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Assessment of the Impact of Urban Expansion on Land Use Changes in New G.R.A Gombe, Gombe State, Nigeria

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ABSTRACT

The study sought to assess the implication of urban expansion on land use changes in New G.R.A. Gombe. The specific objectives of the research were to examine the major causes of land use changes in the study area, analyze the pattern of the land use changes in the New G.R.A Gombe and evaluate the effects of urban expansion in New G.R.A Gombe. Remote sensing data on land use/land cover change for the period of 2008-2018 together with any historical information and archived reference data were used to compute spatial/temporal changes in the expansion of urban settlement and extent of land use/land cover changes. Change detection analysis was performed through G.I.S overlay operations. The study revealed a significant change of land-use/cover between 2008 and 2018 indicating rapid increase in urbanization. Forest land decreased by (10%), bare land (1.27%) and agricultural land (9.53%). 53% of agricultural land was converted to built-up land. Declining agricultural land, increase in unemployment, changing social interaction and lifestyles, increasing land values and housing costs were some of the effects of rural land transformation. The measures put forward to control the rapid land use conversions included zoning for the various land uses, land-use planning and management. The study calls for a combined approach, which involves participation of all the stakeholders in management and planning of land as a vital resource. Hence, stakeholders' participation should be given first priority in land use planning and management process as well as the cost benefit analysis of land use conversions.

Key words: Expansion, Gombe, Impact, Land use changes, Urbanization

1. Introduction

In the last few decades, substantial growth of urban areas has occurred worldwide with population increase being one of the most obvious agents responsible for this growth (Araya and Cabral, 2010). The world urban population has increased from 0.73 billion in 1950; 1.51 billion in 1975 to 3.42 billion people in 2009, and is projected to double (6.29 billion) by 2050 (UNDESA, 2010). In Africa, the urban population is projected to be more than double. By 2030, and by 2050, there will be more than 1.2 billion African city dwellers (UN-HABITAT, 2008).

Gombe state being Nigeria principal economic and cultural centre is one of the smallest and fastest growing cities in Northern Nigeria. It has experienced a rapid growth over the last 10 years in terms of population and spatial extent. The increasing demand for land in Gombe has led to the city expanding to its rural fringes to cater for residential, commercial, industries, and recreational developments. According to the Gombe Rural and Urban Development Board

(2010), 60% of new housing development in Gombe town, especially in new G.R.A is occurring in peri-urban zones. These are parcels of fertile agricultural land being converted for urban developments (principally, residential use) at an alarming rate. The result is that urban development is expanding in to agricultural land, without due consideration for its effects on agricultural practices. Gombe that has been known for the production of cereal crops and perishable crops such as maize and vegetables consumed in Gombe and its environs, has declined tremendously as result of agricultural land being converted to residential and commercial uses. However, there have been very limited detailed and comprehensive attempts (as provided) by Remote Sensing data and GIS tools to evaluate this status of changes over time with a view to detecting the rate of land use/cover change due to minimal monitoring of urban expansions attributed to ill-equipped land monitoring system. In view of this, there is the need to effectively and efficiently deal with land use conversion based on well-founded knowledge of the planning and management response to land use changes. Consequently, there is need to examine the causes, extent and rate to which urban expansion has affected agricultural land use in Northern area of Gombe.

The aim of the research is to analyze the effect of urban sprawl on agricultural land in new G.R.A of Gombe state. Specifically, the study analyzed the major causes of urban expansion the study area, identified the pattern of urban expansion of new G.R.A Gombe as well as examined the implication of urban expansion on land use in the study area. Rapid urbanization resulting into abysmal decrease in agricultural land in favor of the provision of residential accommodation and other infrastructure necessitated the study. The study spanned from 2008 to 2018 and focused on impacts, causes, consequences and patterns of urban expansion in the study area.

2. Literature Review

2.1 Definition of concepts

2.1.1 Urbanization

Urbanization is the process of evolution of urban settlements. It can be seen as a process by which rural areas are transformed in to town areas via the growth of city population and natural increases of population (Bakure, 2005). According to Wikipedia dictionary, urbanization refers to the increasing number of people that live in urban areas. It results predominantly in the physical growth of urban areas, be it horizontal or vertical and is closely linked to modernization, industrialization and the sociological process of rationalization. So the term urbanization can represent the level of urban development relative to overall population, or it can represent the rate at which the urban proportion is increasing. By 2050, it is predicted that 64.1% and 85.9% of the developing and developed world respectively will be urbanized (The Economist, 2012)

2.1.2 Land Use

Land is defined as a place on which all human activity is being conducted. Hence, use of land resources by the people gives rise to "land use". Land use varies with the purposes it serves, land could be used for food production, provision of shelter, recreation, extraction and processing of materials (Shaghla, Jasmeen and Bushra, 2018). Therefore, land use involves the management and modification natural environment or wilderness into built environment such as settlement and semi natural habitat such arable fields, pasture and managing wood. It has also been defined as the total of arrangements, activities and inputs that people undertake in a certain land cover type (FAO, 1997). Hence, Land use concerns the function or purpose for which land is used by

the population. In other words, it refers to human activities that are directly related to land, making use of its resources or having an impact on them.

