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LAND USE CHANGE EFFECTS ON ABA URBAN SPATIAL EXPANSION PATTERN

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ABSTRACT

Purpose: Land uses and Land cover, over time, have undergone changes due to various urban developmental activities, occasioned by socio-economic growth of an area. This paper attempted to examine land use and land cover change effects in Aba Urban.
Design/methodology/approach: To accomplish this Aba urban land use and land cover spatial change variables were obtained from satellite imageries of 2001 and 2010 epochs. The Area Analysis Technique was employed in calculating the area in hectare and percentages, while overlay method was used to identify the actual location, rate and pattern of change. Equally, paired Samples T-Test and Eta squared techniques were used to estimate the magnitude of effect as it is relatively independent of sample size.
Findings: The study among other things discovered that increase in land cover was occasioned by population growth, and increased need of land for various uses.
Originality/value: Hence, it is therefore recommended that the government of the state should initiate, prepare and implement master plan for the urban area to check the rate and pattern of the land use and land cover change.

Keywords: Urban land use; land cover; land use change; change effects; satellite imagery

1. INTRODUCTION

The use of land for residential, commercial, industrial, recreational, institutional, Agricultural, forestry, and other uses has modified the natural environment into built environment. These land uses over time have undergone changed occasioned by the socio-economic growth in Aba Urban. Therefore, the use of land by man has changed the structure and functioning of the natural ecosystems, thereby causing unprecedented changes in bionetwork and environmental process at various scales of time. They affect population, biodiversity loss; climate change, pollution of water, soil and air (Ellis, 2013).

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The change in structure and functioning of the ecosystems and environmental processes impact on the natural, economic, and social landscape, water quality, land and air resources, ecosystem process and function, climate, biodiversity, the ability of natural systems to support life (Abbas, Muazu and Ukoje, 2010; Igbokwe and Chigbu, 2011 and Ellis 2013). The sequences of these effects are deforestation, desertification and Stalinization, soil erosion and land degradation. Population growth and urbanization pressures force man to invade the undeveloped environment thereby tampering with the landscape and disturbing the natural habitat. Demographic and Scio-economic factors have had increasing pressure on the landscape of Aba Urban due to man's quest for food, water shelter and fuel.

Aba urban population growth is phenomenal due to rural-urban migration, commercial and industrial activities and of recent increase in educational – institutional land use development. The rapid growth and development contribute to land use change, population increase, urban economic developments, spatial urban form and related land used change with attendant effects (Abdullah, 2016).

The alteration of the earth's landscape from natural vegetation to any other land use activity results in habitat loss, environmental degradation, fragmentation and leapfrogging with devastating effects on biodiversity and the general environment of Aba at local level as well as regional or global scales. The conversion of land from one use to another is the greatest cause of extinction of terrestrial spaces especially deforestation that converts land from agricultural to other uses.

The advent of the Geographic Information System (GIS) has made it possible to monitor and manage rural and urban land use changes spatially. The GIS aids researchers to capture, manage, manipulate analyze model and display spatially referenced remote sensed data at different points in time.The GIS has been applied in several studies on land use change effect on urban spatial expansion (Oluseyi, 2006 and Angel, Et.al., 2011).

The rapid growth of Aba urban without development plan calls for the assessment of the urban spatial expansion as to detect the land use spatial change effects over a period of time 2001 and 2010.The objectives of the study was to identify the existing major land uses in Aba urban, to determine the extent of urban spatial land use changes in Aba urban and to determine the rate and pattern of urban land use spatial expansion in Aba Urban.

2. LITERATURE REVIEW

The study on land use and land cover change concern the human modification and conversion of earth's terrestrial surface (Chukwu, 2015). Man has been in the business of modifying and converting land resources to meet his insatiable need for generations. The extent, current rates, magnitude and intensities of land use and land cover changes are enormous. Man's use of land has changed the structure and functioning and patterns of the ecosystem, affected population, brought climatic change, loss of biodiversity, pollution of water, soil and air (Ellis, 2013).

Urban growth, concentration of people and activities in urban areas have led to unprecedented urban spatial expansion creating extensive urban landscapes. Many farm lands, wetlands, forests and deserts that formed the natural environment have been changed into human settlements over the years (United States Geological Surveys USGS. 1991). The USGS, reported that one hundred years ago, approximately 15% of the world's

population was living in the urban areas. In 1991 over 50% live in the urban areas and that last 200years, world population increased six times, stressing ecological and Scio-economic systems. Urban population has increased astronomically, concentrating more people on the land, which leads to urban spatial expansion.

The spatial expansion has its attendant effects of urban sprawl, loss of natural vegetable and open spaces and a general deadline in the extent and connectivity of wetlands and wildlife habitat and conversion of one lad use to another (like residential areas to commercial uses). Abdullah (2016), observed that changing population size and commercial needs often necessitate demand for land and change in land use and that pressure on land due to same changing population size leads to urbanization fives room for demand for housing, infrastructure and social services. According to Ellis and Pontius (2006) and Abba, Muazu and Ukoje (2010), human alteration of landscape from primary forested land to other uses, result loss of forest species or habitat, climatic change, degradation and fragmentation. All these have devastating affected on biodiversity.

