Analysis of Urban Expansion on Agricultural Food Production in Calabar, Nigeria

U. M. Ogban, M. A. Oyinloye, and O. S. Aboyeji

ABSTRACT

Urban growth appears to have direct effects on the available agricultural land in and around urban area which in turn affects food production and other agricultural activities in the city. Indiscriminate urban growth and increasing losses of agricultural lands have become an issue in developing countries. The aim of this study is to use Remote Sensing and GIS to monitor the impact of urban expansion on agricultural food production in Calabar, Nigeria. Landsat images of 1986, 2003 and 2018 of Calabar municipal and Calabar South were obtained. The study employed supervised digital image classification method using ILWIS 3.2 and ArcGIS 10.2a software. GIS software was used to classify the landuse into built-up area, natural vegetation, bare soil, agricultural land and water bodies. Also, a set of structured questionnaire were administered using the stratified random sampling technique to elicit information on the socio economic and driven factors responsible for conversion of agricultural landuse, effect of urban expansion on agricultural food production and measures adopted to preserve agricultural land uses. The results revealed increase in urban expansion on food production over the periods (1986–2018). Recommendations were provided that will reduce the rate of urban expansion on agricultural food production in the study area.

Keywords: agricultural food production, GIS, Supervised digital image.

I. INTRODUCTION

Urban growth/ expansion and agricultural development have become global issues for decades. Developed and developing countries are seeking sustainable solution to manage the effects urban growth has on agricultural lands and urban food security [1].

Most cities in developing countries are experiencing rapid spatial expansion. People move to the city in search of better employment and opportunities [2]. This leads to an increase in size well beyond the limits of the city. Often, these growths lead to other problems associated with decrease in available agricultural lands around the cities [3]. Urban expansion as a result of rapid urban growth is one of the foremost threat facing agricultural lands in Nigeria [4]. It occurs in ever widening bands surrounding large urban centres, it often emanates from disconnected developments and single family homes that are established outside urban areas well beyond city limits, but usually within commuting distance to the urban core [4]. Adesina noted that rapid urban expansion and sprawl in Nigeria has affected 400,000 hectares of vegetation annually [5]. While urban centres are growing in population and extent, the surrounding agricultural lands are undergoing rapid transformation. This is due to increasingly intense pressure through construction to provide space for an array of urban land uses. These have huge agricultural effects such as low or reduced food production, low agricultural produce, ecological degradation, as well as environmental and socioeconomic challenge [6]. Calabar is one of the towns in the mangrove swamp region where agricultural activities have been threatened by urban growth and development. In fact, there is no consensus on the relationship between the rate of urban growth, agricultural activities and response mechanisms of the farmers in the bid to ensure food security in the area. Therefore, there is need for an investigation into the implications that urban expansion might have brought on food production and food security as well as land cover/use change in Calabar.

The aim of the study therefore is to examine the impacts of urban expansion on agricultural production in Calabar, Nigeria between 1986 and 2018 using Remote Sensing data and Geographic Information System (GIS) techniques with a view to ensure sustainable balance between food production, consumer demand, and population growth in the future. The objectives of this study are therefore to:

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i. identify the land use changes in remotely sensed data sources;
ii. assess the rate of land use change on food production between 1986 and 2018 using Remote sensing and GIS in the study area
iii. examine the socio-economic factors that affect food production and land use types in the study area.

II. LITERATURE REVIEW

The conversion of agricultural lands to urban development is a phenomenon currently affecting countries as their population grows. Although urban sprawl may not threaten overall agricultural productivity of a country, it does result in the alterations and declines in local agricultural activities and to the loss of agricultural land as highlighted by literature. Organisation for Economic Cooperation and Development, OECD (1979) has documented the loss of peripheral agricultural land to sprawl in some European countries such as Netherlands and Norway which respectively lost 4.3 percent and 1.6 percent of their land annually to sprawl. Also, the United States of America and Canada lose 4,800sqkm of prime cropland annually to roads, buildings, reservoirs and other non-agricultural uses [4].

