Urban Expansion and Agricultural Land Use in Peri-Urban Makurdi, Nigeria

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Abstract: **This study explored the impact of urban physical growth on agricultural land use in peri-urban districts of Makurdi town from 1986 to 2016. Satellite data from RS images and GIS maps of the area in combination with data from questionnaire survey of 150 farmers and key informants were used for the study. Again RS and GIS techniques were used to analyse the data in conjunction with descriptive tools such as percentages, tables and pie charts. The result of the study shows that built up land use class expanded significantly in the city from barely 8.73% by 1986 to 64.15% in the year 2016. On the contrary the finding also shows that whereas agricultural land use occupied 32.6% of the city region in 1986, it decreased in the following three decades to 7.50% by 2016. Also from the findings all other land uses and land cover classes such as forest/vegetation, bare lands, and wetlands similarly declined in area coverage significantly in the period due to conversions. This finding shows that the city's expansion was derived largely from conversion of other land uses/cover classes to built-up land use type especially mixed agricultural land use. From the result the highest land conversion to built up area was from mixed agricultural land use class. About 72% of prime agricultural land use class was converted and this accounted for 57% (more than half) of the growth of built up land use. Finally the survey result also shows a dramatic reduction in the sizes of farmlands owned by farmers now as against ten to twenty years ago. This development has likely effect on livelihoods and food security of urban and peri-urban residents. Consequently it has been recommended that an agro-ecological map of Makurdi town using zoning regulation be developed as part of a long term spatial development framework that can safe guard all prime agricultural lands from further encroachment by urban developments. And that further investigation be carried out to unravel the emerging livelihood and food security issues that could have aroused following depleting agricultural lands in the city's peri-urban regions.**

Key words: **Urban expansion, Agricultural land use Change, Remote sensing, Geographic Information System GIS.**

I. INTRODUCTION

Globally, there has been a tremendous growth of urban areas in the recent decades. This trend according to Araya and Cabral (2010) [1] has been largely due to an expanding world population coupled with rural-urban migration. The world urban population according to UNDESA (2010) [2] increased from 0.73 billion by 1950 to 1.51 billion by 1975, 3.42 billion by 2009 and an estimated 6.29 by 2050. According to (ESCAP, 2011) [3] although Africa is one of the least urbanized regions in the world, it nonetheless had the highest global average annual urban population growth rate (3.5%) between 2005 and 2010. According to a report of the United Nations HABITAT (2008) [4] the population of urban residents in Africa by 2007 stood at 373.4 million. Estimates from this shows that the population figure will more than double by 2030 and that by 2050 about 1.2 billion Africans will be living in towns and cities [4].

In Africa, Badianne (2005) [5] observed that Nigeria is the fastest urbanizing country in the Sub-Saharan region with an annual urban population growth rate of 7.5%. Most of such growth is however occurring in the major cities especially the Federal Capital city Abuja and the state capitals that are the principal administrative, economic and commercial centres of the country. Makurdi is one of such cities that are growing rapidly both in population and physical size since it became the administrative capital of Benue state in 1976. There has been rapid physical infrastructural development that has seen many of the vast surrounding villages been engulfed into the city's fabric.

Nevertheless, the rapid urban population growth in the town as elsewhere according to Olima (2003) [6] is without equivalent increase in urban land supply as land is fixed in supply and does not increase with the increasing population. Consequently, the pressure exerted by this increasing population at the centre tends to stimulate competition for space among different land uses whereby other sectors suffer deprivation of the needed land and have to move outwards. Consequently, Naab (2012) [7] observed that rapid increases in urban population do stimulate environmental, social, spatial and economic changes in the fabric of the society through urban infrastructural facilities development, destruction of natural habitats and land cover as well as transformation of land uses

The increased population pressure at city centre directly lead to eventual sprawl of urban development and the entire built form into the peri-urban areas. According to Hern (2008) [8] urban growths are generally characterized by steady expansion of the city margins, development of new communities at nodes distant from the city centre and the

replacement of natural and cultivated agricultural landscapes by urban structures. Through the process of invasion and distant colonization [9], all outlying communities are engulfed and absorbed by an expanding central city. According to Briggs (1991) [10], the main zone of direct impact are the peri-urban areas which are characterized by diverse land uses that often vary according to their functional linkages between the truly urban and truly rural sectors.

Due to their spatial proximity to urban areas, agricultural lands are the first to be affected adversely from urban sprawl as urban land uses such as roads, residential and commercial take over in competition for more space. Njiru (2016) [11] notes how in Europe the cities have primarily expanded to the former agricultural lands in the recent years. For example, throughout the Mediterranean region, 3% of farmland was lost to urbanization in the 1990s, and 60% of this land was prime farmland (EEA, 2006) [12]. Again Doygun *et al.* (2008) [13] have also pointed out that Turkey has been subject to land transformations into urban–industrial land uses, especially with the loss of fertile agricultural lands to urbanization.