2.1.3 Land Use and Land Cover Changes

Land-Use Change means to change the way land is used, for instance, clearing of forests for agricultural use, including open burning of cleared biomass. According to Briassoulis (2005), land use and land cover changes refer to (quantitative) changes in the aerial extent (increases or decreases) of a give type of land use or land cover, respectively. The author further reiterated that land cover cahanges may result either from land conversion (a change from one type to another),or land modification (alterations of structures or functions without a wholesale change from one type to another), or even maintenance of land in its current condition against agents of change. In the same way, land use change may encompass either conversion from one type of use to another (i.e.,changes in the mix and pattern of land uses in area), or modification of a certain type of land use (i.e. changes in the intensity of use or alterations of its characteristics, quality or attributes).

2.2.4 Factors of land use change

Land use/cover changes are influenced by a variety of factors. According to Kiita (2013), the five factors likely to cause land use change include under resource scarcity, natural population growth and division of land parcels, which may cause slow land use changes while decrease in land availability due to encroachment by other land uses may cause of fast changes. Changing opportunities created by markets, especially improvement in accessibility through road construction may be another common cause of land use change. Outside policy intervention, especially poor governance and corruption and rapid change in policy may be another cause of land use change (Mundia and Aniya, 2005).

Perhaps the most notable causes of land use changes in Nigeria may be changes in social organization, resource access and attitudes occasioned by changes in institutions governing access to resources by different land managers. Other factors include growth of urban aspirations; growth of individualism and materialism and lack of public education and poor information flow on the environment (Mundia and Aniya, 2005). In Gombe, the main drivers influencing land use changes are the rural-urban fringe, housing and land market failure, population increase, weak and conflicting institutional regulations, social-cultural and economic drivers (Thuo, 2013).

2.2.5 Implications of land Use change

In many developing countries, urban expansion is at the expense of productive and fertile agricultural farmland. Thengvel and Sachithandan (2010) reported the case of Abeokuta metropolitan in Oyo state that the residential areas that was 4,314 hectares of farmland in 2012 increased to 20,747 hectares in 2015 creating environmental problems. Also, Egypt lost more than 10% of the productive farmland owing to urban expansion (Hardoy, 2010, cited by Minwuyele 2009). According to Cooney (2008), when sprawl takes place at the periphery of a certain locality it has direct or indirect impact on other parts of the same locality within its border or on a neighboring community. The consequences of rapid urbanization on peri-urban areas include changing labour and market conditions, loss of farmlands, changes in social and cultural lifestyles. Planning and development control become a problem where existing institutions are not adequately structured to handle

consequences of urbanization (Thuo, 2013). The rapid urban expansion in developing countries is usually associated with unplanned development in the periphery that requires high cost of infrastructure. It is also evident that even in planned activity; the development of infrastructure usually does not correspond to the large tract of land that develops in a low-density pattern. Thus, urban expansion consequently results in social, environmental and economic problems to the society (Abdissa, 2005).

3. Materials and Methodology

3.1 Study area

New G.R.A is located at latitude 10^0 16' 30''N and longitude11^0 8' 30''E. The area is an extension of urban Gombe to the south of the town. The new G.R.A climatic setting is characterized by distinct seasons such as dry season (November-March) and wet season (April-October). That is, the higher temperature regimes of dry season are characterized by the dusty and sunny conditions, the wet season condition is associated with torrential rain which causes flooding. The soils of the study area are typically ferruginous types. They are dark gray in color with a PH value of 4.6 (Abba et al.,1999). The vegetation comprises of light close canopy with sprinkling of under shrubs and a sparse growth of grasses to a more open grass of lesser height, more spreading, stunted shrubs and dense growth grasses. Other vegetation types include stunted shrubs and stumpy trees of sixteen to twenty feet high. Abba et al (1999) stated that, the vegetation and ecology of the area have been adversely affected by excess cultivation, bush burning cutting down of trees for fuel wood, population increase, construction of road, houses, schools bridges and play field, the creation of industries, the state agricultural development programs etc.

