2197.61km^2), forest (1534.83km^2) and finally built up area (935.88km^2).

As table 2 indicated, in 2008, farmland had the highest areal extent of 2728.22km^2, followed by bush fallow (2244.35km^2), built up area (2134.67km^2), compound land (2728.22km^2) and forest (1169.22km^2). Also see figure (2).

Table 3 shows land use area in 2012. As depicted on the table, farmland still maintained the highest areal expanse as in 2008 (2927.04km^2), followed by built up area (2628.85km^2), bush fallow (1704.84km^2), compound land 91579.18km^2) and finally forest (1060.92km^2) (see figure 3).

It is interesting to note that before 2003, Ika was plagued with communal clashes with the neighbouring areas and so because of the insecurity in the area, people migrated from the place. But between 2008 and 2012 when peace returned, there was influx of people back to the area hence, the need for farmland and a place to build. That explains why between 2008 and 20112, farmland and built-up area increased in size in the area.

As Table 4 indicated, built up area increased tremendously by 409.88km^{2,} followed by bush fallow and then compound farmland. On the other hand, forest decreased by 1106.33km^2 followed by farmland (154.51km^2).

As seen in table 5, the only land use type that changed positively was farmland. It changed by 268.51km^2. Other land use changed negatively; forest (40.93km^2), bush fallow (471km^2), compound farmland (315.2km^2) and built up area (562.13km^2).

Table 6 indicated the lanuse change between 2003 and 2012. From the analysis, built up area changed significantly by 1571.5km^2 followed by farmland (1374.8km^2. others were bush fallow (728.84km^2), compound farmland (733.06km^2 and finally forest (195.5km^2.)

Table 1: Land Use Area in 2003

Land use Type	Area (km^2)	Percentage
Forest	1534.83	13.5
Bush fallow	2197.61	19.4
Farmland	4045.65	35.8
Compound land	2579.23	22.9
Built up	935.88	8.4
Total	11293.2	100

Source: Author's Field Survey, 2012

Table 2: Land Use in 2008

Land use Type	Area (km^2)	Percentage
Forest	1380	12.0
Bush fallow	2455	21.6
Farmland	2937	26.6
Compound land	2173.5	19.0
Built up	234.67	20.8
Total	11293.2	100

Source; Author's Field Survey, 2012

Table 3: Land Use Area in 2012

Land use type	Area (km^2)	Percentage
Forest	1339.39	11.9
Bush Fallow	1983.31	17.6
Farmland	3205.51	28.3
Compound farmland	1857.10	16.4
Built-up	2907.8	25.7
Total	11293.2	100