The studies of (Oluseyi, 2006); Burchfield, Overman, Puga and Tunner (2006), (Angel *et.al*, 2011), (Hepps, 2011) among others applied GIS and remote sensing on assessing the impacts of land use and land cover change on urban land use spatial development in their localities. The studies noted that urban growth and expansion have increased built-up areas, decreased open spaces and contiguous areas and that growth is by succession and invasion. The authors in this paper intend to identify the impacts of land use change in Aba urban spatial expansion pattern with a view to making appropriate mitigative measures.

3. RESEARCH METHODOLOGY

The study area, Aba Urban lies between latitudes 5o05'N and 6 o 33'N, and longitude 7007'E and 8 015'E and covers about 38380.61 hectares. Aba is located on a transportation node where Port-Harcourt-Enugu railway lines meet with the Aba-Owerri-Ikot-Ekpene arterial route. The Port-Harcourt – Enugu Express way traverses the city on north to south direction while Owerri Road, IKot-Ekpene Road and Port-Harcourt Road divide the city in three parts in radial pattern. The growing population and socio-economic activities have exerted physical, social and economic influence on the land use mechanisms in the area. This growth has affected the land use and spatial structure of Aba urban.

The study employed the GIS technique in acquisition, processing and analysis of data. The Landsat images of ERDAS Imagine and ArcGIS software acquired from Federal College of Land Resources Technology (FECOLART), Owerri were used for land use classification for the two-time periods (2001 and 2010) in terms of metropolitan spatial changes. The Landsat image acquired from Natural Space Research and Development Agency (NARSDA) was digitised on-screen using ArcGIS 10.3 software. The features were digitised in layers, i.e. each group of features occupying each layer. For example, water body (Aba River) was digitised as a layer. The image as a result was first digitised, then ortho-rectified and geo-referenced. Four ground control points were established using Ground Positioning System (GPS) with an internalised coordinate system assigned and different data sets were extracted via digitizing. Polygonised imageries were classified using bilinear interpolation system. The Minimum Distance (MD) supervised image classification method was used for sampled imageries while the manual unsupervised classification was used for the Polygonised and sampled base map based on minimum distance algorithm. This was carried out because the MD algorithm offered the best output in terms of details of land use and land cover classification as it defined the distance

between two distinct codes (pixels) (Igbokwe 2010; Chigbu, Igbokwe and Orisakwe, 2011). Using the ERDAS imagine 9.2 software, various classes of urban spatial changes were developed and colours were assigned appropriately to depict the result in cartographic format for visual interpretation.

Urban land use and land cover spatial change variables obtained from the satellite imageries were urban built-up area, urban open space, rural built-up area, farm land, forest, water body, urban land cover and rural land cover for both 2001 and 2010.This variables were measured within these two period to ascertain any changes within the land use structure. The area analysis technique was employed in calculating the area in hectare and percentages, overlay method was used to identify the actual location, rate and pattern of change. The overlay approach way adopted because it is best fit for data description, selecting alterative and identifying impacts (effects) and showing some of the factors (Igbokwe, 2010). Equally, paired Samples T-Test was used in repeated measure as each subject was tested twice on the same variable and the Effect-Size Sample T-Test known the Correlation Ratio (R^2) as the most frequently used Effect- Size for T-Test, ANOVA and Regression. It was used to estimate the magnitude of effect as it is relatively independent of sample size. The eta squared Index guideline of n^2 = .01 (small effect), n^2 =.06 (moderate effect), and n^2 =.13 (large effect) was engaged.

4. DATA ANALYSIS

4.1. Land use and land cover distribution

In examining the urban Land Use Change Effects on Aba urban spatial expansion, the land use and land-cover distribution for the study as derived from the two-time remote sensing satellite imagery of Aba metropolis for 2001 and 2010 periods, was presented in Table 1 and Figures 1, 2 and 3. Therefore, objectives one (1) and two (2) were considered simultaneously.

Table 1: urban land use changes distribution - 2001 and 2010, in Aba urban

Nos	Land Use	2001		2010	
		Area (Ha)	Area (%)	Area (Ha)	Area (%)
1	Urban built-up	4997.28	26.02	6709.84	34.94
2	Urban open space	3572.87	18.60	3095.00	16.12
3	Rural built-up	2910.13	15.15	3749.63	19.53
4	Farm land	4468.51	23.27	2767.93	14.41
5	Forest	3227.00	16.80	2859.76	14.89
6	Water body	29.03	0.15	19.82	0.11
7	Urban land cover	8570.15	44.62	9804.84	51.06
8	Rural land cover	10605.64	55.22	9377.32	48.83

Source: Land Sat Imagery Analysis, 2013.

