JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 08, ISSUE 02, 2021

IMPLICATIONS OF POPULATION GROWTH ON AGRICULTURAL LANDUSE IN OBUDU, NIGERIA

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ABSTRACT: This research examined the implications of population growth on agricultural land use in Obudu, Nigeria between 1986 and 2013. Three sets of remotely sensed data were used to measure the land use/land cover changes in Obudu during the periods 1986, 2000 and 2013. Population growth was analyzed using data on census results obtained from National Population Commission. The objectives of the study were: to examine the causes of rapid population growth on agricultural land use, to ascertain the extent to how population growth affect agricultural land use and to proffer solutions to the impacts of population growth on agricultural land use in Obudu. Data were obtained through questionnaire administration to respondents randomly in the four micro agro ecological zones of the study area. The data was analyzed using descriptive statistics such as frequency tables, percentages and charts among others. Relationships were tested using Pearson's product moment correlation coefficient. The findings revealed that there exist a consistent increase in population size leading to the decline in agricultural landuse in Obudu. Illiteracy, high fertility, improved medical facilities, availability of job and good road network contributed to population growth in the study area. The result of the analysis of the satellite imageries further revealed that agricultural and forestlands continually dropped in land area while built-up, bush fallow with trees and fresh water swamp grassland constantly increased. Recommendations were made which include placing restrictions and curbing migration in the study area to check population as well as enforcing sanctions on land use abuses that convert agricultural land to other land uses in Obudu.

Keywords: Population growth, GIS, landuse, agricultural landuse, remote sensing, Obudu.

Introduction

Man has brought in changes to land use and land cover in the world mainly through growth in human population and urbanization. According to Cunningham and Saigo (2001), for every second, an average of four or five children are born somewhere on the earth. In that same second, two other people die. The difference between births and deaths means a net gain of nearly 2.5 more humans per second in the world population (Njungbwen, Mbakwe and Leke, 2010). An assessment of the world population revealed that from 1900 to 2011, world population grew from 1.6 billion to 7.8 billion persons (United Nations, 2011), indicating a tremendous increase. Today, the world population is estimated at about 8 billion. Among the 12 largest countries in the world according to population, namely: India, China, Pakistan, United States, Nigeria, Indonesia, Brazil, Bangladesh, Ethiopia, Iran, Mexico and Russia, Nigeria which had a population of 140,431,170 million in 2006 has been projected to be the fifth most populous country in the world in 2050 with a population of 3.38 million people (World Resources Institute 1999).

According to the National Population Commission (1988), the total population of Nigeria in 1991 was 88,992,220, made up of 44,529,608 males (50.04%) and 44,462,612 females (49.96%). The growth rate of 2.8% for the period (39 years) 1952/53 to 1991 is the closest to the expected growth rate for the country and the average growth rate for most developing countries during the period. With this rate, it was envisaged that it will take Nigeria 24.5years for her population to double itself. In 1991, Cross River State had a population of 1,911,596 million people and this increased to 2,892,988 million inhabitants by 2006 (NPC, 2007). NPC estimate indicates that by 2020 and at 2.8% growth rate, the state will have a population of 4,258,437 million. Obudu is not an exceptional to the global, country and state population surge, this increase in human population is expected to exert influence on land uses in the study area.

The impact of population growth on agriculture and natural resource management has been debated at least from the time of Malthus (Malthus, 1872). Although the dismal predictions of Malthus regarding the inability of agricultural production to keep pace with population growth have not come to pass in the industrialized nations, agricultural production per capita has fallen and poverty has increased in many developing countries including Nigeria in recent decades (Pender, 1999). There are serious and growing concerns about the impacts of rapid population growth on the environment and natural resources including forests, land, water, biodiversity and other resources (World Commission on Environment and Development, 1987, Elrlich and Ehrlich, 1990).

Rapid population growth appears to have direct effect on the available agricultural land which in turn affects food supply in the rural and urban areas. Food security and increasing losses of agricultural lands have therefore become an issue of global concern.

Land is inevitably the pivot of man's absolute existence. Sheng (1989) stressed this by asserting that in the past, present and through the foreseeable future, land continues to be the foundation of our food supply chain

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which is a vital recurrent and capital resource of any nation. Land use is subject to varied notions. It can be defined as the human activity associated with a specific piece of land. FAO (1995) conceived 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 a physical territorial space by the human population inhabiting it. To Briassoullis (2000) land use is the way in which, and the purpose for which human beings employ the land and its resources. Briassoullis' notion emphasizes culture as an attribute that shapes land use.