López et al. opined that, Urban Expansion and the Loss of Prime Agricultural Lands in Puerto Rico, shows that between 1977 and 1994 the urban area of Puerto Rico increased from 11.3 percent to 27.4 percent [7]. They therefore asserted that if the pattern of encroachment by urban growth into farmlands continues Puerto Rico’s potential for production in the future will be dimmed.

The extent of dependable agricultural land available for agriculture has been declining in recent decades, due to the consumption of agricultural land for urban uses and other non-agricultural uses [8]. This rapid loss of agricultural lands as a result of urban expansion is prevalent throughout the world and much more evident in developing countries [9]. Jiang, Deng and Seto stated that the urban expansion on agricultural land is associated with both shrinking agricultural land area and a higher level of urban development [10]. The former triggers greater land pressure and the latter indicates increasing off-farm employment opportunities. However, expansion and economic development can lead to rise in the agricultural land use intensity, off-farm opportunities and the resulting labour shortage in the agricultural sector [11]. These have posed additional challenges for the security of food provision and the preservation of natural ecosystems.

The nature and magnitude of their relationship directly influence agricultural production and food provision which may have further outcomes on the patterns of a nation’s agricultural land [10]. López studied agricultural censuses in Puerto Rico shows rapid losses agricultural lands have occurred since 1950, with the highest rate of change occurring between 1964 and 1974 due to urban expansion [7]. This loss of potential agricultural lands to irreversible non-agricultural uses reduces its capacity for the future. Humphrey observed that urban sprawl has transformed the landscape of Singapore and elevated the economy to almost a developed country status over the past decade [12]. Correspondingly, in the face of this rapid urban and industrial growth, agriculture has to make significant adjustments.

The first was the loss of agricultural land leading to shortages in food productions. During the 1960s approximately 250 hectares were required annually for public housing and industrial development, often at the cost of fertile agricultural land. Singapore, Japan, Indonesia, Thailand and recently Malaysia exhibited this trend. The implication of this is the importation of food as Asian countries lost their diversified food production capabilities. This according to Pernia is a reflection of a country’s loss of comparative advantage in diversified farming practices as a country loss its fertile land to urban sprawl and heads up the economic ladder [13]. The same trend was found in a study carried out by Yoveva et al. [14] in the city of Sofia, where land use is shown to be in a state of transition. The peri urban villages to the south of Sofia (Dragalevixi, Simeonovo and Pancharevo) are no longer areas of agricultural production as the agricultural land has been turned into housing complexes. For example, the cities of Darvenitza and Mladost were built on prior agricultural land. On the other hand, studies have attributed the fast rate in which agricultural lands in the peripheries of Taipa, South Korea, dwindle to sprawl [15]; [16]. Thus, the reductions of agricultural land and biodiversity in the peripheries have been attributed to sprawl. This is because sprawl encroachment into peripheral agricultural lands results in the loss of fertile land. Farmers, therefore, need to enhance the fertility of the land by adding fertilizer, changing to new farm techniques or changing to more productive crops. This change in prior farming techniques will definitely change the constitution of biodiversity that has adapted to the former farm management.

Before Nigeria’s independence in 1960, agriculture was the most important sector of its economy, which accounted for more than 50% of GDP and more than 75% of export earnings [17]. However, with the rapid expansion of the petroleum industry, agricultural development was neglected, and the sector entered a relative decline [17]. Studies indicated that Nigeria moved from a position of self-sufficiency in basic foodstuffs to one of heavy dependence on imports [17]-[19].

Under-investment, a steady drift away from the agricultural practices to urban areas, increased consumer preference for imported foodstuffs (particularly rice and wheat) and outdated farming techniques are factors that have threatened food security in Nigeria and other developing countries [18], [20]. However, because of the persistence increase in population and the need for population to be accommodated, and as well carry out other human induced activities, most agricultural land areas have been taken over by urban growth processes [21]. Although, urbanization in itself is a positive development to any area, such as increasing market size and attracting basic modern amenities, but where rapid urban growth does not take into account sustaining food production from agricultural activities, could produce catastrophic consequences in the long run.