The Urban Land Use variables listed on Table 1. Was also use in the Study by (Angel, *et al*., 2011). The land use and land cover distribution statistics in Aba metropolis is represented in the Table 1 and Figure 3. The land use area was determined and presented in hectare (Ha) and percentage (%).

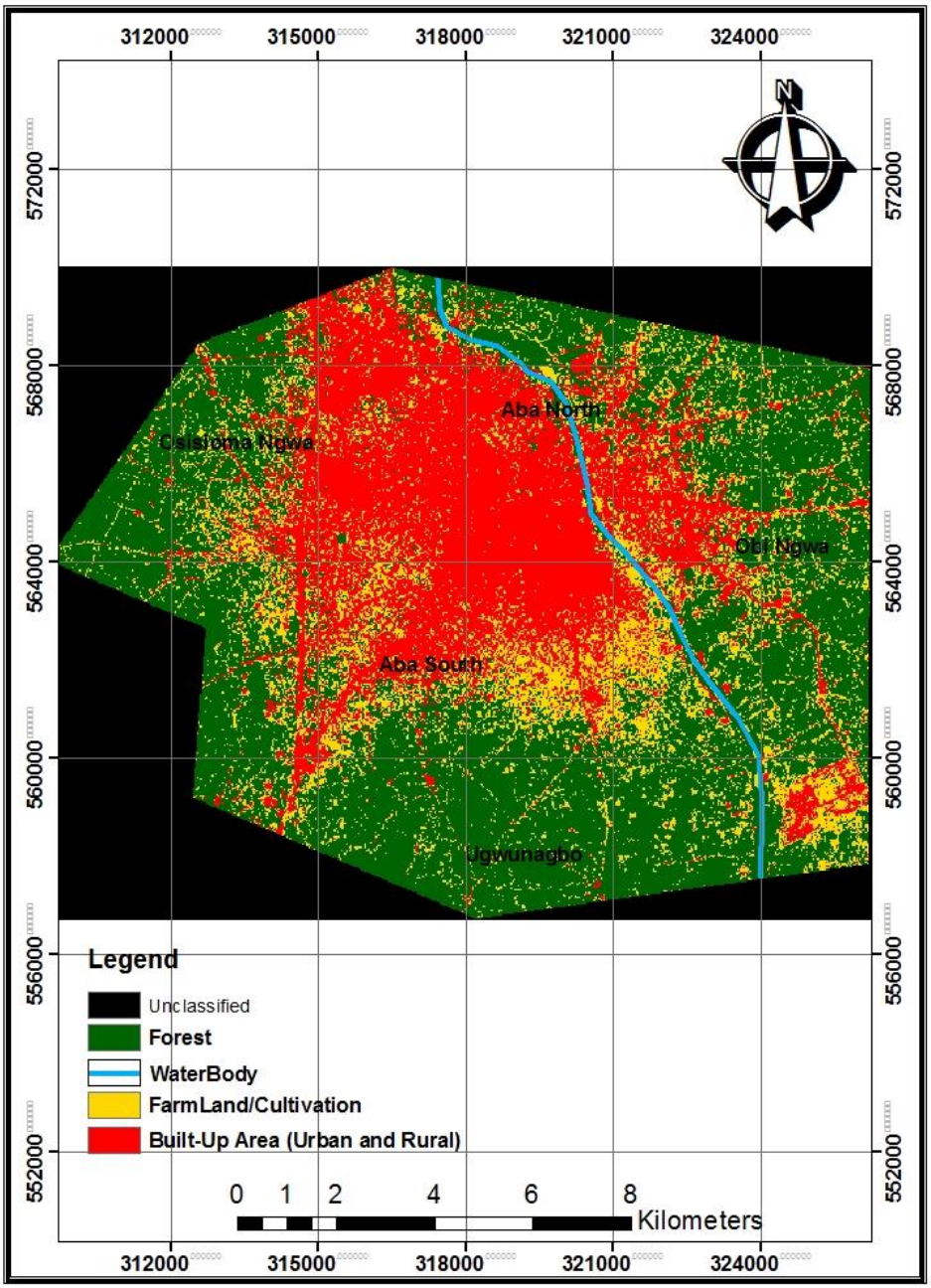


Figure 1: Land use and land cover image of Aba, 2001

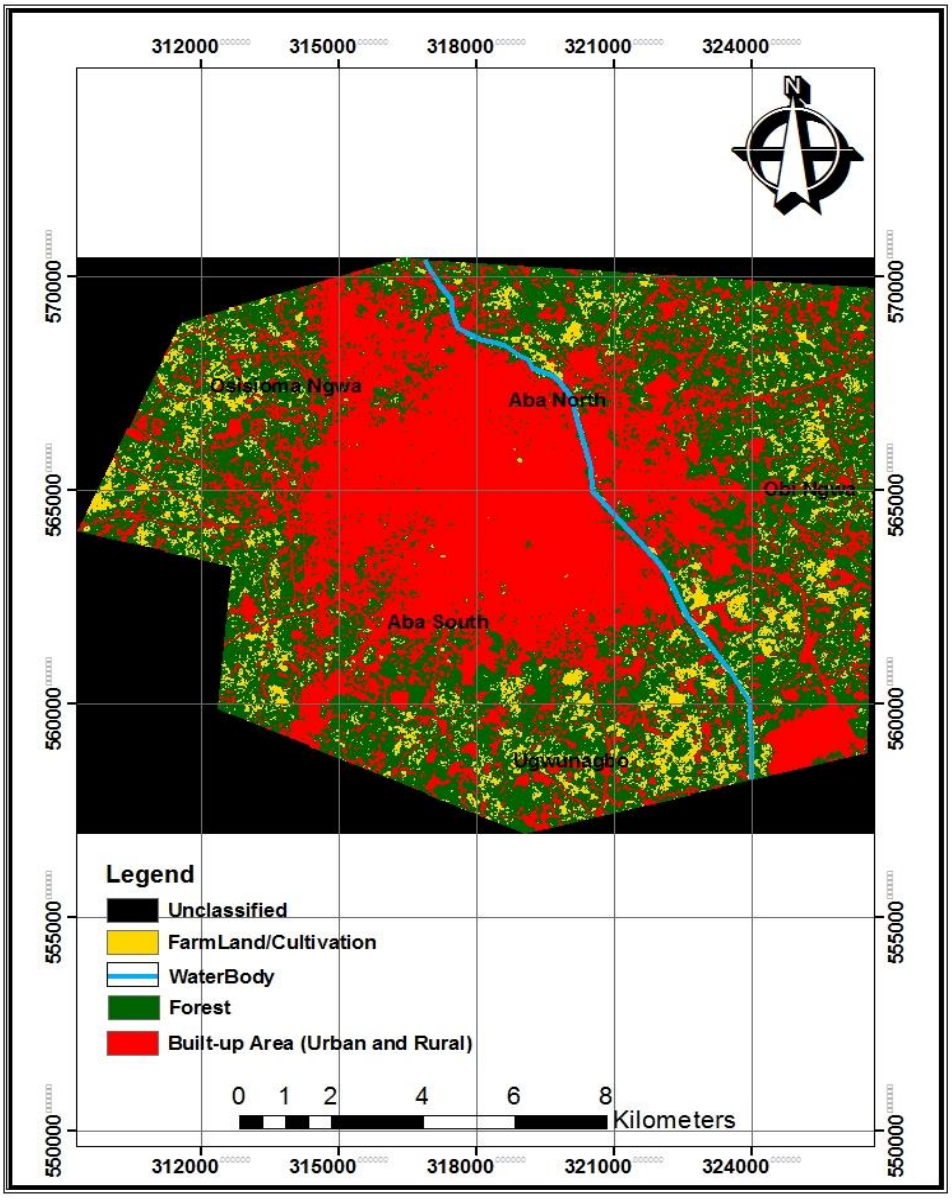


Figure 2: Land use and land cover image of Aba, 2010

4.1.1 Urban built-up area

The urban built-up area in 2001 was 26.02% (4997.28 hectares) of the total classification and in 2010; it was 34.94% (6709.84 hectares). The urban built-up area is the highest class in the urban land use expansion. The increase in the built-up area is as a result of population increase, urbanisation, and increase in infrastructural development and political activities in the study area.

4.1.2 Urban open space

The urban open spaces land use activity had 18.60% (3572.87 hectares) in 2001 and by 2010 it decreased to 16.12% (3095.00 hectares). The land use spatial difference showed a negative difference as the urban open spaces reduced subject to increase in the demand for

land space for developmental activities of various categories.

4.1.3 Rural built-up area

The rural built-up area which is development within the contiguous area of the metropolis was 15.15% (2910.13 hectares) of the total land cover in 2001 and in 2010 it was 19.53% (3744.63 hectares). The rural built-up land use spatial difference showed an increased in the rural built-up area. This increase in rural built-up was associated with the natural increase in rural population, provision of facilities and services.