The four land use categories in the world as given by FAO (1999) are forests and woodland (32%), range and pasture (26%), cropland (11%) and others (31%). The "others" category include tundra, desert, wetlands, marsh, scrubs, urban areas, ice or snow. Different land use categories are also found in Africa as the years pass by, human population keep increasing as land use changes take place. The continued increase in human population, a decrease in fresh water supplies, loss of croplands and land use changes at the expense of agricultural lands are all factors that may influence the ability of societies to produce sufficient food to meet the world inhabitants, Population growth and economic changes are two important factors influencing land use changes (Bilsborrow and Okoth-Ogendow, 1992, Helmer, 2000, Lugo, 1996 and Turner, 2002) and the distribution and amount of agricultural lands.

Agricultural landuse

Conceptually, agriculture is the production of food, feed, fiber and other goods by the systematic growing and harvesting of plants and animals. It is the science of making use of the land to raise plants and animals. It also involves the simplification of nature's food needs and the rechanneling of energy for human planting and animal consumption (Akinboye, 2008). In the same way as ideas vary on the concept of land use, notions of agricultural land uses are varied. Moss (1969) defined agricultural land use as an expression of production system which represents the interaction between the ecological and economic factors in which the vital link is man, the decision matter.

Geertz (1971) conceived agricultural land use as a process of intervention into natural ecosystem which affects the ratio between the number of species and the number of organisms in a biotic community. According to him, a natural biotic community has a higher diversity index than an artificial community. In using land as an ecosystem therefore man seeks to manipulate ecological processes in such a way that much of the ecological potential and energy flow are channeled into plants or animals perceived as valuable to man for food, timber and clothing (Marther, 1986). In other words, agricultural land use simplifies the complex natural ecosystem for man's advantage.

The integration of remote sensing and Geographic Information System (GIS) has been widely applied and recognized as an effective tool in detecting land use and Landover change (Ashbindu *et al.,* 2001). Satellite remote sensing collects multispectral, multi-resolution and multi-temporal data and turns them into information valuable for understanding and monitoring land processes and for building land cover data sets. Geographical Information System on the other hand provides a flexible environment for entering, analyzing and displaying digital data from various sources necessary for urban and rural features identification, change detection and data base development. As a result, it became a handy tool and was applied to carry out this study.

Initially, Obudu (the study area) was a large local government area created in 1976 and majorly a dispersed settlement typical of the area. Obanliku local government area was created out of Obudu in August 27th, 1991. This transformation over time brought about increased immigration into Obudu, increase in population and human activities, land use dynamics and by extension urban expansion/growth and development projects affected various land uses in Obudu most especially the agricultural lands. In view of the above, it became necessary for this research on implications of population growth on agricultural land use in Obudu Local Government Area.

Based on the foregoing contextual introduction, the main purpose of this research is to examine the implications of population growth on agricultural land use in Obudu, Nigeria. The objectives include:

- To examine the causes of rapid population growth in Obudu
- To ascertain the extent of how population growth affects agricultural landuse in Obudu
- To proffer solutions to the impacts of population growth on agricultural landuse in the study area.

Hypothesis

There is no significant relationship between population growth and agricultural land use in Obudu.

Study area

Obudu Local Government Area is one of the 18 local government areas of Cross River State and one of the five local government areas that make up the Northern Senatorial District of Cross River State. It is majorly comprised of the Bettes, Ukpe/Alege and Utugwang. Obudu has an aerial extent of about 1200km^2 and lies precisely between latitudes

6^{0}22' and 6^{0}43' North of the equator and longitudes 8^{0}53' and 9^{0}14' East of the Greenwich Meridian (Figure 1).

