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POPULATION PRESSURE ON LAND AND ITS IMPACT ON AGRICULTURAL LAND IN IGABI LOCAL GOVERNMENT AREA, KADUNA STATE

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Abstract
The paper examines the impact of population pressure on land as it affects agricultural land in Igabi local government, Kaduna state. The study employed the use of Geographic Information System (GIS) imagery of 1995, 2005 and 2015 to generate data. Data were analyzed using frequency tables, percentages and multiple regression. LandSat result shows that built-up areas increased from 16.46% to 19.43% and 20.99% in 1995, 2005 and 2015 respectively while agricultural land use increased from 9.34% to 18.27% and 27.72% in 1995, 2005 and 2015. High forest area decreased by 55.0% between 1995 and 2005 and 27.9% between 2005 and 2015. Then water body decreased from 2.30% in 1995 to 1.21% in 2005 but rose by 2% in 2015. Degraded forest increased from 32.55% in 1995 to 43.39% in 2005 and then declined to 36.52 in 2015. Result from the regression analysis shows that build-up areas, degraded forest and water bodies were significant factors affecting agricultural land in the study area at 5% significance level. The study therefore recommends policy intervention to serve as a check on excessive clearing of forest area for agricultural use and unregulated exploitation of forest which is the major cause of forest degradation and environmental pollution.
Keywords: Population Growth, Agricultural land, Land Sat imagery

Introduction

Cities in the world faces continuous increase in population as it accommodates rapid inflow of migrants from villages and other small cities. Population growth and urban expansion are responsible for the changes in the land use of an area. For instance, as population increases, construction of dwellings also increases thus engendering conversion of cropland and forest land to settlements (Oluabunmi & Ayoade, 2014). According to Cunningham, Cunningham and Siago (2005) it has been noted that rapidly increasing human populations and expanding agricultural activities have brought about extensive land use changes throughout the world. In Nigeria, as population increases, land becomes scarce. The growing population requires increasing area for agricultural production and, hence, large areas of forestland need to be opened up. As the rate of land area expansion falls short of the growth rate of population, land becomes scarce relative to labour. As a result fallow periods tend to be shorter and soil fertility declines and farming becomes unsustainable with very low yield.

Rapid population increase, urbanization and changing socio-economic pattern are deriving forces that influenced land use change in peri-urban areas (Jongkroy, 2009). Although multifaceted, the main cause of urban expansion is population pressure. Many cities are rapidly growing into their fringe, engulfing former villages and farm lands and transforming them into urban development. Therefore, rapid urban population growth means more people living in established urban areas, it also means more people living in the outward thrusts of these urban areas which form the peri-urban areas. As a result of population pressure, rural areas of cities and towns are continuously converting to peri-urban status so that their land uses change from those dominated by agricultural activities to less agricultural activities.

Increased land use due to increase in population has become a major form of land degradation as expansion leads to the removal of large areas of the best agricultural land for production to built-up structures which consume large areas of land at the expense of agricultural land for food production. Land use change, however does not come without costs where conversion of farmlands and forests to urban development reduces the amount of lands available for food production (Wu, 2008). Adesina, *et al.* (1999), observed that in Nigeria, 400,000 hectares of agricultural land is lost annually and most of this land is deliberately removed to make way

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for mineral exploiting, development of infrastructure such as roads and railway and expansion of settlements as well as high level of household dependent on fuel woods for the supply of domestic energy most especially among the low-income earners.

High population densities lead to competition and conflicts over land and natural resources as land is converted from agricultural to residential and business uses, and as the intensity of agriculture practiced on scarce spaces available increases. It is estimated that growth in human population affect the global land use available for agriculture, forest land cover, nearby area of different type of water bodies. The rapid increase of human population is putting extraordinary pressure on the natural resources available e.g. land, water, ecosystem services etc. (Shivani, 2017). Kaduna metropolis is one of those fast growing cities in terms of population in Nigeria which grows from 896,055 (census, 1991), 1,570,331 (census, 2006) to 2,057,078 (NPC projection, 2015). The metropolitan city is unique for its rapid urbanization and urban expansion which resulted in transformation of the farmlands, river flood plains and forests into settlements thereby causing land use changes (Opatoyinbo, Adepoto and Abdullahi, 2015). As a result, more settlements were created outward of the major city to include part of Igabi Local government. This local government area has experienced a continuous increase in population where most of the land that was previously meant for agriculture were transformed to build up areas with residential buildings, industrial estates, government institutions which causes high level of land degradation. Steady population growth is inherent in Kaduna which leads to increasing urban sprawl that become ever more pressing on land nearby. With an estimated population of 1.5 million people (UN-Population Division, 2014) and 2 million in 2015 (Saleh et al, 2014).