III. THE STUDY AREA

Administratively, the city is divided into Calabar municipal and Calabar South Local Government Area. It has an area extend of 406 km² (157 m²). The location lies between
Latitudes 4° 50’ N and 5° 50’ and Longitudes 8° 10’ E and 8° 25’ E (see Fig. 1). Essentially, Calabar is an inter-fluvial settlement, built on a high land between two adjacent river valleys; it is bordered by the Great Kwa River on the east that flows into an estuary (the Cross River Estuary) and the Calabar River on the west. It stretches northwards to Ikot Omin bordered by Odukpani Local Government Area, East by Akpabuyo Local Government Area and South by the swamps of the mangrove forest. Major growth and expansion takes place northwards due to the existence of these two river systems.

IV. DATA ACQUISITION AND METHOD

This study is interested in the analysis of urban expansion on agricultural food production in Calabar, Nigeria. It also seeks to use the capabilities of Geographical Information System and remote sensing techniques to determine the rate of urban expansion on agricultural food production in the study area. To achieve this, Multi-temporal set of Remote Sensing data of the study were used to classify the study area into different land uses. These datasets included mainly Landsat images (TM 1986, ETM 2003 and OLI 2018) from (USGS) with a spatial resolution of 30 meters. These images were geometrically corrected and ground control points obtained through intensive ground surveys permitted the co-registration of all images to a Universal Transverse Mercator (UTM). All the images were made to pass through processes of image enhancement, georeferencing, re-sampling, image classification and digitizing. Anderson Land use/Landcover Classification Scheme was used to classify the study area into five different land uses: Vegetation, Bare land, Built-up, Agricultural land and water body. Digital image processing software IDRISI was used to process, analyze and integrate the spatial data. Geographic Information Software ArcGIS 10.4 was used to produce the map output. Structured questionnaire was administered on the two Local Governments in the study area. The socio-demographic questions specifically focused on the age, educational, income, type of food crop produced and severity level of land use on food production.

Also, the identification of the total number of farmers within the study area was achieved from the register gotten from the farmers association in the two LGAs of the study area. Coordinates location of selected farmlands were obtained using a handheld GPS device and were plotted on the agricultural landuse to enhance navigation (see Fig. 2).

Lastly, specific subject for questionnaire administration was selected systematically - every 20th farmer, after the first on the record for each LGA, this makes a total of 250 copies of questionnaire in all. Table I shows that out of the 250 copies of questionnaires distributed, 220 were received back and analysis. The address of the specific farmers on the list was used to trace them.

V. RESULTS AND DISCUSSION

The impact of urban expansion on agricultural food production between 1986, 2003 and 2018 using remote sensing as shown by GIS output are discussed below.

Table I: Questionnaires administered in each Local Government of the study area

| S/N | Local Government | Registered farmers (Population) | 5% of randomly selected farmers | Questionnaire retrieved |
|-----|------------------|---------------------------------|---------------------------------|------------------------|
| 1   | Calabar municipal | 2160                            | 108                             | 95                     |
| 2   | Calabar South    | 2840                            | 142                             | 125                    |
|     | Total            | 5000                            | 250                             | 220                    |

Source: Field Survey, 2018.
major land use was natural vegetation with 21847.5 hectares representing 60.6%, bare soil has 3572 hectares representing 9.9% of the total land area and agricultural land with 4559.1 hectares representing 12.6% of the total land uses in Calabar.