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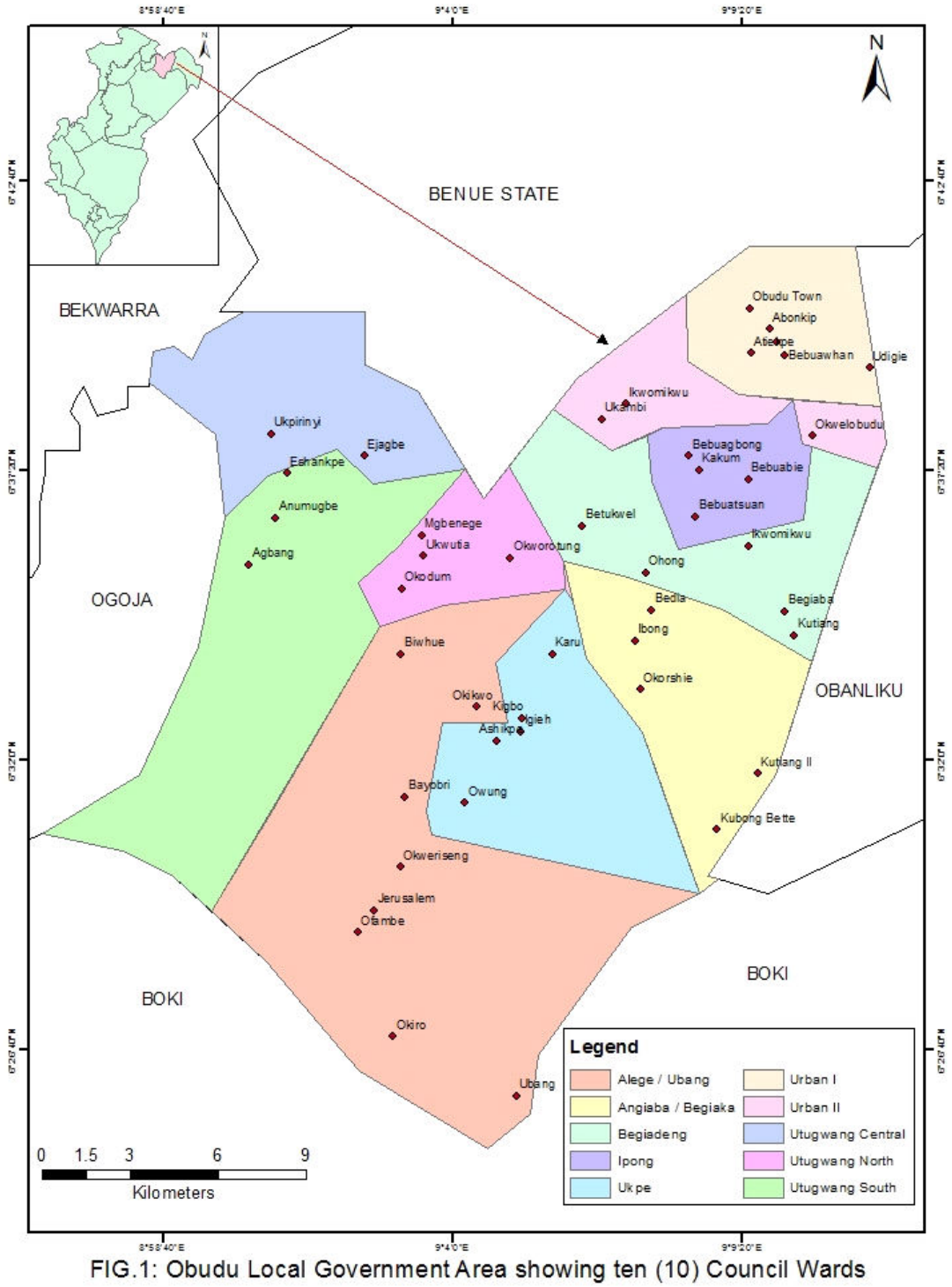

FIG.1: Obudu Local Government Area showing ten (10) Council Wards

Obudu is bounded by Vandeikya and Kwande Local Government Area to the South, Obanliku Local Government to the East, and Bekwara and Ogoja Local Government Areas to the West respectively (Oko and Okpiliya, 2019). The economy of Obudu is predominantly reliant on farming for food and cash crops. The soil is naturally fertile for agriculture and the people take a good advantaged of it. The inhabitants of Obudu are well versed in various farming techniques that make them renown in the production of yams, cassava, potatoes, rice,

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millet, pepper, locust beans, black eye beans, garden eggs, plantain and banana, cocoa, maize, melon, oranges, bush mangoes, oil palm etc.

Materials and method

Data for the study were obtained from the four micro agro ecological zones of the study area. The sample population used for the study is 400 respondents. To arrive at the sampled population, the number was determined statistically using the Taro Yamene's (1967) which gave a sample size of 400.
Simple random sampling was adopted in the selection of the respondents as seen in table 1.