Livelihood and environmental sustainability challenges that come with sprawling city growth and transformations on the countryside in the developing world are enormous and have been highlighted by Lawanson, Yadua and Salako (2012) [14]. In most cities, Lee-Smith (2010) [15] argued that peri-urban agriculture has a significant role in food and nutrition security and the peri-urban interface is in most cases the agricultural hub of the urbanites as it supplies most of their food requirements. An immediate consequence of rapid urbanisation is the crowding out of agriculture land, and the reduction of agricultural production capacity (Kim *et al*., 2003) [16]. Farmers could be left with little or no land to cultivate and this renders them vulnerable. Beside livelihood challenges, environmental sustainability issues also abound; these include illegal land tenure, disorderly residential patterns, lack of public infrastructure and services, informal livelihoods, poverty and increased social and economic costs. These negativities that are synonymous to the peri-urban experience are often ignored by professional planners and city managers. However as it has been argued, appropriate land use planning at various spatial levels could minimize future unsustainable land use changes which are major driving forces of global environmental change (Grimm et al 2008) [17].

The peri-urban zone is known as the interface area, the transitional setting in which processes of urban growth and development intersect with the pressures of rural preservation (Nelson 2007) [18]. It is an area of transition between the core built up area and the pristine rural hinterlands that is experiencing profound social, economic, environmental and land use changes. The population here is often heterogeneous in nature and according to Thuo (2010) [19] consist of original resident farmers, migrant residents, recreational land users, industrial users, natural resource users, investors, and speculators, developers, and builders. They share similar demographic, social and economic characteristics with those of urban residents, and their lifestyles are transiting from rural to urban. Nevertheless, residents of peri-urban districts have varying access to urban services and facilities and more importantly, they have only a limited voice in urban planning and development [11].

The ensuing conflicts in land utilization in the peri-urban zones therefore stimulate the need for their urgent resolution through land use planning. According to FAO (1995) [20] managing land resources sustainably to meet human requirements, requires effective resolution of the conflicts between the uses based on an understanding of the new demands and changes on land brought by the urban dynamics. Such understanding could be derived from broad based interdisciplinary research that employs new sophisticated technologies for detecting the changes. The key element for mapping such change is the ability to discriminate between rural uses (farming) and urban use (residential, commercial, and recreational).

In recent decades, analysis of urban spatial growths and the land use changes over time have been made easier through the application of Remote Sensing (RS) tools in combination with Geographical Information System (GIS) mapping techniques and Global Positioning Systems. This approach according to Grey *et al*., (2003) [21] and Herold *et al., (*2003) [22] has proved useful in mapping urban areas, and as data source for the analysis and modelling of urban growth and land use/land cover change. It could also provide critical insights into the change processes and implications of city growths on its contiguous areas. The integrated method has therefore been widely applied and recognized as a powerful and effective tool in detecting urban land use and land cover change (Ashbindu *et al.,* 2001) [23]. Specifically Kachawalla (1985) [24] observed that multispectral images in digital form coupled with the contemporary advanced digital processing and analysis have made change detection through remote sensing easier. Thus geographic information system (GIS) and remote sensing (RS) satellite imageries have accordingly brought to the fore one of the most powerful and cost-effective tools for assessing the spatial and temporal dynamics of land use/ cover (Geist & Lepers, 2003) [25]. With the new technologies, classified images can be used to calculate the area of different land uses/covers and observe the changes that are taking place in the span of the data. The space-borne satellite data according to Dong, Forster, & Ticehurst (1997) [26] are particularly useful for developing countries due to the costs and time associated with traditional survey methods.

By and large, as the nations move towards overcoming environmental challenges arising from haphazard urban development such as pollution and deteriorating environmental quality, land use transformation and destruction of prime forests / wetlands, several extensive researches have been carried out on land use land cover globally using remotely sensed satellite data. However most of these studies are concentrated in countries of the developed

world ([27], [28], [29], [30], [31], [32]). For instance Yuan et al (2005) using multi-temporal Landsat TM data was able to map out and monitor land cover change in the Twin Cities Metropolitan Area of Minnesota using five epochs 1986, 1991, 1998 and 2002 as the baseline of the study. The research results showed that between 1986 and 2002, the amount of urban land increased significantly from 23.7% to 32% of the total land while for the same period, amount of rural land cover including agriculture, forests and wetlands decreased from 70% to 61%. Similarly Pooja et al (2012) [28] using the survey topographic sheet of India for 1965 and the LISS III satellite data for 2008, was able to quantify the land use /cover change at Gagas watershed district Almora for the 43 year period.