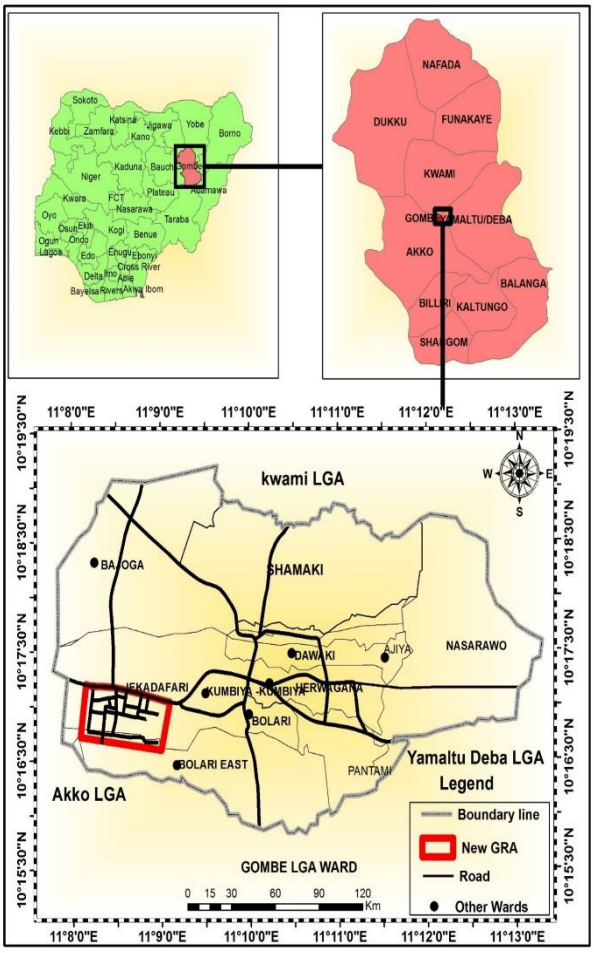

Figure 3.1: Study Area
Source: GIS unit, Geography Department, Gombe State University, Gombe.(2019)

3.2 Methodology

The data for study were obtained from both primary and secondary sources. The primary sources of data were interviews and questionnaire administration. Data gathered for this research included demographic and socio-economic characteristics of respondents, information on land use changes, causes, patterns and implications on agricultural. The secondary sources of data were derived from previous research work, journals and article publications from the library, internet etc. Two-stage sampling technique was employed for the study. Firstly, New GRA was divided into two i.e. north and south using the major road that passes through the heart of the community. Secondly, major streets within each division

were identified and questionnaire administered to household systematically on the bases of every second and third household in each street until the required number of sample was obtained. To obtain the sample size for the study, Yamane (1967) technique of sample size determination was employed. The population of New GRA was 762 based on INEC, 2015 number of registered voters in the community (Table 3.1). Using Yamane (1967) table of sample size, a population size range between 700 and 800 could be **163 (**precision of error of 7%**).** Hence, a sample size of 163 was used for the study.

3.1 Methods of data analysis

The information on the effects of urban expansion on agricultural land use and development as it relates to new G.R.A area of Gombe state was obtained from the field through questionnaire administration and oral interview. These were carefully analyzed using descriptive statistics for proper understanding. In addition, the following GIS methods were adopted to detect the land use/land cover changes. Firstly, satellite image (Landsat8 for 2004, 2008 and 2018) was acquired; this was followed by the land use classification (Land use, land cover) of the study area. Change detection technique using Erdas or GIS application to know the change in the urban sprawl was carried out. Lastly, the land cover was calculated based on the following categorization: settlement, waterbody, farm/cultivated land, vegetation etc.