Table 1: Sampled zones and sizes

S/NO	Micro agro ecological zones (MAEZs)	1991 Population of Obudu	2013 projected population	Proportionate sample	Percentage
1.	Montane	12,909	22,224	118	29.5
2.	Rainforest	10,431	17,941	95	23.8
3.	Swamps	10,266	17,382	94	23.5
4.	Guinea savanna	10,106	17,382	93	23.3
	Total		75,205	400	100

Source: Analysis by author, 2014

The remote sensing and the GIS technologies were adopted in carrying out the land use and land cover analysis of Obudu Local Government Area. Landsat Thematic Mapping (TM) of 1986 and Enhanced Thematic Mapping (ETM+) of 2000 and 2013 each with a spatial resolution of approximately 28.15km^2 were obtained from the United States Geological Survey (USGS). These three images covering a 28 year time span were chosen based on data availability and the need to capture meaningful changes within the period. In addition, an existing land use map of 1982 and large scale aerial photographs of 2000 of the area were acquired from Cross River State Ministry of land and used. The step wise methodology followed in the analysis was careful examination of the satellite imageries, development of an interpretation key, plotting of Obudu LGA boundary, geo referencing of the digital data, interpretation of the data, collection of ground truth data, editing, finalizing of maps and extraction of the statistical data for the different land use and land cover types. This was as seen and applied in the works of Singh and Loshali (2005), Laymond (2003), Acevedo *et al.,* (2003), Gourmelon*et al.,* (2004), Ashbindu*et al* (2001) and Jesuleye*et al.,* (2013).

The interpretation of the satellite imagery was onscreen using ArcView 3.2 software in a Window XP Professional operating environment. This was possible because the imagery was digital. The correction of overshoots and undershoots were done using Arc/Infor Software. Typology was established among the lines and polygons and the coding of the various land uses, layouts were developed for them and the final maps were produced. Quantitative data for the different land use types for the different time periods were then extracted.

Change detection analysis has been found to be an efficient method for discovering and monitoring the development trends or changes in the area (Williams, 1984). Change detection analysis was thus carried out in this study. This was calculated through simple subtraction of the previous inventory data from the correct one and the rate of the changes was determined by calculating their respective percentage values. Information on the population census data of Obudu was obtained from National Population Commission (NPC, 2007). Population growth trend of Obudu is as presented in Table 2 and figure 2 respectively.

Table 2: Population growth trend of Obudu from 1986 to 2013

S/N	Year	Population figures
1	1986	72,820
2	1987	75,077
3	1988	77,404
4	1989	79,804
5	1990	82,278
6	1991	84,799
7	1992	88,530
8	1993	92,425
9	1994	96,492
10	1995	100,738
11	1996	105,170
12	1997	109,797
13	1998	114,628
14	1999	119,672
15	2000	124,938
16	2001	130,435

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17	2002	136,174
18	2003	142,166
19	2004	148,421
20	2005	154,951
21	2006	161,457
22	2007	165,978
23	2008	170,625
24	2009	175,403
25	2010	180,314
26	2011	185,363
27	2012	190,553
28	2013	195,888

Source:*National Population Commission 2006*

The population of Obudu in the base year of the study was 72,820 persons. Within a period of ten years down the line, it increased to 100,738. Furthermore, it is observed from table 2 that in 2000, the population of Obudu was 124,938 while in 2005, it increased to 154,951. It is further revealed that by 2010 Obudu had a population of 180,314 which increased to 195,888 in 2013. This implies that Obudu has over the year been on steady increase though not following a regular pattern

From the result of the analysis of satellite images and aerial photograph, eight (8) categories of land use types were identified as seen in table 3.

Table 3: Land use types in Obudu (1986 to 2013)

S/NO	Class name	1986 (Ha)	2000 (Ha)	2013 (Ha)
1.	Mature forests	7834.27	6270.95	3602.28
2.	Bush fallow with trees	7519.95	7884.59	8223.77
3.	Bush fallow	4805.73	5150.09	4776.32
4.	Secondary forests	6124.77	6077.39	5210.82
5.	Freshwater swamp grassland	5185.17	6083.51	7023.51
6.	Mountain grassland	6610.14	6085l.73	5597.02
7.	Farmland	7466.31	6747.86	6636.19
8.	Built-up/bareland	2447.04	3693.26	6423.46
	Total	47993.38	47993.38	47993.38

Source: Author's fieldwork, 2014

Results and Discussion

Causes of population growth in Obudu Local Government Area

This section analyzes the factors causing poplation growth in the study area

Table 4: Shows the factors responsible for population growth in the study area

S/NO	Causes	% SA	%A	%D	%SD
1.	Lack of family planning and birth control	72	18	7	3
2.	Improvements in medical care and health facilities	69	20	8	3
3.	Decrease in mortality rate	90	8	2	0
4.	Illiteracy	56	22	18	4
5.	Advancement in science and technology	70	15	14	1
6.	Abundance of amenities	70	14	15	1
7.	Availability of job opportunities	90	3	7	0
8.	Good security network	84	11	4	1