However for the purpose of comparison Fragkias et al (2012) [33] argued that since considerable dissimilarities exist in terms of speed, scope, and experiences of urbanization and peri-urbanisation between the developed and developing nations, research findings from North American context and other climes might not easily be interpreted in the context of other regions with different cultures, governance regimes and levels of socio-economic development. Similar studies are therefore necessary from cities of the developing world to corroborate the research findings from the developed regions.

In Nigeria and much of the developing world, while there is a growing body of researches in the field much of the studies continue to focus on the environmental consequences of urbanization and the ecological foot print of cities (see [34], [35], [36]). The direct impacts on agricultural practices of the onslaught of urbanization is yet to fully examine extensively in academic circles especially among the medium sized cities. The main purpose of this study is to remedy this deficiency. Such knowledge is necessary as it would facilitate the development of appropriate planning methods for monitoring and managing urban expansion in lieu of agricultural practices as the basis for livelihood and food security requirements of city and peri-urban residents.

Our study area Makurdi is one of the fast growing capital cities that have not been extensively explored in this direction even though it is undergoing tremendous socio-economic growth and physical expansion since it emerged the administrative capital of Benue state in 1976. Increasing population pressure at the city centre has stimulated the expansion of physical urban infrastructure such as residential housing estates, new markets, urban road network, schools, clinics and recreational facilities. Since land is inelastic in supply, these developments could have significantly interfered with the cities peri-urban land uses which according to Browder and Bohland (1995) [37] are predominantly agricultural. What remains unclear is the extent of the encroachment on agricultural land uses and the implications for livelihoods in the region. This study analysed urban physical growth in Makurdi as it relates to agricultural land use at the city's peripheries.

II.THE STUDY AREA

Makurdi town, the capital of Benue state lies between latitudes 7^{o} 37' and 7^{o}47' North of the equator, and between longitudes 8^{o} 28' and 8^{o}40' East of the Greenwich Meridien. The town is situated astride River Benue in North central Nigeria, about 300 kilometres south of Jos and 450 kilometres from Enugu in the South (fig 1). The city of Makurdi as currently defined politically, covers a radius of 10 kilometres. The city stretches from the Nigerian Airforce base in the East along Gboko road to Adaka village along Ankpa road in the West. In the South it is bounded by Apir village while in the North it is bounded by Agan Toll gate. The River Benue traverses through the town from the Northeast to the Northwest thereby bifurcating it into two major parts: - the northern and southern parts known commonly as Northbank and South bank districts (fig 1a and 1b).

Makurdi town lies in the gently rolling lowland fertile alluvial plains of the Benue River in the Guinea Savannah vegetation belt that consists of vast wetlands and Marshes that are intermittently punctuated with tributary stream channels. The city is therefore surrounded by vast fertile agricultural lands that are the hub of production of myriads of agricultural crops. Consequently agriculture is the mainstay of the local economy and the main supplier of nutritional needs of the local population, the city and the entire country.

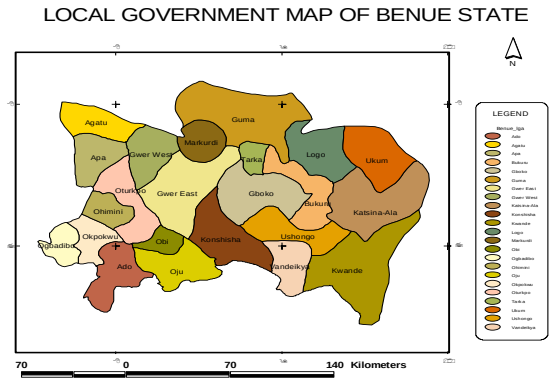

Fig 1a: Map of Benue State showing Makurdi Local government area.

Figure 1b. Makurdi town showing residential neighbourhoods.

Makurdi town started as a small fishing village known as Lobi in the Sourthern Bank of River Benue at what is now the Wadata Market at the dusk of the nineteenth Century. The onset of colonial administration in Nigeria influenced the eminence of the settlement first as sales depot of European traders' goods, then as administrative headquarters of the former Benue province by 1927. However it was the post independence political restructuring in Nigeria namely the creation of states and local governments in 1976 that boosted the significance of the town both as the capital of Benue state and head quarters of Makurdi local government area. These developments facilitated massive population agglomeration into the town. Thus between 1977 and 1986 the population of the city rapidly rose from 78432 to 193110 (Table 1). According to the table, since state creation when Makurdi became the capital city of the state, the population of the city has been increasing in leaps and bounds such that by 2016 over 300,000 people inhabited the city.