4. Results and Discussion

4.1 Socio-Economic Characteristics of Respondents

Data on the socio-economic characteristics of the respondents is depicted in Table 1. These include information on sex, age, marital status, educational qualification, household size and income status of the inhabitants of New GRA Gombe. Regarding age distribution of respondents, Table 1 has shown that the age of respondents ranges from 20 years to more than 50 years. Table 1 further revealed that majority of the participants 57 (43.2%) fell between the age brackets of 31 – 40 years of age. This has shown that most of the respondents were young and active and were the most affected by urbanization in New GRA Gombe. With respect to sex, Table 1 disclosed that out of the 132 participants in this study, 144 respondents, representing 86.4% were male participants. 18 respondents, representing 13.6% were female participants. The greater percentage of male participation (86.4%) indicates that male households dominate in New GRA Gombe. The low percentage of female participation is attributable to gender bias occasioned by possible cultural afflictions noticeable in our national life. Hence, Berem, Obare and Owuor, (2010) acknowledged that women have limited right to property in Africa and this limit their access to landed properties. Concerning educational attainment of respondents, Table 1 has depicted that the studied participants had varying forms of education. Out of 132 respondents, 11 (8.3%) attained tertiary education, 89 (67.4%) completed primary education, 20(15.2%) had attained Islamic education, while 12 (9.1%) had informal education. This has revealed that a greater percentage (67.4%) of the participants had primary education indicating low literacy level of the respondents. This result is contrary to general beliefs that Gombe being a cosmopolitan town, serving as state headquarters and center of many tertiary institutions would have given the inhabitants opportunities to be more educated. As regards marital status, Table 1 disclosed that 18 respondents representing 13.6% were single, 69 participants representing 52.3% were married, and 21 subjects representing 15.9% were separated, whereas 24 representing 18.2% were divorced. This analysis has depicted that the married constituted a greater

proportion (52.3%) of participants. This is followed by the divorced, separated and single respectively.

Table 1: Socio- Economic Characteristics of Respondents (132)

Characteristics	Frequency	Percentage
Sex		
Male	114	86.4
Female	18	13.6
Age		
20-30	23	17.4
31-40	57	43.2
41-50	33	25.0
Above 50	19	14.4
Education		
Informal	12	9.1
Islamic	20	15.2
Primary	89	67.4
Tertiary	11	8.3
Marital Status		
Single	18	13.6
Married	69	52.3
Separated	21	15.9
Divorced	24	18.2
Household size		
1-5	28	21.2
6-10	32	24.2
11-15	44	33.3
16-24	16	12.1
Income		
10000	48	36.4
20000	41	31.1
50000	21	15.9
51000	22	16.7

Source: Fieldwork, 2018.

In terms of household size, it can be seen from Table 1 that a greater proportion (44%) of the respondents had household size of 11 – 15 persons. Next in percentages are 24.2% (6-10), 21.2% (1-5) and 12.1% (16-24) respectively. Table 1 further displayed household monthly incomes. It has demonstrated that 48(36.4%) participants earned ₦10000, 41(31.1%) earned ₦20, 000, 21 (15.9%) earned ₦50, 000, while 22(16.7%) earned 51000. This result has expressed that more than one- third (36.4%) of the participants earned ₦10000 monthly indicating that a greater proportion of the respondents have low economic status.

4.2 Factors of Land Use Change

Data from the field suggest that over the last two decades, land use in New GRA Gombe has been changing from predominantly agricultural (from cropping and animal husbandry) uses to non-agricultural uses, such as provision of residential and recreational space, transportation facilities, and industrial production. This is mainly dictated by the urbanization phenomenon. The increasing demand for land in New GRA has led to rapid expansion of the community to cater for urban developments such as residential, commercial, industries, and recreational growths. Table 2 expresses data on reasons for changes in the value of land in the study area. Majority (43%) of the respondents affirmed that the rapid changes in land uses in the study area were because of the increasing number of people in the metropolis. Since the creation of Gombe state over two decades ago, it has been increasing in population with persistent needs and demands, which involve the use of land. As increases in population comes with the increasing demand for land, it is not out of place to see large family sizes exert pressure on family lands as family members demand land for activities such as farming, residential and commercial purposes. This ultimately leads to land fragmentation resulting in smaller parcels of land available for agriculture.

Other reasons given for land use changes in the study area were growth in commerce (17%), change in attitude towards land (24%)

and migration (16%). The increasing commercialization of New GRA is one of the major factors accounting for the land use changes as indicated by the respondents. There is no doubt that pressure in the community has forced some dwellers to move to the peripheral areas. Residential lands in prime locations in the community center are being taken over by commercial activities while at the same time prime agricultural lands in the peripherals are also being taken over by residential developments.

In terms of change of attitude towards land, 67.4% of the participants had primary education indicating low literacy level of the respondents. However, due to public education and other civil organizations in the community, many landowners are being enlightened about issues concerning land. This obviously influences the nature and use of land in the community.

Table 2: Reasons for Change in Land Use

Reason	Frequency	Percentage
Population increase	57	43
Growth in commerce	22	17
Change in attitude towards land	32	24
Migration	21	16

Source: Fieldwork, 2018.