Methodology

The study area is Igabi Local Government Area of Kaduna State which lies at the urban fringe of Kaduna metropolitan city and is experiencing the effect of urban out push into the areas. Therefore, the study area was chosen because it forms part of Kaduna metropolis and is experiencing continuous increase in population. In order to achieve the objective of the study, a causal modelling technique was adapted from the study of Jinadu (2008) with a multiple regression model technique. Therefore the functional relation of the model is specified as follows:

$$ALU = f(BU, FA, DF, WB) \quad \text{..... 2.1}$$

Where, ALU represents agricultural land use, BU represents built-up areas, FA represents forest areas, DF represents disturbed/degraded forest and WB represents water bodies.

For this study, the multiple linear regression model is specified for estimation and is expressed in stochastic form as;

$$ALU_t = \beta_o + \beta_1 BU_t + \beta_2 FA_t + \beta_3 DF_t + \beta_4 WB_t + \varepsilon_t \quad \text{..... 2.2}$$

Where, β_o is the constant term (intercept), β_i is the regression parameters (1….. 4), t is the time (t = 1,……., n) and ε is the error term.

Therefore, only β_2 is expected to have positive relationship with agricultural land use (ALU) and predictor variable. This implies that increase in forest area (FA) would result to an increase in agricultural land use. Likewise, β_1, β_3 and β_4 are expected to have negative relationship between agricultural land use and the respective predictor variables.

The techniques used for the estimation of data for the study were informed by the nature and type of data for the research. Therefore, data was captured through the use of Landsat imagery. The data was summarized in tables for report writing through the use of descriptive analysis and regression model. Descriptive analysis was used to clearly show the extent of different land use activities that occurred with the use of frequencies and percentages with the regression determining the factors affecting agricultural land use in the study area base on the landSat result. The regression model was employed to analyze factors affecting agricultural land use base on the data captured from the GIS. The use of linear regression is to find the impact of the identified land use factors on the dependent variable (Agricultural land use).

The basic form of the model is expressed as;

$$Y = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots \beta_n X_n \quad \text{..... 2.3}$$

Where: Y = dependent variable,

X_1, X_2, ……..X_n = independent variables.

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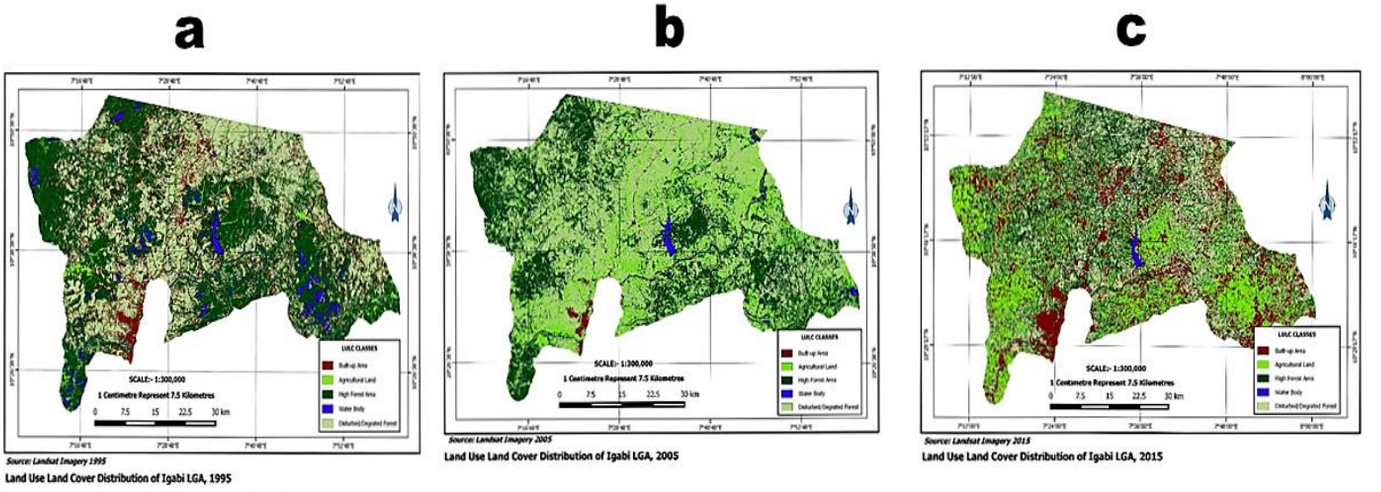
Discussion of Results

Extent of Land Use change in the study area

This section analyzed the extent of changes in different land uses using satellite images and GIS between 1995, 2005 and 2015. Information generated from the Landsat imagery for the study aims to monitor and analyze population pressure on land using satellite images and GIS between 1995, 2005 and 2015.