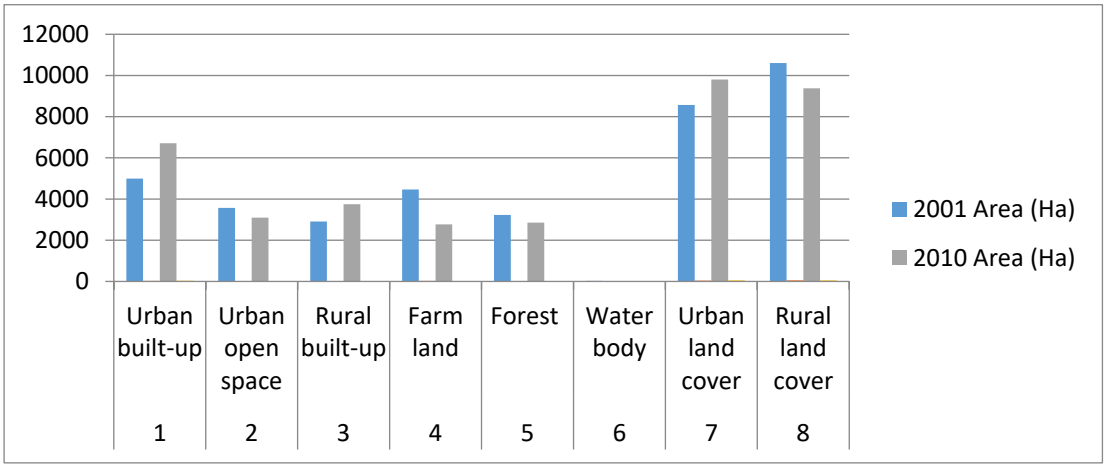


Figure 3: Clustered column showing urban land use spatial distribution 2001 and 2010

4.1.4 Farm land

The farm land or crop land is the cultivated land which circumscribed the built-up area. In 2001, the total farm land area was 23.27% (4468.51 hectares). In 2010, farmland was 14.41% (2767.03hectares) and had decreased by 8.86% (1701.15 hectares) spatially. This land use decrease was occasioned by the built-up areas that increased, which is primarily consequent upon population growth of the Aba metropolis.

4.1.5 Forest

The forest is the bush land left to fallow. Forest made up 16.80% (3227.00 hectares) of the total land area in 2001 and 14.89% (2859.76 hectares) in 2010. The spatial land use difference between forest in 2001 and 2010 was a sign of the ecological foot print of the urban area for forest products like timber for building construction works and for fossil fuel, among others.

4.1.6 Water body

The only drainage basin in the area is the Aba River. In 2001, the water body (Aba River) had a total land area of 0.15% (29.03 hectares) and in 2010, it was 0.11% (19.82 hectares). The cause of this negative spatial difference in the volume of Aba River was due to urban population growth as the water is used for recreation, domestic, commercial and industrial uses and climate change that reduced the volume of water discharged into the river. Also, industrial discharge of effluence into the river and soil erosion, aided silting of the water body in the study area.

4.1.7 Urban land cover

The total land cover for the urban area in 2001 was 44.62% (8570.15 hectares) and in 2010 it increased to 51.06% (9804.84 hectares). This increase in land cover was caused by population growth, increase in the demand of land for various uses like institutional, commercial, residential, industrial, etc that made the urban land cover to expand into the contiguous area.

4.1.8 Rural land cover

The total rural land cover in 2001 was 51.06% (9804.84 hectares) and 48.83% (9377.32 hectares) in 2010. The rural land cover spatial change (decrease) was naturally as a result of the factors that are responsible for the increase in the urban land cover mentioned earlier.

4.2. Land use and land cover changes, rate and patterns

The land use and land cover change; rate and pattern for the study area are shown in Table 2 and objective 2 of the study are considered here.