Source: Fieldwork, 2014

Analysis of Table 4 shows that 90% of the respondents are of the opinion that lack of family planning and birth control is a factor responsible for the growth in population in Obudu, thus leading to a reduction in agricultural land. Population growth over the years has strongly contributed to changes in agricultural land use. The creation of Obanliku local government area out of Obudu has led to rapid transformation in land uses through erection of buildings and other physical development projects in Obudu. 89% of the respondents are of the view that improvements in medical care and health facilities are largely responsible for the growth in population in the area. People tend to migrate to areas with good medical facilities and health care. The table revealed that 98% of the respondents attested that decrease in mortality rate is a factor responsible for population growth in the study area. As less people die and more people are born, population increases geometrically overtime, hence posing a threat towards agricultural land use. 78% of the respondents reported

ISSN- 2394-5125 VOL 08, ISSUE 02, 2021

that illiteracy and lack of formal education has indirectly caused population growth in the study area. Without proper education, people do not know the consequence of having many children and depriving them proper education. 85% of the respondednts are of the opinion that the advancement in science and technology in Obudu has led to the increase in population. People tend to migrate to areas with advanced facilities, but on the other hand, 15% of the respondents refuted this assertion. 84% of the respondents are of the view that the abundance of amenities in the area has attracted population. Furthermore, 93% of the respondents attributed the growth in population in the area to availability of job opportunities and improved standard of living which attracted population in the study area and which subsequently put pressure on available agricultural land in the area, while 95% of the respondents opined that population growth in the area is due to good security network. People generally feel secured living in areas with maximum security network.

Impacts of population growth on agricultural land use

Table 5: Land use changes in Obudu for the periods 1986 – 2013

S/NO	Land use classes	Areas in the 1986	% of area ihn 1986	2000 (Ha)	% of area in 2000	2013 (Ha)	% of area in 2013
1.	Mature forest	7834.27	16.3	6270.95	13.0	3602.28	7.5
2.	Bush fallow with trees	7519.95	15.6	7884.59	16.4	8223.77	17.1
3.	Bush fallow	4805.73	10.0	5150.09	10.7	4776.32	9.9
4.	Secondary forests	6124.77	12.7	6077.39	12.6	5210.82	10.8
5.	Fresh water swamp grassland	5185.17	10.8	6083.51	12.6	7023l.51	14.6
6.	Mountain grassland	6610.14	13.7	6085.73	12.6	5597.02	11.6
7.	Farmland	7466.31	15.5	6747.86	14.0	6636.19	13.8
8.	Built-up/bareland	2447.64	5.0	3693.26	7.6	6423.46	13.4
		47993.38	100	47993.38	100	47993.38	100

Source: Analysis by author, 2014

Table 5 gives a breakdown of the change analysis results as derived from the images for three epochs under study. From the table, it is seen that while bush fallow with trees, fresh water, swamp grassland and built-up/bareland areas are rapidly increasing in sizes, mature forests, secondary forest, mountain grassland and farmland (agricultural land) are declining.

In 1986, farmland accounted for 7466.31 ha representing 15.5% of the areal extent of the study area. The land use distribution of Obudu for the year 2000 showed that built up/bareland category continued to show increasing prominence with its 3693.26ha (7.6%) coverage. The agricultural land use (farmland) has diminished to 6747.86 (14%) of the total land area. The 2000 land use distribution shows that the farmland (agricultural land use) occupied 6747.l86ha (14.0%) of the total land area while the farmland category has further diminished to 6636.19 ha (13.8%).

From figures 3, 4 and 5 and table 5, it is observed generally that the built-up/bareland, bush fallow with trees and fresh water swamp grassland kept on increasing in areal extent from 1986 to 2000 and to 2013. On the other hand, there was continuous loss of agricultural land use (farmland) especially from 1986 through 2000 to 2013.

Ho: There is no significant relationship between population growth and agricultural landuse.

Hi: There is a significant relationship between population growth and agriculoturallanduse.

To test this hypothesis, data in table 3 was used. More so, the Pearson Correlation coefficient was employed as the test statistics. This is deemed fit because the essence is to establish the nature of relationship between agricultural land use change and population count in the study area. The result of the analysis is presented in Table 6.