The classified Landsat image of 2003 shows that built-up area covered 4565.5 hectares (12.7%) of the total area (Fig. 4 and Table III); natural vegetation occupied the major landuse with 22445 hectares (62.2%); water body covered 3178.7 hectares (8.8%) of the total land area. Bare soil was 3596 hectares (10%) while Agricultural Land uses reduced from 4559.1 hectares (12.6%) in 1986 to 2192.2 (6.1%) in 2003 of the land areas. It is observed that built up area increase between the period of 1986 and 2003 as a result of increase in population, urbanization as well as infrastructural development to cater for the rising population. However, Agricultural land reduced from 12.6% in 1986 to 6.1% in 2003. This may be as a result of oil boom that have had direct effect on agricultural practices during that period. vegetation and agricultural lands were now being found around the fringes of Calabar. This might have accounted for the shift of attention from agriculture to other sectors of the economy.

The classification of Landsat image (OLI) of 2018 in the study area indicates that Built-up areas have increased to 5320 hectares (16.3%) as against 4565.5 (12.7%) in 2003 (Fig. 5 and Table IV) This implies that Calabar has developed rapidly over the years. It shows that the process of urbanization has been on alarming rate over this period. The built-up area has increased beyond the current boundary of vegetation particularly expanding towards the adjoining communities. Most of the areas usually used as agricultural lands have been consumed by built-up areas basically to make up for the infrastructural needs of the increasing population. Meanwhile, agricultural land in 2018 experienced a slight increased to 3173 hectares (9.7%) from the 2192.2 hectares (6.1%) in 2003. This could be attributed to farmers making advancement into other land use with the adoption of modern methods of farming such as the application of fertilizers and the used of improved variety seedlings for planting. Again, the encroachment into other land use like natural vegetation and bare soil for farming is a way to compliment the feeding needs of the rising urban population.
Agricultural Land has the appreciable increased as process of urbanisation involves the taking up on 2003 Bare soil n 2018. Initially, it increased to the increase of 5320 hectares (16.3%) against 4556 hectares (12.7%) in 2003. Yearly increment can be attributed to the influx of migrants in view of the fact that Calabar is fast becoming a tourist destination in Nigeria. In addition, industrial, transportation, commercial and physical development of the area could also be noticed, the increasing land use type, locating and upgrading of new and existing social amenities; and the accompanying rise in socio economic indices of the area to reflect the new status of the state capital (Study area). Influx of people was majorly due to employment opportunities that contribute substantially to population growth and sets off the process of urban expansion. Natural vegetation and Agricultural Land has the highest land coverage of the study area in 1986, 21847.5 hectares (60.6%) and 4559.1 hectares (12.6%) respectively. This is not surprising as farming is one of the major occupations in the study area as at that time (1986). But in 2003, Agricultural land decreased significantly almost by half, 2192.2 hectares (6.1%). This was as a result of rapid physical development (such as construction of road, buildings etc.) and urban expansion which tend to absorb more farmland to accommodate the growing population at the cost of the agricultural land. Natural vegetation which occupied 60.6% of the study area in 1986 witnessed increasing trend between 1986 and 2003 but decreased in 2018.

Table V shows various phases of land use types between 1986 and 2018. Built-up Land use which occupied small portion in 1986 increased significantly to almost double of the initial size in 2003. Also, in 2018, built up was also noticed to be on the increase to 5320 hectares (16.3%) against 4556 hectares (12.7%) in 2003. This increment can be attributed to the influx of migrants in view of the fact that Calabar is fast becoming a tourist destination in Nigeria. In addition, industrial, transportation, commercial and physical development of the area could also be noticed, the increasing land use type, locating and upgrading of new and existing social amenities; and the accompanying rise in socio economic indices of the area to reflect the new status of the state capital (Study area). Influx of people was majorly due to employment opportunities that contribute substantially to population growth and sets off the process of urban expansion. Natural vegetation and Agricultural Land has the highest land coverage of the study area in 1986, 21847.5 hectares (60.6%) and 4559.1 hectares (12.6%) respectively. This is not surprising as farming is one of the major occupations in the study area as at that time (1986). But in 2003, Agricultural land decreased significantly almost by half, 2192.2 hectares (6.1%). This was as a result of rapid physical development (such as construction of road, buildings etc.) and urban expansion which tend to absorb more farmland to accommodate the growing population at the cost of the agricultural land. Natural vegetation which occupied 60.6% of the study area in 1986 witnessed increasing trend between 1986 and 2003 but decreased in 2018.