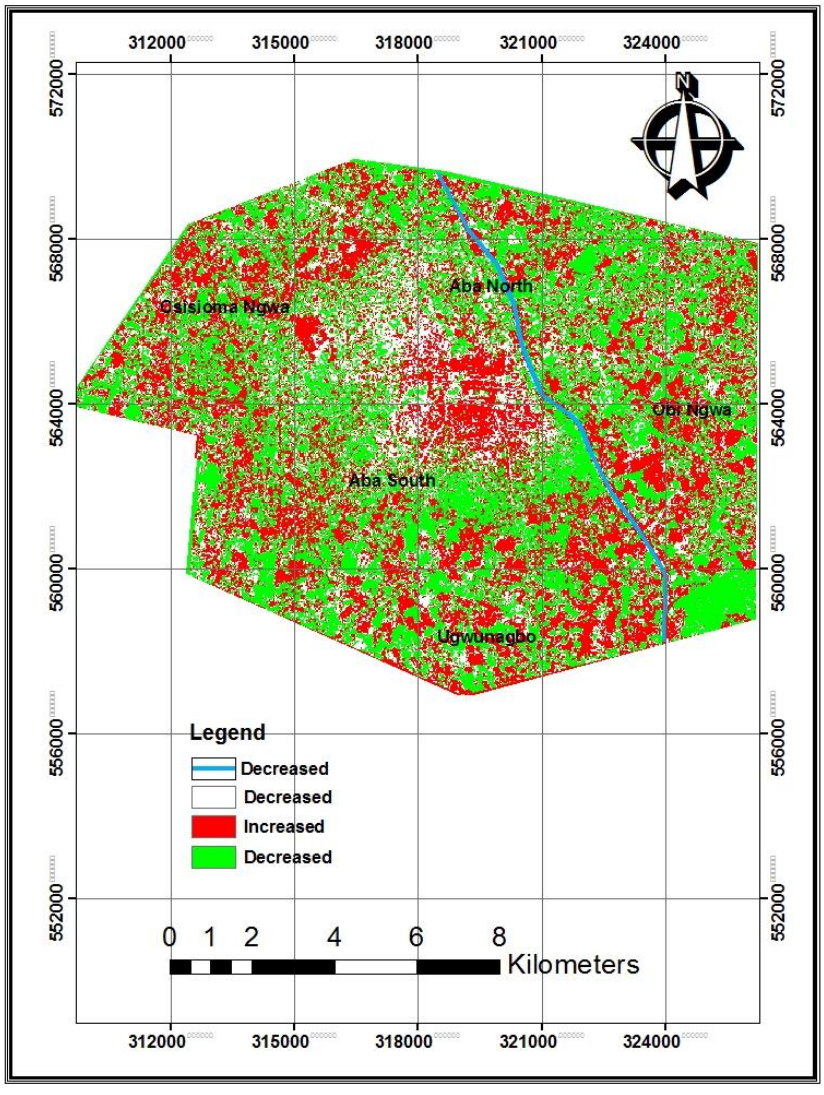


Figure 4: Land use and land cover image (change detection) of Aba, 2010

Table 2: Land use and land cover change, rate and pattern

Nos	Land Use	2001		2010		Change	Change
		Area (Ha)	Area (%)	Area (Ha)	Area (%)	(Ha)	(%)
1	Urban built-up	4997.28	26.02	6709.84	34.94	1712.96	8.92
2	Urban open space	3572.87	18.60	3095.00	16.12	-477.87	-2.48
3	Rural built-up	2910.13	15.15	3749.63	19.53	839.50	4.38
4	Farm land	4468.51	23.27	2767.93	14.41	-1701.15	-8.86
5	Forest	3227.00	16.80	2859.76	14.89	-367.24	-1.91
6	Water body	29.03	0.15	19.82	0.11	-9.21	-0.04
7	Urban land cover	8570.15	44.62	9804.84	51.06	1234.69	6.44
8	Rural land cover	10605.64	55.22	9377.32	48.83	-1228.32	-6.39

Source: Landsat imagery analysis, 2013

In Table 2, the land use and land cover change rate and pattern showed how a land use type and land cover changed relative to the other classes. It was observed that an increase in urban built-up area, rural built-up area and urban land cover, increased. Conversely, urban open spaces, farmland, forest, water body and rural land cover decreased. These are caused by urbanisation and population dynamics. As noted earlier on, Aba has attracted an influx of people into the city. The population of Aba urban has experienced fast growth due to in-migration and natural increases. This increase has led to various human activities associated with land use like building construction works, socio-economic activities and urban spatial expansion. This is manifest in the steady rise in the built-up areas in the city.

Table 2 indicated that the various urban land use spatial changes varied, changed and expanded as follows in descending order: urban built-up area 8.92% urban land cover 6.44% and rural built-up area 4.38%. On the other hand, land use and land cover variables decreased as follows: water body -0.40%, forest -1.91%, urban open spaces -2.48%, rural land cover -6.39%, and farm land -2.48%. These percentages show the rate and pattern of urban land use and land cover spatial changes and their impacts on the land use activities in Aba metropolis is discussed in section 5.

The urban built-up area had the fastest rate of change. The rate of change of urban built-up area between 2001 and 2010 was 8.92%, urban land cover rate of change was 6.41% and rural built-up area changed by 4.38%. the increase in the area of urban built-up, urban land cover and rural built-up accounted for about 10.77% (2068.39 hectares) of reduction in the farm land and forest and 0.15% (9.21 hectares) of water body decrease as observed between 2001 and 2010. It then can be inferred that about 2068 hectares of land available for farming and forest had been converted to other uses between 2001 and 2010. This may be a threat to farming and food supply and availability of forest products, as farm land and forest land is reduced at a high rate. This increase thus contributed to the physical expansion of Aba urban as seen in the increase of urban built-up, urban land cover and rural built-up areas respectively. The increases and decreased in the spatial change, rate and pattern, had been dictated in Figure 4.