4.5 Pattern of Land Use Change

The changes occurring in land use in New GRA, Gombe are very rampant. The major cause of this change is urbanization. It is having a negative impact on the form and structure of the community. Property owners and caretaker chiefs revealed a swift change in the use of land in and around the metropolis. Figure 3 displays information on land use ten years ago and now. Results in figure 3 showed that 56% of lands acquired ten years ago were used for agricultural purposes,12% (commerce), 24% (residential) and 8% (local industry) respectively. Regarding current years, 47% of land acquired was used for residential, 29% (commerce), 8% (agriculture) and 16 % (local industry) correspondingly. With this situation, one can conclude that agriculture played a significant role in New GRA community where majority of its land acquired were used for agriculture ten years. However, the current changes in land uses have therefore posed serious consequences on agriculture as the agricultural land base was reduced (from 56% to 8%) leading to less land available for agriculture. This result is in harmony with a study undertaken by Francis, Romanus and Raphael (2013) in Tamale, Ghana that rapid urbanization sparked up a succession syndrome where prime agricultural lands were converted to residential and other land uses believed to be the highest and best use.

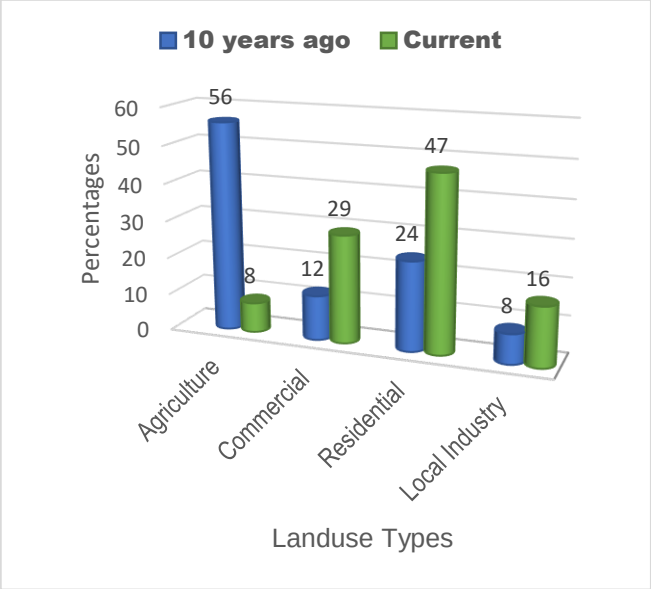

Figure 3: Land use before and Now
Source: Fieldwork, 2018.

4.6 Mode of Land Acquisition

Figure 4 demonstrates information on the mode of land acquisition. A greater

percentage (83%) of the respondents acquired land through purchase, 38% got land by inheritance from family members, while 11% were given land as gifts from friends or family members. Hence, the major means of land acquisition in the community was outright purchase.

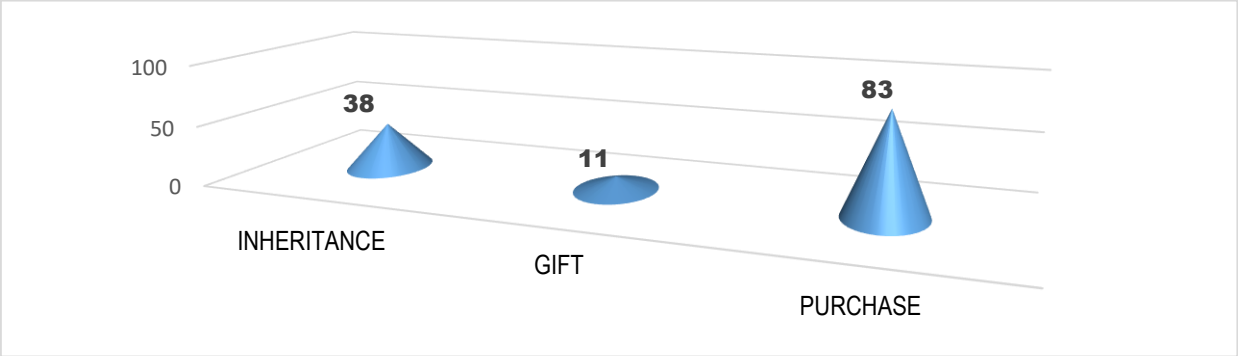

Figure 4: Mode of Land Acquisition
Source: Fieldwork, 2018.

4.7: Land Use and Land Cover Change between 2008 and 2018

From the ground truth data and classified Landsat images of 2008, 2014 and 2018, the study area has undergone various land-use and land cover changes. The general statistics for land use land cover distribution for 10 years' period covered as derived from the thematic maps are presented in the Table 3.