Table 1. Population of Makurdi Town from 1986-2026*

Year	Population
1973	34568
1977	78,432
1986	193110
1996	275872
2006	297398
2016	327137

*Projected from 1973, 1991 and 2006 National population census of Nigeria. National Population Commission Office, Makurdi.

The rapid population explosion in the city has significantly influenced physical development of the city in the form of road construction, housing and other public infrastructural facilities. Consequently the boundaries of the town have expanded outwards tremendously into the hitherto peri-urban hinterlands. This horizontal physical growth entails continuous encroachment on pristine natural ecosystems and prime agricultural lands.

III. MATERIALS AND METHODS

Considering the overwhelming consensus among scientist on the efficacy of Remote Sensing and GIS tools in monitoring and documenting changes on the land surface at local, regional and global scales ([38], [39], [40]), this study relied much on information derived from RS satellite images and Geographic Information Systems (GIS) to investigate urban encroachment on agricultural land use in the peri-urban areas of Makurdi town between 1986 and 2016. Consequently, Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper plus (ETM+) and OLI satellite data for four epochs: 1986, 1996, 2006 and 2016 were downloaded from the Global Land Cover Facility (GLCF) data base with the properties as shown in Table 2. Also, the base map of Makurdi town (Figure 2) was acquired from Survey Division of the Benue state Ministry of Lands and Survey Makurdi while the town's population was estimated from data acquired from the office of the National Population Commission.

Table 2. Features of the Landsat images used .

S/N	Data Type	Date of Acquisitions	Resolution	Source
1	Landsat TM	January 1986	30m	GLCF
2	Landsat TM	November 1996	30m	GLCF
3	Landsat ETM+	December 2006	30m	GLCF
4	Landsat OLI	December 2016	30m	GLCF
5	Shapefiles	Nigeria shapefiles showing Admministrative boundaries	-------	OSGOF, Abuja

A). Software used and classification scheme

Erdas Imagine 9.2 software was used for composing the images and subsequent classification and for change detection analysis. ArcGIC 10.0 was used for clipping the study areas by masking them out from the Landsat Images using the Administrative maps. A Garmin Etrex 32 handheld GPS was used to record coordinates for training sites. Determination of appropriate classes was done based on Level I of the Land use/cover classification of the United States Geological Survey (USGS) as reviewed by Anderson, et.al (1976) [41]. Five (5) classes were identified (Table 3).

Table 3. Land use classes.

LULC	Description
Built-up land	This include all residential and commercial complexes such as markets, communication/utilities, industrial complexes, transportation routes, paved surfaces and restricted use structures for education and administrative offices, hospitals and religious purposes etc.
Forest/Vegetation	Land covered with natural and manmade forests, natural grass lands, shrubs and grass-like vegetation.
Mixed Agricultural	These include arable lands, cultivated farming and fallow fields, crop lands with permanent crops –orchards, nurseries and plantations
Bare lands	This include all cleared land surfaces, barren lands, undeveloped plots, football fields,
Wetlands	This includes marshlands lying around the banks of streams, lakes and the Benue river.
Water body	This includes all areas of open water such as lakes streams, rivers, and ponds as well as natural flood reservoirs.

Source: Modified from Anderson, 1967.

The extents of Land use change was determined by using the attribute and statistics data generated from the classification result and used for post-classification comparison among the years. The built-up was also extracted for each of the periods and the extent of the built up area was calculated in Square hectares. The extent of the urban sprawl

was analyzed by subtracting the reference year of land cover of 2016 from the base years.

B. Data Processing

1) Image pre-processing

All images were clipped out according to the study area by using "clip" function in ArcGIS 10.5. Since the image had been ortho-rectified, there was no need for radiometric and geometric corrections. However, the images were geometrically corrected to Universal Transverse Mercator (UTM) coordinate system using ArcGIS 10.5. Ground Control Points (GCPs) were collected through an extensive field survey throughout the study area using Global Positioning System (GPS). This is to obtain accurate locational point data for each land use and land cover class included in the classification scheme as well as for the creation of training sites and for signature generation and also later used for accuracy assessment of the project.

2) Satellite Image Enhancement

The Landsat satellite imagery is a false color composite. The colors of false features such as water bodies and vegetation appear as opposite of what they are on ground. However, due to insufficient contrast between and among many objects on the imagery, the vegetation types are not easily distinguished and some shallow water areas seem to have similar reflectance with the wetlands. The imagery is composed of 3 bands after color composite combination. The enhancement operation performed basically consisted in splitting the multispectral landsat image composite into individual RGB channels and then re-compositing these bands by changing their grouping.