Table 6: Summary of Pearson correlation coefficients of the relationship between the components of land use and population growth trend in Obudu

S/NO	Sub-component of land use	Correlation coefficients	P-value
1.	Mature forest	-0.998	0.039
2.	Bush fallow with trees	0.999*	0.029
3.	Bush fallow	-0.158	0.899
4.	Secondary forest	-0.819	0.389
5.	Fresh water swamp grassland	0.997*	0.048
6.	Mountain grassland	-0.994	0.069
7.	Farmland	-0.884	0.310
8.	Built-up/bareland	0.992*	0.079

* Significant at = 0.05

Source: Analysis by authors, 2014

ISSN- 2394-5125 VOL 08, ISSUE 02, 2021

From the table, it could be observed that bush fallow with trees ($r = 0.999$, $p < 0.05$) is the only land use/land cover that has significant positive relationship with the population growth trend, indicating that as the population of the area increases, these land use also increases.

However, mature forest ($r = -0l.998$, $P< 0.05$) was found to have significant inverse relationship with population growth trend, showing that as population grows, the land use/land cover for mature forest decreases. Notwithstanding these, built-up areas/bareland is also on the increase ($r = 0.992$, $P<0.05$) as population is increasing, but the level of increment did not justify statistical significance.

Furthermore, mountain grassland ($r = -0.994$, $P>0.05$) farmland ($r = -0.884$, $P> 0.05$), secondary forest ($r = 0.819$, $P>0.05$) and bush fallow ($r = -0.158$, $P>0.05$) have inverse relationship with the population growth trend of the area. This shows that as the population of the area is on the increase, mountain grassland, farmland, secondary forest and bush fallow are on the decrease. However, the decreased did not justify statistical significance. In the light of this, the null hypothesis which states that there is no significant relationship between population growth trend and agricultural land use is rejected while the alternate hypothesis is upheld.

Implications of population growth on agricultural landuse in Obudu

The implication of rapid population growth on land uses especially on agricultural land use cannot be overemphasized. That is why land disputes between communities in Obudu and the neighboring communities in Benue State constitute a major challenge to the government of Cross River State and Obudu local government area in particular.

There are direct and indirect economic implications of the changing pattern of agricultural land use. The loss of agricultural land and forest implies a reduction in available land for economic activities thereby reducing the means of the livelihood of those who depend on the land. Another economic implication of the loss of agricultural land and the forest is the loss of breeding grounds for many flora and fauna and subsequent reduction i8n biodiversity. Other implication associated with the increasing loss of agricultural land is in the area of food security.

In addition, land use change generally is increasingly recognized as a major driver of environmental change, while its positive impacts may be associated with negative and positive influences that affect the ability of biological systems to support human needs (Chhabra *et al.,* 2005). From experience, while the positive impacts are in the short run, the negative impacts increases with time from the short to the long run. Some of the positive impacts include resource use efficiency, wealth, livelihood security, welfare and human well being. However, the undesirable and negative impact of land use changes which are very profound include massive alteration of biogeochemical series, ecosystemprocesses, earth atmospheric interactions, loss of biodiversity etc.

According to Awosika( ), the cutting down of mangroves for fuel wood and construction of homes has been blamed for the depletion of about 50% of the forests in Nigeria. Other impacts include socioeconomic consequences that are detrimental to agriculture and tourism.

Summary and conclusion

The study examined the implications of population growth on agricultural land in Obudu, Nigeria. Findings revealed that rapid population growth is responsible for the decline in agricultural landuse in the study area. The improvements in basic amenities and infrastructural development in the area has also constituted to population growth in the area which resulted to increased fertility and lowered mortality rates. Improvements in healthy facility has equally caused the study area to become favorite region to live and receive medical attention. Others include the availability of job opportunities which has continued to act as pull factors for job seekers, improvements in standard of living and housing quality has also resulted to increased population of the area and the good security network in the area has pulled people to the area for safety leading to expansion of the study area to accommodate the immigrants. The relationship between population growth trend and agricultural landuse as evaluated showed that as population grows, the available agricultural land diminishes.

Recommendations

Based on the findings and conclusion of the study, the following recommendations are made;

- More land should be alternated for agricultural land against other land uses. Moreso, strict laws should be passed to tackle agricultural land use conversion to other uses. Laws regarding agricultural land use violation should be made strict and offenders sanctioned. Agricultural land use violators should be made to pay huge fines as penalty for their offences.
- Family planning programme which will help to educate the citizens should be introduced to guide against population explosion.
- Development control should guide against haphazard and illegal developments.
- Finally, care must be taken to ensure that agricultural land are protected from unnecessary sprawl.

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