Source: Author's Field Survey, 2012

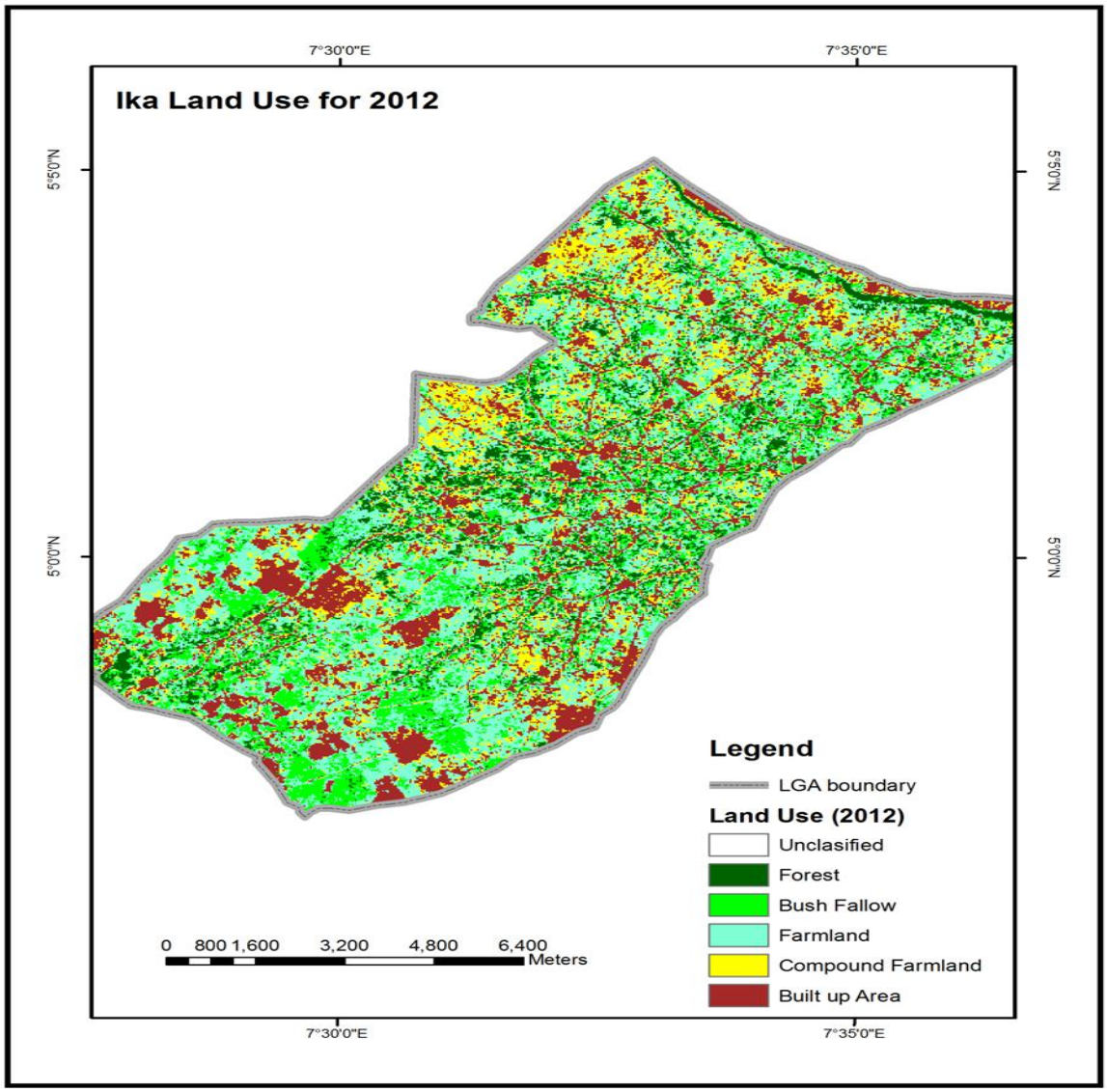

Figure 3: Map showing Ika Land Use for 2012

Table 4: The Rate of Landuse Change between 2003-2008

Land use Type	Land use area in 2003 (km^2)	Land use area in 2008 (km^2)	Change In (km^2)	Direction of Change
Forest	1534.83	1380.52	154.83	Decrease
Bush fallow	2197.61	2455.45	257.84	Increase
Farmland	4045.65	2939.32	1106.33	Decrease
Compound farmland	2579.23	2172.37	406.86	Decrease
Built up	935.88	2345.77	1409.88	Increase
Total	11293.2	11293.2	0.03	

Source: Author's Field Survey, 2012

Table 5: The Rate of Land Use Change between 2008 and 2012

Land use Type	Land use change in (km^2) IN 2003- 2008	Land use change in (km^2) 2008 - 2012	Total change in land use (km^2)	Direction of change
Forest	1380.32	1339.39	40.93	Negative
Bush fallow	2455	1983.31	471	Negative
Farmland	2937	3205.51	268.51	Positive
Compound farmland	2173.5	1857.10	315.2	Negative
Built up area	2345.67	2907.8	562.13	Negative
Total	11293.2	11293.2	136783	100

Source: Authors Field Survey, 2012

Table 6: The Rate of Landuse change between 2003-2012

Land use Type	Land use change bettween 2003-2008 (km^2)	Lland use change between 2008-2012 (km^2)	Total change in land use (km^2)
Forest	154.57	40.93	195.5
Bush fallow	257.84	471	728.84
Farmland	1106.33	268.51	1374.8
Compound farmland	406.86	315.2	722.06
Built up area	1409.43	562.13	1571.5
Total	3335	1657.7	4592.7

Source: Author's Field Survey, 2012

Table 7: Summary table of Analysis of Variance

Source of variation	Difference sum of squares	Degree of freedom	Variance estimate
Between samples	3738.28	2	1869.14
Within samples	9233.28	13	7102.52
Total	9237.18	15	7121.21

RESULT OF HYPOTHESIS

From the analysis, calculated value is 37.91, while the table value is 16.32. thus, since the calculated value is greater than the table value, we reject the null hypothesis at 0.05 level of significance and accept the alternate one. This is to say that there is a significant change or variation in land use type over the years in the study area.