3) Image classification

To detect changes in the land use/cover at different years, post classification comparison of the change detection techniques was used. ERDAS imagine software was used for the pixel-based classification. Supervised classification was performed using maximum likelihood classifier. The different images were classified into different land cover types based on the classification scheme. Supervised classification allows natural spectral clusters to be distinct with high degree of objectivity (Hudak & Brockett, 2004) [42]. This method of classification involves the procedure of identifying pixels possessing the same spectral features. ERDAS imagine software was used in digitally processing and identifying the spectral clusters on the Landsat images. By carrying out this classification, the signature editor was used via the classifier icon of the ERDAS IMAGINE to identify the spectral signature of different features.

4). Area Calculation, Assessment of Results and cartographic output

Areas were calculated in hectares of the resultant land use/land cover types for each study year for subsequent comparison. There was also an assessment of classified results to be able to detect the accuracy of the classification with respect to ground features. Classic symbolization techniques in ArcGIS were applied to the feature classes for good cartographic finishing. A uniform graticule gridding set in geographic coordinate system referenced to WGS datum was used. With careful representations of the symbology and geometry of features through rules and interactive editing tools, we refined the visualization of feature classes and manipulated graphic elements that enhance the communication of the map.

5) Data Analysis

To determine the extent of urban land use in 1986, 1996, 2006, and 2016. The attribute and statistics from the classification result was generated and used for post-classification comparison among the years. The built-up was also extracted for each of the periods and the extent of the built up area was calculated in hectares.

To analyze the extent of urban growth between 1986 and 2016. The extent of the urban growth was analyzed by subtracting the reference year of land cover from the base year as represented mathematically:

ET = B - A

A = the base year (1986)

B = the reference year (2016)

ET = the total extent of urban growth between 1986 and 2016

IV. RESULTS AND DISCUSSIONS

The results obtained from change detection analysis of multi-temporal images of the study area (figures 2-5) from 1986-2016 are presented in tables in the following sections.

***A**. Land use/land cover change in Makurdi from 1986-2016.*

From the classified Landsat images of 1986, 1996, 2006 and 2014, Makurdi town has undergone various land-use and land cover changes. The statistics for land use land cover distribution for the 30 years period covered as derived from the thematic maps (figures 2-5) are presented in the Table 4

From Table 4 by 1986 built up lands comprising of residential, industrial and commercial as well as land for transportation uses occupied 8.7% of the city's land mass. The predominant land use /cover types were mixed agricultural lands and forests/ vegetation cover. These respectively occupied 33% and 21% of the study area's entire landmass. Other next important land use/cover categories this time included wetlands, bare lands and water bodies in descending order. These respectively covered 15%, 13% and 10% of the area. The spatial distribution of land use change in the area during the year 1986 is shown in figure 2.

Table 4. Land use Land Use/ Cover distribution in Makurdi city

Land use type	1986		1996		2006		2016	
	Area (ha^2) 000	%	Area (ha^2) 000	%	Area (ha^2) 000	%	Area (ha^2) 000	%
Built-up	7.22	8.73	27.12	32.8	38.30	46.3	53,010	64.15
Forests Vegetn	17.10	20.7	12.1	14.6	10.02	12.1	7,015	8.49
Mixed Agric	27.00	32.6	18.0	21.7	13.01	15.7	6,200	7.50
Bare lands	11.00	13.3	8.10	9.80	6.10	7.38	4,100	4.96
Water body	8.10	9.80	8.09	9.79	8.00	9.68	8,104	9.81
Wetlands	12.2	14.7	9.20	11.1	7.20	8.71	4,200	5.08
Total	82.62	100.	82.6	100.	82.62	100.	82.62	100.

Source: Computed from TM, ETM, & OLI satellite imageries of Makurdi.

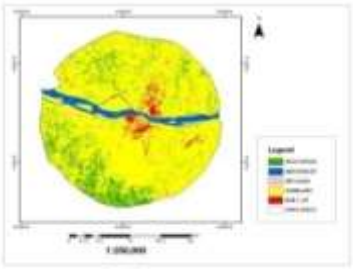

Fig2. Classified Landuse/Landcover distribution in Makurdi in 1986.

A decade later by 1996 land use /land cover distribution in the city as presented in Table 4 and Figure 3 shows that built-up urban lands dramatically increased to cover 32% of the city's land mass and so became the dominant land use/cover type while agricultural lands and forest vegetations covered only 22% and15% respectively. Also by this time wetlands occupied 11% of the city while bare lands and water bodies constituted 10% each of the land mass. Spatial land use change distribution during this period is shown in Figure 3.