Logically, as built up areas increases, agricultural land decreases, so also natural vegetation. As population increases, more surrounding land which is basically agricultural land are encroached for urban uses such as constructions of building and roads, farmers are likely to open up new forest land for agricultural activities. This is what probably gave rise to the increased noticed in agricultural land from 2192.2 hectares (6.1%) in 2003 to 3173 hectares (9.7%) in 2018, as well as the accompanying population pressure on forest resources and biodiversity. However, a different scenario played out for Natural vegetation which was seen to increase in 2003 because of the fact that more agricultural Lands were taken up by built up and the natural vegetation that is left were allowed to fallow. Many youths and young graduates see farming as worthless occupation due to civilization, thus neglected it in search of white-collar jobs. Also, more concentration was given to oil and gas at the expense of agricultural activities. However, by 2018, Agricultural Land records some appreciable increased as many farmers are seen to be returning to farming and making encroach into natural vegetation to cultivate food crops in order to cope with current economic reality and urban pressure which accounts for the reduction in natural vegetation as recorded in the classified OLI land sat image of 2018 which compelled more lands to be exposed for development.

Bare Surface which was noticeable in 1986 and 2003 reduced greatly in 2018, this could also be attributed to the facts that the process of urbanisation involves the taking up of bare lands, natural vegetation and agricultural lands in most cases to accommodate the rising population. Water body also recorded slight rise and fall changes over the decades under review; this could also be linked to climatic changes among other factors.

Fig. 6 shows the overall Land use change within the study periods indicates that Built-up and water body recorded increase of 8.8% and 1.5% respectively. While other Land use; agricultural land, Natural vegetation and Bare-soil recorded a decline of -3.8%, -8.9% and -7.4%, respectively.

Table V shows various phases of land use types between 1986 and 2018.

**TABLE IV: RESULT OF CLASSIFIED LANDSAT (OLI) OF CALABAR IN 2018**

| LULC Classes         | Area(Hectares) | Percentage (%) |
|----------------------|----------------|----------------|
| Built-Up             | 5320           | 16.3           |
| Bare Soil            | 919.9          | 2.8            |
| Natural Vegetation   | 18639          | 57.2           |
| Agricultural Land    | 3173           | 9.7            |
| Water Body           | 4512.5         | 13.6           |
| Total                | 32646.4        | 100            |

**TABLE V: LAND USE CHANGE (IN HA/YEAR) AND (%/YEAR) OF CALABAR BETWEEN 1986 AND 2018**

| LULC Classes | 1986 | 2003 | 2018 | Change |
|--------------|------|------|------|--------|
|               | Area (Ha) | Perc (%) | Area (Ha) | Perc (%) | Area (Ha) | Perc (%) | Area (Ha) | Perc (%) |
| Built-up      | 2130.6 | 5.9  | 4565.5 | 12.7   | 5320 | 16.3  | 8.8     |
| Bare soil     | 3572  | 9.9  | 5956   | 10.0   | 919.9 | 2.8   | -7.4    |
| Natural vegetation | 21847.5 | 60.6 | 22445  | 62.2   | 18639 | 57.2  | -8.9    |
| Agricultural Land | 4559.1 | 12.6 | 2192.2 | 6.1    | 3173  | 9.7   | -3.8    |
| Water Body    | 3968.3 | 11.0 | 3178.7 | 8.8    | 4512.5 | 13.6  | 1.5     |
| Total         | 36077.5 | 100  | 36077.5 | 100    | 36077.5 | 100  | 0       |