CONCLUSIONS

It is suffice to conclude here that the manner in which land is being put into use by mankind has tend to alter the structure and functioning of the entire ecosystem. Spatially and economically, land is being put into use in various forms such as construction, building, resources, agriculture, recreation and or extractive industries. Thus, in the face of a teeming population, land invariably requires to be transformed from one form to another so as to provide for the expansion of food production. This may be achieved through forest devastation and the provision of infrastructures to cater for the teeiming population. In the study, there are basically five classes of land – forest, farmland, compound farmland, built up area and bush fallow. It was discovered that each of the land use type has been changing during the study period.

Contribution to knowledge

With the growing population of *homo sapiens* all over the world, there has been a corresponding need for more land to match up with this trend in the growing population. The quest for land by man has made it to be changing from one form to another especially as it is being used for several purposes such as construction, forest reserve, agriculture, recreation, tourism and transportation. This study was able to come out with the findings that between 2003 and 2012, land has constantly been changing between five major classes which include farmland, compound farmland. The change in each of these classes has been both positive and negative. This study also revealed that this change in landuse during the period under review has been significant at 0.05 level.

REFERENCES

Akinbola, G. E. (2003) *Changes in Land Use Pattern, Soil characteristics and potentials of agriculture in Ibadan Urban.* Unpublished Ph.D Thesis in the University of Ibadan, Ibadan – Nigeria.

Barbier, E. J. and Burgess, J. C. (1996) *Economic* Analysis of Deforestation of Mexico. *Evironment and Development Economic.* 2(2).

Briassoullis, H. (2000). Anlysis of Landuse change: Theoretical and Modelling Approaches. In Loveridge, S. (ed). *The web book of Regional Science:* Mgantown; West Virginia Univesity.

Effiong, J. (2011) Changing Pattern of Landuse in the Calabar River Catchment, Southeastern Nigeria. *In Journal of Sustainable Development.* Canada: Canadian Centre of Science and Education. Vol.4. No.1, February, 2011. p.91-101.

Ellis, E. (2007) Landuse and Landcover Change. In Cleveland, C. J. (eds). Encyclopedia of the Earth. Washington DC. Environmental Information Coalition, National Council for Science and Environment.

FAO, (1995) Planning for Sustainable use of Land Resources. FAO land and water Bulletin 2. Rome: Food and Agriculture Orgnization of the United Nations.

FAO, (2004) FAOSTAT on-line statistical service. Rome: Food and Agricultural Organization of the United Nation.

Ituen, U.; Whyatt, J. D.; Blackburn, G. A.; and Inyang, L. B. (2006) Landcover Change and Agricultural Practices in the Tropical Environment of Northern Akwa-Ibom State, Nigeria. In Implementation2006, Stata Lesna Slovakia of Landscape Ecology in New and Changing Condtions (Proceedings of the 14th International Symposium on Problems of Landscape Ecology Research 4 – 7th October, 2006, Stata Lesn Slovakia Institute of Landscape Ecology Slovak Academy of Sciences.

Jakurbauskas, M. E. (1990) Assessment of Vegetation Change in a fire-altered Foret Landscap. Photogrammetric Engineering and Remote Sensing 56(3), pp.371-377.

Lambin, E. F.; Geist, H. J. and Lepers, E. (2003) Dynamics of Landuse and Land cover change in tropical regions. *Annual Reviews of Environment and Resources.* 28(1): 205-241.

Meyer, W. B. (1995) *Past and present land use and landcover in the USA:* consequences, pp.24-33.

Oyinloye, M. A. and Kufoniyi, O. (2011) Analysis of landuse/landcover change and Urban expansion in Akure, Nigeria. *Journal of Innovative Research in Engineering and Sciences 2(4)* June 2011. Global Research publishing 2011.

Sheng, T. C. (1989) Soil Conservation for small farmers in the humid tropics. FAO soil Bulletin. Vol.60 FAO: Rome 1989.

Vink, A. P. A.(1975) Landuse, in Springer V. And Berlin, H. Fidelberg (*eds*). *Advancing agriculture.* New York.

Weismiller, R. A., Kristof, S. J., Scholz, D. K.,Anuta, P. E. And Momin, S. A. (1997) *Change detection in coastal zone environments.* Photogrammetric engineering and remote sensing, vol.43, pp.1533-1539.

Zubair, A. O. (2006) Chage detection in landuse and landcover using remoe sensing data and GIS: A case study of Ilorin and its environs in Kwara state. Unpublshed (Master's Thesis), University of Ibadan, Ibadan.