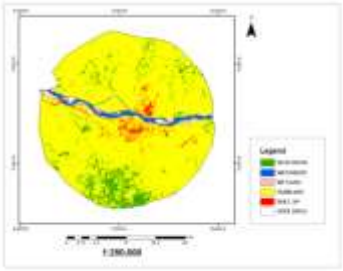

Fig 3. Classified land use/landcover map of Makurd in 1996

Again changes in land use as reflected in table 4 and figure 4 by 2006 shows that, built-up land use grew rapidly to cover 46% of the city while mixed agricultural lands were degraded to 16 %. Besides, forests /natural vegetation land cover and water bodies respectively depreciated in size to 12% and 10% of the city's land mass while bare lands occupied the least percentage portion of the city.

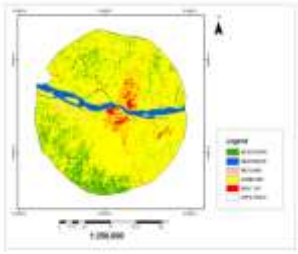

Fig 4. Classified land use/landcover map of Makurd in 2006

Finally, three decades from the base year of the study, the Classified land use/land cover distribution map of Makurdi in 2016 (figure 5) shows that built-up urban land uses had increased to cover over 64% or more than two thirds of the city's landmass.

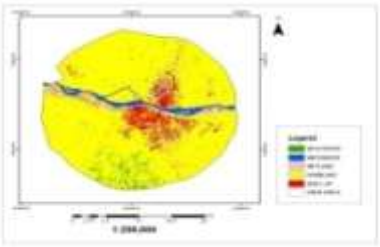

Fig5. Classified land use/landcover map of Makurdi in 2016

According to the data, mixed agricultural land use type was depreciated to 7.5% of the city's landmass as against its initial 32.32% while forest/vegetation and bare lands also were respectively decreased to cover barely 8.49% and 4.96% respectively.

The thematic land use/cover distribution in the city over the four epochs has been further represented in Fig.6. From the figure, built up land use type has a persistent increase in size throughout the 4 time periods. The increases in built up area in the city reflects the dynamics of urban growth in the various time periods.

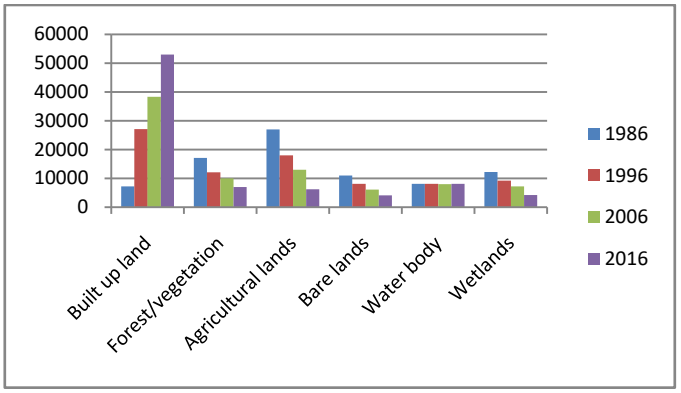

Figure 6. Land use/ cover distribution in Makurdi (1986, 1996, 2006 and 2016).

On the contrary mixed agricultural land use type seems to have suffered persistent depletion over the four time periods. From initial area coverage of over 27,000 square hectares in 1986, it diminished to 6,200 square hectares by the year 2016. The persistent decrease in area coverage of agricultural land use type could have been due to encroachment of urban land uses. Rapidly increasing population in cities according to Naab (2012) stimulates dramatic increase in the demand for land for residential, commercial, industrial and other public infrastructural development. Consequently all rural land uses and land cover types lying close to the city become the prime targets of transformation.

Figure 6 shows that other land uses such as forest/vegetation, wetlands, and bare lands also suffered depreciating area coverage in the city as from their initial distribution in 1986. Furthermore figure 7 shows the extent of change experienced by each of the land use/cover class between 1986 and 2016. According to the Figure, built-up land increased in size during the period by 457996 square hectares. On the contrary mixed agricultural land use on the other hand depreciated by more than 20,000 hectares. Similarly, forest /vegetation and wetlands also lost over 10,000 and 8,000 hectares respectively.