**Fig. 6. Bar graph showing land use change of Calabar between 1986 and 2018.**

Fig. 7 and Fig. 8 show the landuse transition in Calabar between 1986 and 2018. It is observed that between 1986 and 2003, the area of Calabar occupied by agricultural Land decreased from 4559.1 hectares (12.6%) to 2192.2 hectares (6.1%) in 2003 and then increased to 3173 hectares (9.7%) in 2018. This implies that although agricultural land which was seen to have dropped in 2003, records appreciable increased in 2018. This is so because, as the urban population and built-up area is increasing, farmers move further inwards into Bare-lands to sustained farming activities to scale up food production for the rising urban population. Urbanization is majorly the reason for the conversion of agricultural Lands to other Land uses as seen in the change detection of classified Landsat TM of 1986 and ETM of 2003. But between 2003 and 2018, agricultural land was seen to have increased by 3173 hectares (9.7%) against 2192.2 hectares (6.1%) in 2003. A contrast was recorded for built-up as it increased by more than 50% (from 2130.6 hectares (5.9%) in 1986 to 4565.5 hectares (12.7%) in 2003 and 5320 hectares (16.3%) in 2018.

**Fig. 7. Diagram showing landuse changes of Calabar between 1986 and 2018.**

**Fig. 8. Diagram showing landuse changes of Calabar between 1986 and 2018.**
respectively. Natural vegetation recorded an increase from 21847.5 hectares (60.6%) to 22445 hectares (62.2%) but reduced drastically in 2018 to 18639 hectares (57.2%), part of the vegetations were encroached into by the increasing built-up land use, while water body reduced significantly from 3968.3 hectares (11%) in 1986 to 3178.7 hectares (8.8%) in 2003 and in 2018, it increases to 4512.5.

Fig. 7. Land use Transition of Calabar between 1986 and 2018.

Fig. 8. Bar graph showing Land use Transition of Calabar between 1986 and 2018.

**A. Socio-Demographic Profile of Respondents**

Table VI shows the socio-demographic profile of respondents in this study area. The age group of farmers in the study shows ages below 18 years accounted for 5.4% while those that fall within the age of 18-40 years accounted for 62.3%, those whose ages range between age 41-60 years accounted for 28.2% while those whose ages range were 60 years and above accounted for 4.1% which represents the least proportion of the age group. This implies that majority of the respondents fall within the active/working age bracket (18-60 years). From the table, 22.7% of the respondent had no formal education, 16.4% of the respondents had Primary Education, 35.5% of the respondents had Post Primary Education and 25.4% of the respondents had tertiary education. This implies that the literacy level of the respondents in the study area is as a result of administrative and educational role played by colonial period which influenced their understanding on agricultural practices. The table further revealed the percentage distribution of the average monthly income of respondents in the study area. It could be revealed that 37.7% of the respondent received less than N18,000 as their average monthly income, 47.7% of the respondents received a monthly income between N18,001 - N100,000 while, 9.1% and 5.5% of the respondents received an average monthly income of between N100, 001 - N200, 000 and N200, 001 and above respectively. This implies that majority of the respondents in this study engaged in small scale farming as their income is too small to embark on large scale agricultural farming practices.

**TABLE VI: SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS**

| Socio-economic Variables | Frequency | Percent |
|--------------------------|-----------|---------|
| **Age**                  |           |         |
| Less than 18 years       | 12        | 4.5     |
| 18-40 years              | 137       | 62.3    |
| 41-60 years              | 62        | 28.2    |
| Above 60 years           | 9         | 4.1     |
| **Total**                | 220       | 100     |
| Education                |           |         |
| No formal education education  | 50 | 22.7 |
| Primary                  | 36        | 16.4    |
| Post Primary             | 78        | 35.5    |
| Tertiary                 | 56        | 25.4    |
| **Total**                | 220       | 100     |
| **Income of Respondents**|           |         |
| Less than 18,000         | 83        | 37.7    |
| 18,001-100,000           | 105       | 47.7    |
| 100,001-200,000          | 20        | 9.1     |
| Above 201,000            | 12        | 5.5     |
| **Total**                | 220       | 100     |

**B. Types of Food production between 1986 and 2018**

The dominant crops cultivated in the study area according to the study were vegetables (tomatoes, okro and pepper), root-tubers (yam, cassava and potato) and cereals (maize and rice) respectively (CRSBS). These crops constitute about 80% of foodstuff found in most of the markets within the area; its cultivation spreads across the study areas and beyond.