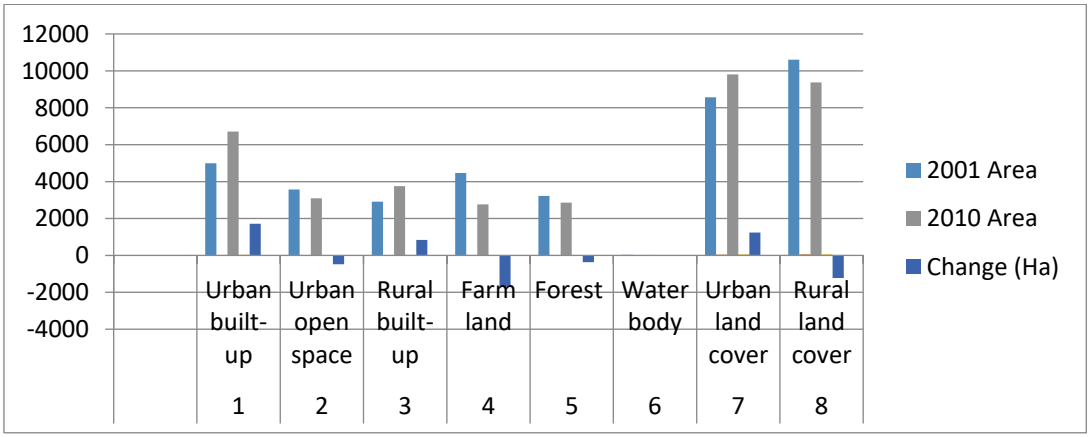


Figure 5: Stacked column (2D) indicating land use and land cover change in Aba Metropolis, 2001 and 2010

It was equally observed from Table 2 that there was a change in other land uses. Urban open spaces reduced by -477 hectares (-2.48%), farmland by 1701.15 hectares (8.86%), forest 367.24 (-1.91%) water body - 9.21 hectares (0.04%) and rural land cover by -1228.32 hectares (6.39%). These show that rural land cover and forest were the fastest in depletion.

Therefore, agrarian land is seriously losing its place in Aba metropolis. This apparently means that the contiguous area of the Aba urban lost about -2068.39 hectares of the rural land cover to the influence of Aba urban growth, and rural need of land for infrastructure (built-up) development. It also means that the agricultural land is equally under threat by man's quest for increased need of land for survival and development.

4.3. Impacts of urban spatial changes on urban land use activities in aba urban

The impacts of urban spatial changes on urban land use activities in Aba urban in 2001 and 2010. was captured using imagery data shown on Table 3.

Table 3: Urban spatial changes on land use activities in Aba Urban

Nos	Land Use	2001 Area (Ha)	2010 Area (Ha)
1	Urban built-up	4997.28	6709.84
2	Urban open space	3572.87	3095.00
3	Rural built-up	2910.13	3749.63
4	Farm land	4468.51	2767.93
5	Forest	3227.00	2859.76
6	Water body	29.03	19.82
7	Density	112.76	120.26
8	Compactness	2.43	1.83

Source: Landsat imagery analysis, 2013

Note: the variables – density and compactness were added to Table 3 due to their significance in land use spatial analysis.

The paired samples t-test; was used in testing whether there is a statistically significant difference in the mean scores for 2001 and 2010 (Tables 4 and 5).

Table 4: Paired samples statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	2001	2415.0013	8	2068.25979	731.24026
	2010	2415.5088	8	2324.95054	821.99415

Table 5: Paired samples test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	2001 - 2010	-.50750	992.32474	350.83977	-830.11174	829.09674	-.001	7	.999

From Table 5, the table labelled Paired Sample Test is the probability value. If the probability is less than 0.05 it can be concluded that there is a significant difference between the two scores. The result of the analysis therefore showed the probability value of 0.999 (Table 5) which is substantially greater than the specified alpha value of 0.05. Therefore, there is no significant difference in the urban spatial changes in Aba urban within the 2001 and 2010 time periods .The implication of these result is that there is no significant impact of urban spatial changes on land use activities in Aba metropolis. This therefore implies that the variation in urban built-up, urban open space, rural built-up, farm land, forest, water body, density and compactness in 2001 and 2010 time periods has no significant impact on urban land use activities in Aba urban.

The t-value (in this case -.001) and the degrees of freedom (df) = 7, shows no significant difference in the relationship between 2001 and 2010 of the imagery analysis. This is further supported by the mean variation in urban spatial changes on land use activities of -.50750 hectares, with a percentage confidence interval stretching from a Lower bound of -.830.11174 hectares to upper bound of 829.09674 hectares. Having established that there is no significant difference, the study took a step further to find out which set of scores is higher (2010 or 2001). In Table 5 the mean score for 2010 is 2415 .5088 hectares and the mean score in 2001 is 2415. 0013 hectares, therefore, it was concluded that there was an insignificant decrease in urban spatial land use activities from 2001 to 2010.

Having established that there was no significant difference in the relationship between the two-time periods of the imagery analysis, the result obtained, therefore, showed that the difference in the two set of scores likely occurred by chance, as a result of meaningful difference or change in less number of variables tested that consisted of the urban built-up area (8.92%) and rural built-up area (4.38%) as indicated on table 2. It does not however, indicate much about the magnitude of the change effect. The most reliable way of calculating the magnitude of change effect is to calculate an effect-size statistic, often referred as Eta Squared (eq. 5). Therefore, substituting with the appropriate values from the t – test output:

$$\eta^2 = \frac{(-.001)^2}{-.001^2 + (8-1)} = \frac{-.000001}{6.99999} = -1.4285$$

Eta Squared is 0.001. Using the guidelines proposed by Cohen (1988) for interpreting Eta Squared values shows: 0.01 = small effect, 0.06 = moderate effect, 0.14 = large effect. Given the calculated Eta Squared value of 0.084, it was concluded that there is a small effect, with a marginal difference which is not quite significant in the urban land use activities between 2001 and 2010 periods of the land sat imageries.