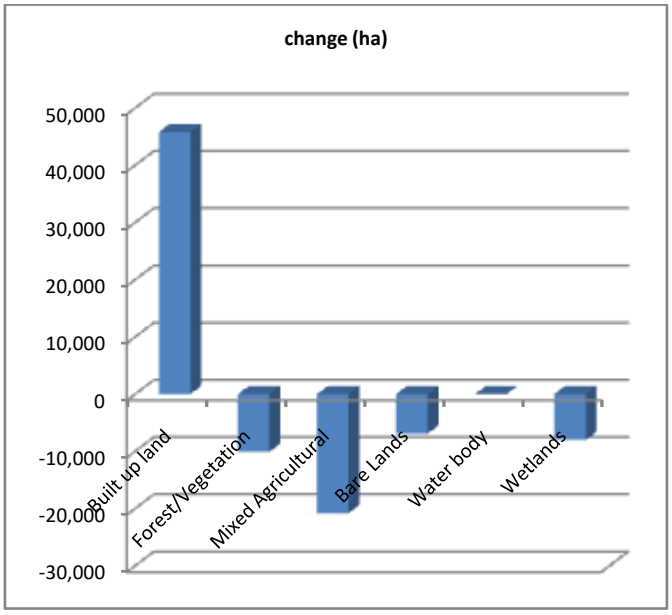

Figure 7 Land use change in Makurdi (1986-2016)

From the fore going discourse therefore, there has been tremendous increase in the built-up land use type signifying substantial growth of the urban area. Over 45,000 hectares of land was added to built-up land use consisting of commercial and residential housing, schools, offices, transportation and other urban activities. The major land-use/land-cover classes that contributed to the increase of built-up area are presented in Table 5

Table 5. Rates of Land use/land cover conversions to built-up area in hectares

Land use/ cover	1986-1996		1996-2006		2006-2016		1986-2016	
	Area (ha^2)	%	Area (ha^2)	%	Area (ha^2)	%	Area (ha^2)	%
Forest/vegetation	4996	25.1	2085	18.6	3005	20.2	10086	21.9
Mixed Agric	8996	45.2	5000	44.7	6806	45.9	20802	45.3
Bare lands	2908	14.6	1999	17.8	2001	13.5	6908	15.0
Water	12	0.1	89	0.7	-	-	101	0.22
wetlands	3000	15.1	1999	17.8	3001	20.2	8000	17.4
Total	19912	100	11172	100	14813	100	45897	100.

From the land-use/land-cover conversion statistics in the table, the period 1986-1996 witnessed the highest rate of conversion of all the land use classes in the city. This was the next decade after Benue state was created and Makurdi declared the capital city. Spillover effect of massive rush of civil servants from Jos –the capital of former Benue Plateau state to Makurdi the new capital, as well as movement of businesses and applicants looking for new jobs in the new state capital since 1976 could have generated the demand stimulated increasing development of housing infrastructure for residential accommodation as well as for accommodating commercial business premises, corporate offices and for industrial purposes in the city at the time. As a new capital more physical infrastructural facilities such as roads, hospitals, recreation centres were also rapidly developed. These physical development activities certainly could have encroached on other land uses and even depreciated the amount of space hitherto occupied by them. Besides, a sudden high demand for accommodation at the city centre could have stimulated hikes in land prices and rental values thereby forcing some people to seek cheaper lands at the city peripheries. Such movement to the city's peripheral areas again accentuated the problem as it led to further encroachment on the prime lands. Encroachment of urban land uses in the fringes of the cities according to GOK (2012) leads to crowding out of agricultural lands with serious food security and livelihood impacts directly or indirectly on the inhabitants and the immigrants in these areas (GOK, 2012).

On the contrary the period that experienced least land use conversion was between 1996 and 2006. This was a time of political transition in the country when power was to be shifted from the existing military government to a democratically elected civilian regime in Nigeria. There was much political tension and apprehension in the land: while the military government on seat had concentrated more investments to put in place needed democratic structures that would usher in a civilian government, both the business class and investors in real estate and the entire citizenry were not sure of the economic climate that would follow. Consequently

little investments were directed to physical infrastructural development and expansion of the city, hence very low encroachment was experienced on agricultural and other existing land uses around the city.

Nevertheless between 1986 and 2016 over 45897 square hectares of land were converted to urban uses. Out of this about 20802 square hectares of rich agricultural lands were encroached upon because of urban expansion. A Focus group discussion was held with some key informants consisting of village heads, community leaders and major cash crop farmers across the fringe communities of Makurdi including Mu, Tse-Poor, Apir and Adaka. The result from the discussion shows that farm sizes have been seriously affected. According to the investigation, most of the farmers have lost their farmlands to residential developments and other urban uses. One of the key informants at Apir gave this testimony…

*… "look at your back and your right hand"… (*pointing towards the buildings of Federal Medical Centre Apir and a Private Nursery School premises*)… all these lands were previously mine and I used same for farming. But I had to surrender some parts to government for [sic* the building of*] that hospital while the other one [*to the right*] I sold it out to people who have built that school and the surrounding residential houses. I initially sold some of the plots at NGN 500,000 but later on, as the pressure was more and demand was higher people became more desperate so I sold the remaining plots between NGN I million and 2.5 million each. I have no regrets for selling the land …from the money realized, I bought three automobile bikes which are been used for commercial transport service 'Okada', I also paid my children's school fees and built new residential houses for my family and for commercial rental purposes to the public".*

This finding corroborates earlier findings from the peri-urban districts of Dar'es Salaam, Tanzania where Briggs and Mwafupe(2000) [44] noted that indigenous communities indulged in selling their high value peri-urban land and moving away to further hinterlands where they engage in intermediate agriculture. This phenomenon is not uncommon in other cities of Africa where the poor tend to survive on selling parts of their land to meet basic needs until when they have nothing more to sell (Chembo 2011) [45].