Table 3: Land use/Land cover Change between 2008, 2014 and 2018

Land Use Category	2008		2014		2018	
	Area(Ha)	Area (%)	Area(Ha)	Area (%)	Area(Ha)	Area (%)
Bare surface	18581.81	1.42	9987.01	0.73	1885.28	0.15
Farm land	1002749.55	76.78	875455.10	63.84	860344.55	67.15
Settlement	125252.04	9.59	450403.04	32.84	390681.36	30.49
Vegetation	159436.82	12.21	35553.59	2.59	28322.48	2.21
Category Total	**1306020.22**	**100**	**1371398.74**	**100**	**1281233.67**	**100**

Source: Fieldwork, 2018.

Table 3 has shown that agricultural land comprising of rain fed arable lands, cropland with permanent crops, farming and fallow land occupied the largest area (78%) i.e. 1002749.55 hectares in 2008. Settlement comprising of residential, industrial and commercial units occupied 10% (125252.04 hectares) in 2008. Bare land comprised of all vacant spaces, sands, rocky areas and cleared lands, which occupied 18581.81 hectares (1.4%), whereas vegetation, occupied 12.2% (159436.82 hectares).

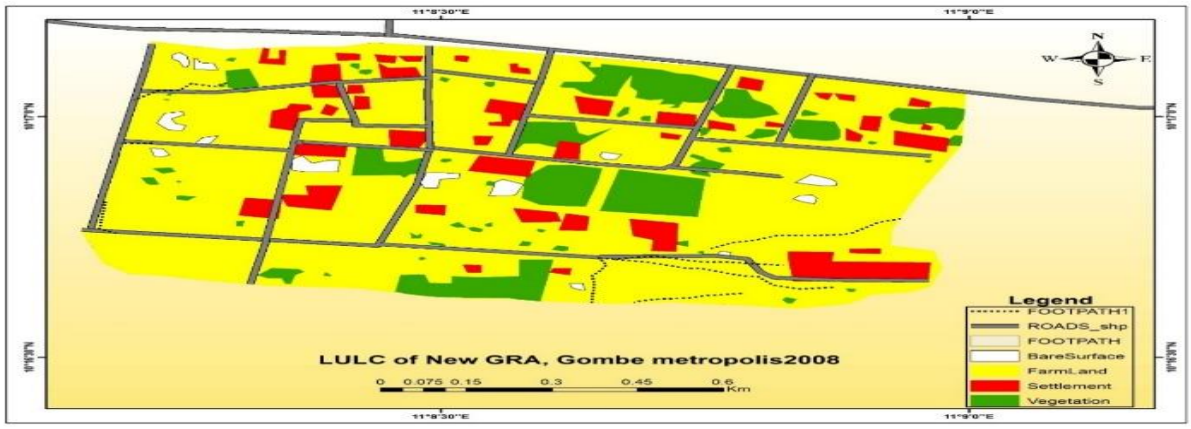

Plate 1: LULC New GRA, Gombe State (2008)
Source: Fieldwork, 2018.

In 2014, the agricultural land in the study area covered 875455.10 hectares (Table 3). This has indicated a 13% decrease in agricultural land from the 1002749.55 hectares recorded in 2008. However, the area under settlement occupied 450403.04 hectares, showing an increase of 23.25% as against 125252.04 hectares in 2008. Similarly, decrease occurred in bare land; 9987.01 hectares 2014 and 18581.81 hectares in 2008. The increase in urban population raises the demand for urban land, that is, more housing developments. Aguilar (2008) observes that rapid urban population increase means an increasing demand for urban land, particularly for housing. The area covered by vegetation occupied 35553.59 hectares in 2014 and decreased to 159436.82 hectares in 1986, as a result of the increased deforestation mainly for charcoal burning, encroachment of people for farming, building of residential and commercial purposes.