Figure 3.1: GIS Mapping of Igabi LGA for 1995, 2005 and 2015



Source: Arc GIS satellite imagery

From figure 3.1, Arc GIS 10.1 was used to map different land uses as a result of increase in population and were characterized into five major land use classes which includes; built-up areas, agricultural land, high forest area, water body and disturbed/degraded forests. The values presented represent the area in hectares and percentage of each land cover present for each year under study obtained from the supervised classification.

Table 1: Distribution of different land use activities (1995-2015)

Land Use Activities	1995		2005		2015	
	Area (Hectares)	%	Area (Hectares)	%	Area (Hectares)	%
Built-up Area	5326.6	16.46	6284.9	19.43	6791.2	20.99
Agricultural Land	3022.5	09.34	5909.6	18.27	8969.7	27.72
High Forest Area	12732.1	39.35	5731.0	17.70	4132.0	12.77
Water Body	739.9	02.30	390.5	01.21	648.1	02.00
Disturbed/Degraded Forest	10532.3	32.55	14037.4	43.39	11812.4	36.52
TOTAL	**32353.4**	**100**	**32353.4**	**100**	**32353.4**	**100**

Source: GIS satellite mapping, 2016.

The land cover area coverage and percentage of each land use category were derived from the satellite image for each study year. As shown in table 1, in 1995, 16.5% of Igabi land was covered by built-up structures (residential and commercial), 9.3% by agricultural land, 39.6% by high forest area, 2.3% by water body and 32.6% by disturbed forest. In 2005, 19.63% was covered by built-up structures, 18.3% by agricultural land, 17.7% by high forest area, 1.2% by water body and 43.4% by disturbed forest. While in 2015, built-up area was covered by 21.0%, agricultural land by 27.7%, high forest area by 12.8%, water body by 2.0% and disturbed forest by 36.5%. The table above shows the extent to which land use activities changed from 1995 to 2015 due to population increase of Kaduna metropolis into the study area which intensifies the different land use activities in the area.

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Table 2: Changes on different Land Use activities (1995-2015)

Land Use Observed activities	Land Use Change (Ha) in 1995-2005	Percentage Change (%) 1995-2005	Land Use Change (Ha) in 2005-2015	Percentage Change (%) 2005-2015
Built-up Area	958.3	18.0%	506.3	8.1%
Agricultural Land	2887.1	95.5%	3060.1	51.8%
High Forest Area	-7001.1	55.0%	-1599	27.9%
Water Body	-349.4	47.2%	257.6	66.0%
Disturbed/Degraded Forest	3505.1	33.3%	-2225	15.9%

Source: GIS satellite mapping, 2016.

Table 3.2 shows the changes that occurs between the period of 1995, 2005 and 2015, whereby built-up land increased by 958.3 ha (18.0%) between the period of 1995 to 2005 and a further increase by 506.3 ha (8.1%) between the period of 2005 to 2014. Agricultural land also increases by 2887.1 ha (95.5%) between 1995 to 2005 and increased further by 3060.1 ha (51.8%) between the period of 2005 to 2015. On the other hand disturbed forest increased by 3505.1 ha (33.3%) within 1995 to 2005 and also declined by 2225 ha (15.9%) of land between the period of 2005 to 2015 while high forest area declined by 7001.1 ha (55.0%) of land between 1995 to 2005 and a further decline by 1599 ha (27.9%) between the period of 2005 to 2015. Water body shows a decline of 349.4 ha (47.2%) within 1995 to 2005 and then increased by 257.6 ha (66.0%) between the period of 2005 to 2015. These changes is as a result of population growth. The table above shows the magnitude of changes or the rate at which changes occurs on the different land use components during the study period. This is as a result of continuous increase in population and outward expansion of Kaduna metropolis into the peri-urban areas which affects the dwellers in the area.