A quick survey of 150 indigenous farming population in the fringes of the city (figure 8) shows that there are now more farmers with less than 5 hectares of land for farming than there were about ten to twenty years ago. Specifically 68.43% farmers currently have farms that are less than 5 hectares as against (13.63%) those who owned land within the same category ten to twenty years ago (Figure 8). Also the finding shows that between ten to twenty years ago much more people had above 10 hectares of farmlands than now. Precisely 84.33% of the respondents owned farmlands that were more than 10 hectares ten to twenty years ago against barely 8.27% of farmers that owned land within the same category now.

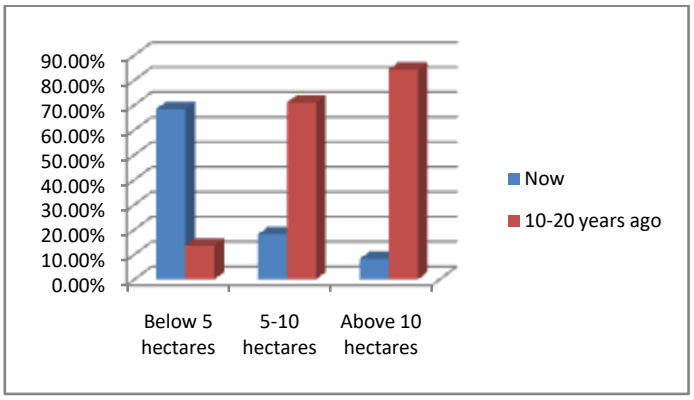

Figure 8. Farm sizes (hectares) in peri-urban areas of Makurdi town

The decreasing sizes of farmlands as an outcome of transformation of much of the agricultural lands could have led to changes in residents livelihood as attested to by the statement of the key informant above (…*I bought three automobile bikes which are been used for commercial transport service 'Okada'…; I also built new residential houses for commercial rental purposes to the public").*Further studies in this direction could therefore suffice in unravelling the emerging livelihoods of peri-urban residents in the wake of the city's continuous expansion.

V. Conclusion

With the aid of satellite data from RS images and GIS technology, this study explored the land use /cover dynamics in Makurdi due to the population growth and physical expansion of the town between 1986 and 2016. It was found that within the study period, there was significant increase in the development of urban infrastructure that resulted to outward expansion of the built up land use. Specifically where as built-up land use covered barely 8.73% of the city in 1986, in the following decades this dramatically increased to 32.83% in 1996, 46.35% in 2006 and 64.15% by the year 2016. This means an annual urban growth rate of 14.99 percent. On the contrary the other land uses and land cover classes experienced significant decline throughout the study period. Specifically, whereas agricultural land use occupied 32.6% of the city region in 1986, it decreased in the following decades to 21.79% in 1996, 15.54% in 2006, and 7.50% by 2016. Thematic maps produced from the satellite images across the study area shows that of all the land use land cover classes around the city transformed agricultural lands are the major contributor (57%) to the city's physical expansion as 72% of agricultural land use class was converted to built-up or urban developments. The glaring effect of agricultural land use transformation is manifest in declining farm sizes (as more and more farmers now own fewer hectares of farmlands than before). This development has likely effect on livelihood pattern and food security of urban and peri-urban residents.

In conclusion this paper has provided a synthesis of knowledge for citizens, planners and policy makers on

implications of urban expansion on agricultural lands at the peri-urban zones of cities. This has helped to illuminate the likely problem of residential expansion on food security which could be the basis for directing more efforts towards better management of land resources. Effective land resource management is an essential element for sustainability in urban and peri-urban areas as it touches on food security and employment generation. We consequently recommend that an agro-ecological map of Makurdi (that outlines all prime agricultural lands) be developed using zoning regulation as part of a long term spatial development framework (covering may be 10 years) that can safeguard all prime agricultural lands from further encroachment by urban expansion. Also we recommend that government through the Benue State Urban Development Board should formulate a policy that involves cooperation and participation of resident population as a tool to regulate the change of uses to land no matter the pressure from burgeoning urban population.

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