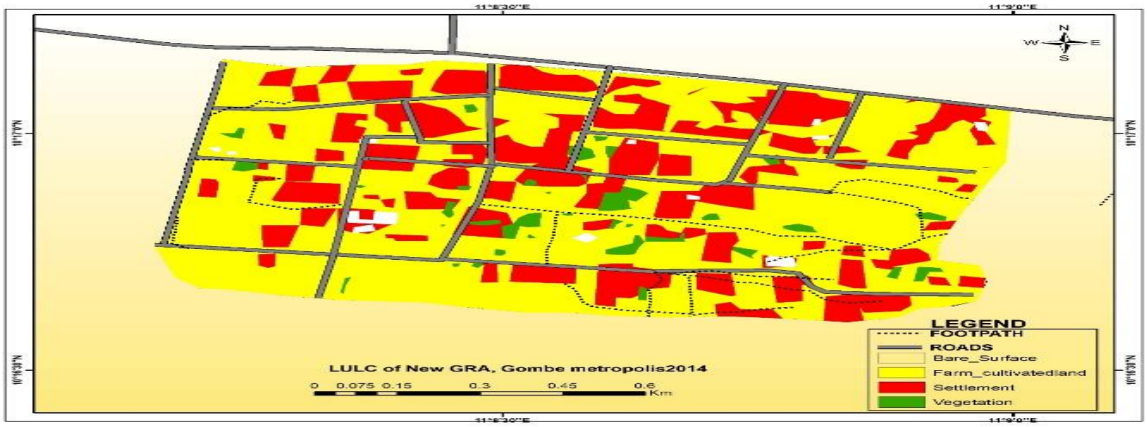

Plate 1: LULC New GRA, Gombe State (2014)
Source: Fieldwork, 2018.

In 2018, the area under agricultural land had decreased to cover 28322.48 hectares. Similarly, settlement had decreased to an area of 390681.36 hectares, representing30.49 % of the land area in the study area. The increase in built-up land area coverage is attributed to the further increase of population that continues to raise the demand for residential

development and other amenities. The area under Forest decreased to 28322.48 hectares as compared to 875455.10 hectares recorded in 2014.

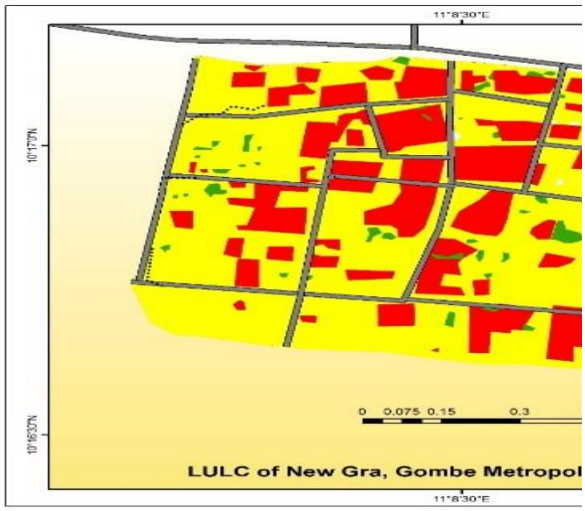

Plate 1: LULC New GRA, Gombe State (2018)
Source: Fieldwork, 2018.

4.9 Changes in size of farm land

Acreage under crops in the study area is on the decline. The decrease is attributed to the increase in population that has continuously led to the demand for land for residential, commercial and infrastructure developments and the low producer prices due to lack of value addition and high costs of inputs (DAO, 2009). According to the survey, most landowners have lost their land to residential use. The study depicted that, 63% of farmers currently have farms below 50 hectares as against 51% of farmers who owned land below 50 hectares ten years ago. It is again clear that 8% of the respondents owned land above 70 hectares ten years ago as against 4% of farmers who owned land above 70 hectares now (Figure 5)