4.4. Summary of findings

The following findings emanated from the study:

The increase in the built-up area is as a result of population increase, urbanisation, and increase in infrastructural development and political activities in the study area;

The land use spatial difference showed a negative difference as the urban open spaces reduced subject to increase in the demand for land space for developmental activities of various categories. The rural built-up land use spatial difference showed an increased in the rural built-up area. This increase was associated with the natural increase in rural population, provision of facilities and services;

Rural farmland decreased by 8.86% (1701.15 hectares) spatially;

The spatial land use difference between forest in 2001 and 2010 was a sign of the ecological foot print of the urban area for forest products like timber for building construction works and for fossil fuel, among others;

The cause of this negative spatial difference in the volume of Aba River was due to urban population growth that used the water for recreation, domestic, commercial and industrial uses and climate change that reduced the volume of water discharged into the river. Equally, industrial discharge of effluence into the river and soil erosion, aided silting of the water body in the study area;

This increase in land cover was caused by population growth, increase in the need of land for various uses like institutional, commercial, residential, industrial, etc. that made the urban land cover to expand into the agrarian land;

The rural land cover spatial change (decrease) was naturally as a result of the factors that are responsible for the increase in the urban land cover.

5. Discussion of Results

The analysis shows that the pattern of land use and land cover change in Aba in 2001 indicates Aba North and South Local Government areas, shows that the pattern of land use and land cover change show that in 2001 Aba North and South Local Government Areas (L.G.A) had open spaces which had been converted into urban built-up area in 2010. The conversion was more intense in Aba North LGA than in Aba South LGA as it has land cover and population less than that of Aba South Local Government Council. Urban built-up in Osisoma Ngwa LGA is greater than that of Obi Ngwa LGA and Obi Ngwa LGA is greater than that of Ugwunagbo LGA. This is as a result of the influence of Osisoma Ngwa industrial and Ariaria International Market areas together with Port-Harcourt-Enugu expressway that traversed the LGA, thereby converting most rural land to urban. Obi Ngwa urban built-up was influenced by the teaming rural population, Ehere Market, NINLAN,

and industrial layout of Aba and agro-based industries located along Ikot-Ekpene Road. While Ugwunagbo axis is influenced by the Asa Nnetu Motor Spare Parts Market.

The rural built-up area was highest in Obi Ngwa LGA followed by Osisioma Ngwa LGA and Ugwunagbo LGA. This was due to the amount of rural land cover, rural population size and influence of the Aba urban area. Figure 5 (2010) shows how the metropolis is drifting into the rural area with increased land use activities.

The result of the analysis from Table 5 therefore showed the probability value of 0.999 which is substantially greater than the specified alpha value of 0.05. This therefore confirms that there is no significant difference in the urban spatial changes in Aba metropolis within the 2001 and 2010 time periods; likewise there is no significant impact of urban spatial changes on land use activities in Aba metropolis. This further implies that the variation in urban built-up, urban open space, rural built-up, farm land, forest, water body, density and compactness in 2001 and 2010 time periods has no significant impact on urban land use activities in Aba Metropolis.

Furthermore, result from Eta Squared analysis indicated a small effect, with a marginal difference which is not quite significant in the urban land use activities between 2001 and 2010 periods of the land sat imageries.

6. CONCLUSION

Land use and land cover change is a continuous process in land use spatial development. Fast land use spatial changes caused by anthropogenic activities may lead to negative impacts such as deforestation, loss of flora and fauna, climatic change, reduction in food supply and underground water recharge, interalia.

This study examined the impacts of land use and land cover change in Aba Metropolis. The results revealed that urban spatial development and population growth has resulted in land use negative and positive spatial difference. The positive spatial difference shows that urban built-up, rural built-up and urban land cover increased; this means that built-up area will continue to expand while the negative spatial difference is fundamental in the reduction in urban open space, farm land, forest and rural lands cover between 2001 and 2010. This implies that built-up areas will continue to increase while land for farming and forest reservation will continue to reduce. This calls for physical planning intervention and control of depletion of contiguous areas to ameliorate urban ecological food prints in the rural areas. Furthermore, result from Eta Squared analysis indicated a small effect, with a marginal difference which is not quite significant in the urban land use activities between 2001 and 2010 periods of the land sat imageries.

7. RECOMMENDATIONS

From the study, it was observed that built-up areas and urban land cover changed, while urban open space, farm land, forest, water body and rural land cover decreased negatively within the prescribed periods. Since there is increase in the built-up areas bringing about reduction in other land use types particularly farmland and forest, which is an off-shoot of master plan for Aba metropolis; it is therefore recommended that the government of the state initiates, prepares and implements master plan for the metropolis to checkmate the rate and pattern of the land use and land cover change.

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