Estimated Regression Model on Factors Affecting Agricultural Land Use

A regression analysis was employed to quantitatively analyze the factors that affects agricultural land use in the study area based on the data generated from Landsat/GIS for the period of 20 years i.e. 1995 to 2015. Therefore, the factors considered are; Built-up areas, Forest areas, Degraded forest and Water bodies. The estimated result is presented in table 3.3 where the dependent variable is Agricultural land use (ALU).

Table: 3.3: Estimated regression result of factors affecting Agricultural land use

Variables	*Coefficient*	*Std. Error*	*t-statistics*	*P - value*
C	-0.01066	0.002241	-4.75751	0.0003
DLOG(BUILT,2)	6.058151	2.467083	2.455593	0.0277
DLOG(DEGFOR,2)	-3.7441	0.74603	-5.0187	0.0002
DLOG(FORES,2)	-0.0102	0.118207	-0.0863	0.9325
DLOG(WATR,2)	-1.11293	0.381292	-2.91885	0.0112

R^2 = 0.897976
F-stat (P.value) = 30.81(0.00001)

Source: *E-views Output, 2017*

The result of the estimation from table 3.3 shows the F-stat (30.81) with a p-value (0.00001) at 5% significant level which is less than 0.05 and indicates that the model is statistically significant where we conclude that the overall model provides a better fit than the intercept-only model. Also, the R squared value of 0.897976 means that the model explains about 89% of the variability in the response and hence the model fits the data. However, the coefficients become elasticity and in addition the use of rate of change because the variables

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have been differenced. The regression result in table 3.3 shows the percentage changes in the rate of growth of the independent variables (Built-Up areas, Degraded forest, Forest area and Water body) influencing/affecting the dependent variable (Agricultural land use) in the study area. Therefore, built-up areas, degraded forest and water body were statistically significant and forest area was not significant at 5%. From Table 3.3, a 1% change in the rate of growth of built up areas increased agricultural land use by 6.1%. This shows a positive and significant relationship because of the increase in population which result to increase demand for farmland and agricultural produce (e.g. vegetables, fruits, livestock etc.). That is, increase in population in the study area paves way for forest clearing for an increased agricultural land in order to supplement the land loss to built-up structures. Population growth is also likely to promote agricultural intensification, shifting cultivation etc. Also, agricultural land use may intensify in order to produce the need of the growing population as observation shows the presence of orchards and poultry farms around the study area.

Also, the regression result shows that degraded forest is negative and statistically significant in explaining its effect on agricultural land use in the study area. That is, a 1% increase in the rate of growth in degraded forest reduces agricultural land use by 3.7%. This shows that an increase in degraded land caused by natural or human factors reduces the amount of land use for agricultural purposes. This can be as a result of leaching soil, erosion and excessive use of land to the extent of soil nutrient exhaustion and barren lands. The large-scale dependence exerts pressure on forests, leading to their excessive exploitation and degradation. Unregulated exploitation of forest is a major cause of forest degradation and also for environmental pollution (FAO, 2011). Therefore, forests are exposed to overexploitation, encroachments, illegal cut down and so on, leading to their degradation. Water bodies from the regression result depicts that the coefficient is negative and statistically significant in determining agricultural land use. A 1% increase in the rate of growth of water bodies leads to 1.1% decrease in agricultural land use. It is assumed that increase in water bodies during rainy season will result to expansion of the river banks and thus eating up agricultural lands close to it. Forest land area from the regression result shows a negative relationship with agricultural land and is not statistically significant at 5%. This means that despite clearing of forest land area in order to increase agricultural land use by the dwellers, this result to extinction or environmental degradation which disrupts the natural ecosystem with consequences of climate effect on the agricultural land. Although, the forest cleared may not be very suitable for farming practices. Deforestation and loss of ecosystems that sustain global atmospheric oxygen and carbon dioxide balance is also another implication.

Conclusion

In conclusion, Life of majority of Nigerians depends largely on agriculture and similar activities in rural areas. As such, there is great pressure on the natural resources (water, land) due to ever increasing population. Among all natural resources, Land is seen as the most important one. All agriculture, animal and forestry productions depend on the land productivity. The entire land ecosystem, which composed of soil, water and plant are used to fulfil the community demand for food, energy and water requirement. The unmanageable use of land is the main reason for destruction of the environment. Agricultural land degradation occurs not only due to population growth but also on other impacts that contribute to environmental degradation.

Recommendations

The study therefore recommends:

1. Policy intervention to serve as a check on excessive clearing of forest area for agricultural use
2. Unregulated exploitation of forest which is the major cause of forest degradation and environmental pollution.

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