Table VII and Fig. 9 shows food crop production between 1986 and 2018 for the period representing the period covered by the study. The result indicates that the total crop production of tomatoes from 1986-2003 was 370 tonnes (15.1%) compared to 379 tonnes (15.7%) produced between 2003-2018 (15-year period). Pepper production in 1986-2003 recorded 376 tonnes compared to 331 tonnes produced in 2003-2018, while okro total production achieved between 1986-2003 was 428 tonnes as against 379 tonnes achieved between 2003-2018, hence indicating a decline in production by 49 tonnes between 1986 and 2018, representing 19.3% decline as shown in Fig. 9 Yam, cassava and maize also recorded various degrees of changes in production as shown in the table.

The declining agricultural activities due to consequences of land conversions and population increase, as most families
formerly relying on farm for food as income are looking for non-farm jobs within their locality for survival. The conversion of agricultural land to urban land use has an adverse effect on the labour force that is engaged in farming activities hence having a negative impact on food production.

C. Severity Level of Land use Effect on Urban food production in Calabar

Comparing the opinion of respondents (farmers) on the severity of variable factors on urban food production in Calabar, the result obtained from the statistical regression analysis in figure 10 suggested that 30.1% of the agricultural productivity has been severely affected. Furthermore, 40.7% of the farmers are of the opinion that loss of farm land is severe to urban food production in the study area; thereby affecting the lands that would have being cultivated for agricultural purposes which in-turn affects agricultural productivity negatively. It was also discovered from the responses that the 30.1% of farmers has severely reduced hence having negative impact on production. This might account for the reason in the moderate increase (35.8%) in non-farm income in the Study area. According to FAO [22], the more increase in population the more the demand for agricultural produce. It was discovered from the study that 33.6% of the people that demanded for farm produce is severe. Because of the severe decrease of agricultural produce, prices of agricultural products are also severely high. From the analysis, 28.7% of the respondents were of the view it is very severe, while 22.7% suggested it is moderate. Also 27.6% said increase in Land value is very severe while 33.6% suggested Severe in their own opinion. The severe increase in the value of land could also be responsible for the severe increase in the cost of land. Also 30.5% of the farmers opine that the movement of rural populace to Calabar is severe, while 23.8% and 26.2% of them were of the opinion that it was very severe and moderate respectively. On the expansion of the built-up areas 31.6% said that the expansion is severe while 33.5% and 29.9% said it was severe and moderate expansion respectively. However, 6% and 7% of the respondents are of the view that the expansion was not severe and even not at all severe respectively. Social facility is one of the major built-up land-uses in an urban centre. These facilities, according to most of the farmer’s respondents seem to be increasing severely (32.5%). Furthermore, industrialization being one of the key measures of urbanization was also reported to be increasing severely (30.5%).

Summarily, the mean score severity level land use effect of each of the variables ranges between severe and moderate effect on agriculture. Reduction in agricultural productivity at the top of the ranking with 2.0 mean score indicating a severe effect while industrialization and increase in social facilities are the least with 2.6 mean score indicating week severe effect as it is close to moderate effect more than severe effect (see Fig. 10).

VI. CONCLUSION

The study has highlighted the problem of urban expansion on food production in Calabar, Nigeria. The conversion of agricultural land into urban land uses poses serious effects on urban food production with the decline in agricultural land as farm lands are being converted to urban land uses.