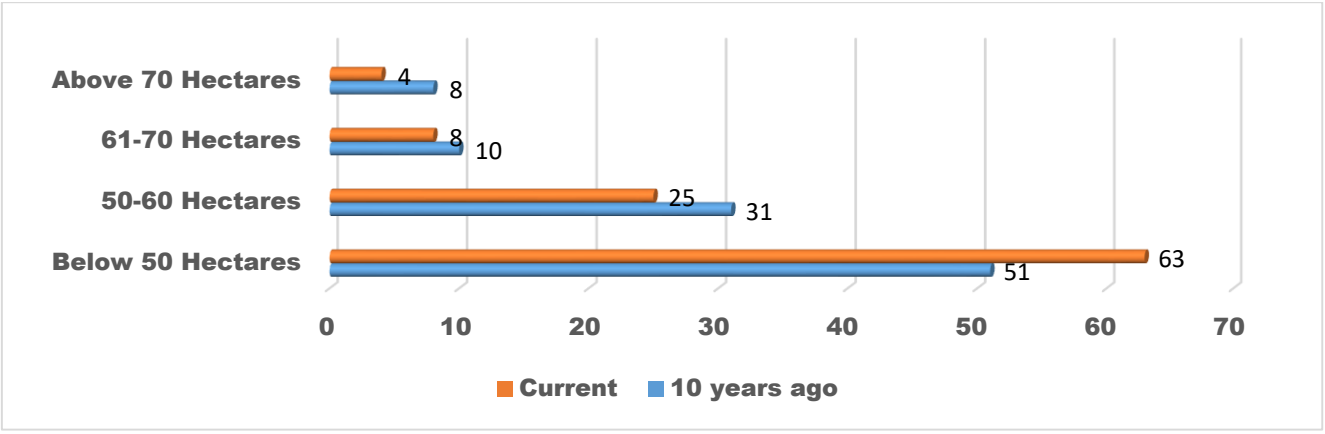

Figure 5: Average size of land 10 years ago and Now.
Source: Fieldwork, 2018.

4.10 Changes in Land Value

As indicated in Table 2, land values 10 years ago were very moderate in New GRA, Gombe. Majority of land sales according to the field 50,000.00. The situation has changed because of the survey were sold below ₦ rapid land use changes of the area. Land values have more than 1000-fold increment over just 10 years. The study confirmed that majority of land sales are now above ₦200,000. This has serious consequences as the vulnerable in the society are unable to cope with these rapid increases in land values and hence are always outwitted. This calls for interventions, as they would always continue to be sidelined in the bid for land. It was observed from the field survey that Land in the Central Business District attracts higher values than those at the periphery of the study area. Because of this, large tracks of land are being purchased at the peri urban areas by residential developers as well as other speculators.

Table 4: Value of a Plot of Land Ten Years Ago and Now

Value	Ten years ago		Current	
	No.	%	No.	%
Below 50,000	54	41	23	18
50000-100000	36	27	16	12
101000-200000	37	28	26	20
Above 200000	5	4	67	51

Source: Fieldwork, 2018.

4.11 Implications of Land Use Changes

Generally, land values in urban settings are high. This is due to the influx of people into these areas. The high population is associated with increased need for accommodation and jobs. This therefore calls for extra space for development of residences, commercial centers, industrial sites and other public institutions. Table 5 expresses information on the implications of land use changes in the study area. Results in Table 5 indicates that agricultural decline, loss of income from agriculture and scarcity of land for agriculture ranked 1 with mean scores of 3.4. This is followed by loss of farmland to housing ranked 4 with a mean score of 3.3, food insecurity and soil degradation ranked 5 with a mean score of 3.1, economic transformation away from agriculture graded 7 with mean score of 2.9 and agriculture intensification and commercialization categorized 8 with a score of 2.5. The forgoing analysis implies that land uses changes in the study area had adverse impacts on agricultural land use.

Table 5: Implications of Land Use Changes

S/n	Effects	SA	A	D	SD	Mean	Rank
1	Food Insecurity	70	28	12	22	3.1	5
2	Loss of farm land to housing	84	21	11	16	3.3	4
3	Agricultural Decline	79	32	21	00	3.4	1
4	Loss of income from agriculture	82	35	2	13	3.4	1
5	Scarcity of land for agriculture	83	27	11	11	3.4	1
6	Soil degradation	68	34	10	20	3.1	5
7	Economic transformation away from agriculture	52	45	8	27	2.9	7
8	Agriculture intensification and commercialization	48	13	29	42	2.5	8

Source: Fieldwork, 2018.

Note: SA= strongly agree, A=Agree, D=Disagree, SD=strongly disagree

4.12 Conclusion

With major changes being agricultural land use giving way to residential land use in the peri urban area and residential land uses giving way to commercial land uses in the city, access to agricultural land is drastically reduced causing food insecurity problems. As

witnessed in the study area through satellite image analysis and interviews as well as observations, it is possible to conclude that urban sprawl has resulted to increased pressure on the natural land. In addition, urban sprawl has negatively influenced agricultural land resulting to conflict of interest in land uses between agricultural uses and built up urban uses.

4.13 Recommendations

Based on the findings of the study the following recommendations are made:

I. **Participation of stakeholders in land use planning process and urban planning**. It is only when the public and land owners are well informed about land management issues that a positive change of attitude, adherence to laws on land use among others can be achieved.

II. **Regulations on sale of land**: The local government and the federal governments should come up with policies to outlaw arbitrary sale of land especially in areas where the main form of land use is agriculture to enhance the effectiveness of zoning regulations.

III. **Mixed land uses**: There is the need to encourage the adoption of mixed land uses by property developers to prevent the wiping out of certain land uses.

IV. Costs benefit analysis: Cost benefit analysis of land use conversions to alternative uses should be carried out for posterity and sustainability of agricultural sector against urban land uses.

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