Urban expansion is driven by certain factors such as populations increase as a result of rural-urban migrations and natural increase; these driving forces have positive and negative effects on farmers. These negatively impact the farmer’s means of livelihood (farmlands). Hence leaves the farmer with the option to either sell the farm and venture into another/ alternative business or relocate to different location in search of farmland to continue their farming. This scenario will lead to decrease in food production in the area, drop in the farmer’s income and overall standard of living. The implications of decrease in food production may be quite severe, these includes; extreme hunger, high cost of food, poverty, loss of government revenue and increase in crime rate among others.
From the GIS outputs, the classified land use classes and types indicates that land use had changed significantly over the period under review (1986–2018). The statistics indicated that the growth rate of built up land maintained a steady increasing movement among other land use categories especially at the expense of agricultural land. It shows a rapid decline in agricultural land between 1986 and 2003 while the period between 2003 and 2018 witnessed relatively slight increase, which could be attributed to more farmers indicating interest in farming and the adoption of modern system of farming and the used of improved farm Seedling to scale up production. The loss of agricultural land between these periods was converted to urban land use and this invariably affects agricultural activities in the study area. From the Land use /land cover change analysis, it was evident that agricultural land which covers 12.6% in 1986, decreased to 6.1% in 2003, and then made a slight increase to 9.7% in 2018. However, the area occupied by built up land increased from 5.9% in 1986 and 12.7% in 2003 and then to 16.3% in 2018. There was also increased in Natural vegetation from 60.6% in 1986 to 62.2% in 2003, and later decreased to 57.2% in 2018. The area occupied by water bodies was 11% in 1986, 8.8% in 2003 and then increases slightly to 13.6% in 2018. The changes in land use are attributed to the growth of urban areas, increase in population fuelled by both natural causes and migration; this reduces agricultural lands in the area to satisfy the demands of increasing urban population.

The study also revealed that the overall Land use transition within the study periods indicates that Built-up and water body recorded increased of 8.8% and 1.5% respectively. While other Land use; agricultural land, Natural vegetation and Bare-soil recorded a decline of -3.8%, -8.9% and -7.4% respectively. It was also noticed that the crops produced in the area within the study period includes Vegetables (Tomatoes, Pepper and Okro), Root tubers (Yam and Cassava) and Cereal (Maize) respectively. Although the study indicates a decline in production from 2251MT in 1986-2003 (17years) to 1959MT in 2003-2018 (15years), the difference is not very significant considering the number of years involved. The reason for the slow pace in food production decline in the face of growing/increasing population and the conversion of agricultural land use to other land uses is traceable to improvement in farming technology and methods such as mechanized system of farming and improved crop yielding seedlings being used by farmers to scale up food production.

The study therefore advances some recommendations as a way of preventing the menace of urban expansion on food production in the study area. There is need for adequate social amenities to be incorporated into the urban fringes development framework to improve livelihood of the people especially those in the rural areas so as to curtail the rate of migration and by extension checking the expansion of the city on agricultural land.

There is urgent need for participation among stakeholders and institutions in land use planning process and urban management. This is important because it is only when the public and land owners are well incorporated into land management issues that a positive change of attitude, adherence to laws on land use among others can be achieved.

There is need for future development control into agriculture land as this will have serious repercussion on food production. Although urban growth cannot be stopped, with proper management and planning it can be reasonably directed in a desirable and sustainable way.

The government should put up policies to outlaw arbitrary sale of agricultural land especially in areas where agriculture is the mainstay of the economics of the people as is the case of the study area to enhance the effectiveness of zoning regulations. It is important that the management of land be made a topmost priority in the study area in particular and the nation at large. The various land agencies and institutions responsible for land management should be made to enforce existing laws on land management. Compliance to such regulations is a function of penalizing all offenders irrespective of who is involved.

Farmers in the study area should be assisted by government and relevant non-governmental organizations through the provision of soft loans and grant facilities to enable them procure modern farming implements and tools to boost or scale up food production.

Impact of population growth and urban expansion on agricultural land use is a continual phenomenon; therefore, accurate monitoring of urban expansion with the use of Satellite image should be employed from time to time.

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