

# AGRICULTURAL LAND-USE CHANGE AND DISAPPEARANCE OF FARMLANDS IN KADUNA METROPOLIS-NIGERIA.

\*Y. SALEH, \*\*A. M. BADR, \*\*F. EL BANNA & \*\*A. SHAHATA

\*Corresponding Author: [yusou90@yahoo.com](mailto:yusou90@yahoo.com)

\*\*Department of Geography, Institute of African Research and Studies, Cairo University-Egypt

\*Permanent Address (Department of Geography, Faculty of Science, Kaduna State University, Kaduna).

## ABSTRACT

**This study assessed agricultural land-use change in Kaduna metropolis. This study combined the use of remote sensing and geographic information system (GIS) application to ascertain the rate of agricultural land-use change from 1980 to 2012 in the study area. The four imageries (Landsat MSS 1980, Landsat TM 1990, Landsat ETM+ 2005 and Nigeria Sat X 2012) used were classified and compared to understand the rate and extent of agricultural land-use change during the different periods. The findings revealed that the study area experienced a significant reduction in agricultural land and these leads to continued disappearance of farmlands. Lastly, the decrease in agricultural lands leads to loss of livelihood, reduction in food supply and increase poverty. This has raised so many concerns about the sustainability of Urban and Peri Urban Agriculture (UPA) production in the study area whereby the small scale farmers are the most affected.**

**Key Words:** Land-Use, Urban, Farmers, Remote Sensing, Geographic Information System (GIS) and Kaduna, Nigeria

## INTRODUCTION

The concept of land-use and land-cover change is as old as the town itself. Many ancient and Pre-colonial cities have undergone different types of land-use transformation during different stages of town growth in order to be compatible with the periods of mans' development. Man has in many ways altered the environment which resulted in having unique and different pattern of land-use.

Land-use change is an issue of much scientific interest. Several researchers have linked land-use change to the overall global change processes (Selvaraj *et al.*, 2013). In other words, land-use is the various ways in to which land is put to use depending on human needs. Also, land-cover describes the total physical land features (water bodies, soil, vegetation, rocks and so on) covering a particular land surface. The issue of land-use/land-cover changes (LULCC) in urban areas has always been a major concern (Saleh, 2009) especially agricultural land.

Therefore, land-use change continues to put agricultural land at risk of conversion.

Hence, information on urban land-use / land-cover changes and possibilities for their optimal use is essential for the selection, planning and implementation of good land-use and environmental policies. The information can also assists in monitoring the dynamics of land-use resulting out of changing demands of increasing population.

However, urban planners and decision makers are being faced with the problems of recognising the importance of UPA production to the sustainability of cities and surrounding areas (Adediji, *et al.*, 2009). The importance of agriculture in the study area cannot be over emphasis. Agriculture is particularly effective in reducing hunger and malnutrition (FAO, 2012), a source of food security to most small scale and poor urban farmers.

## MATERIAL AND METHODS

**Study Area:** Kaduna metropolis is located between 10° 27' N to 10° 38' N and 7° 20' E to 7° 35' E. It experiences two climatic seasons, it has a rainfall season from April to October and dry season for the rest of the year. The geology of the study area is underlined by basement complex rocks (Udoh, 1970). The main reason for selecting Kaduna metropolis, Nigeria is that it has undergone structural changes in its physical form, population (Table 1), economic and social composition over the last century due to urban growth (Saleh *et al.*, 2014). There is no doubt these would lead to land use changes in the study area. Table 1 shows the fast population growth of the metropolis from about 3,000 in 1919 to 45,000 in 1952, 896,055 in 1991 and estimated at over 2 million by 2015. The unprecedented rise of population and as well as composition of the population, and such other characteristics as socio-economic and political factors are some of the main driving forces of land use changes in the study area (Saleh *et al.*, 2014).

Thus, Kaduna is rapidly undergoing physical development and expansion, with remarkable changes in its land-use and urban landscape. These changes may be largely adduced to its proximity to the federal Capital Territory, Abuja (Abbas, *et al.*, 2010), better job opportunities and raising standard of living (Adewuyi & Baduku, 2012). These situations were derived largely from human activities such as agriculture, mining, construction, industrialization, deforestation, urbanization and so on. Even though, Kaduna was planned, but just as it is common with most developing cities, poor land management has often marred land-use planning with adverse consequences (Ndabula *et al.*, 2012).

**Table 1. Population Growth Rate Of Kaduna Metropolis (1919-2015)**

Year	Population	Percent Change	Year	Population	Percent Change
1919 <sup>4</sup>	3000	-	1931 <sup>2</sup>	10653	-0.94
1921 <sup>2</sup>	3791	2.16	1948 <sup>1</sup>	20874	5.6
1923 <sup>1</sup>	5206	18.6	1952 Census <sup>1</sup>	45000	28.8
1924 <sup>2</sup>	6097	17	1963 Census <sup>3</sup>	147317	20.6
1925 <sup>1</sup>	7800	28	1991Census <sup>3</sup>	896055	18.1
1926 <sup>2</sup>	8649	10.8	2006Census <sup>5</sup>	1570331	5
1927 <sup>1</sup>	9368	8.3	2011 Estimate <sup>5</sup>	1824464	3.2
1928 <sup>1</sup>	10048	7.2	2013 Estimate <sup>5</sup>	1937283	3
1929 <sup>2</sup>	10859	8	2015 Estimate <sup>5</sup>	2057078	3

Source: Bolanle (2008)<sup>1</sup>, Oyedele (2011)<sup>2</sup> Shehu (2011)<sup>3</sup>, Udoh (1970)<sup>4</sup> and Olusimeka & Salim (2011)<sup>5</sup>

The economy of Kaduna, especially during the Pre-British period, depended almost entirely on agriculture, but socio-political changes early in the 20th century resulted in a shift to modern economy and technological development.

The pattern of political changes, shift in economy, and an increase in population has resulted in an increased urban area. This pattern of urban expansion affects prime agricultural farming areas and it limits the potential of farming in the study area. Thus, converting agricultural areas in the urban and peri-urban areas to an urban status continues due to the process of urbanization. This problem is more pronounced and is also being driven by government developmental activities by taking over large areas of agricultural lands for one project or the other in the study area. As a result of urban development activities such as road construction, schools, hospitals, and other development projects taken place in the study area.

Therefore, the impact of such urban growth and human activities would be different types of land-use and its conversion from one type to another with or without regard to urban planning. This is due to low level of planning, non compliance to land-use provision and inefficient or non enforcement of planning laws/ land-use control in the study area.

This study examines Land-Use/Land-cover changes of Kaduna Metropolis between 1980 and 2012 with the use of Geographic Information System (GIS) and Remote Sensing. The study gives emphasis to agricultural land-use changes that has taken place between these periods. The methodology used in this study is the use of remote sensing and Geographical Information System (GIS) to determine land-use changes and how agricultural areas have converted to built-up areas and other urban land-uses in the study area.

The satellite imageries of the study area collected comprises of Landsat Thematic Mapper (TM) of 1980, Landsat TM 1990 and Landsat Enhanced Thematic Mapper Plus (ETM+) 2005 respectively. They were downloaded from the website of the Global Land Cover Facility (GLCF) of the University of Maryland, Maryland,

USA ([www.glc.f.umd.edu](http://www.glc.f.umd.edu)). The landsat imageries have a spatial resolution of 30 meters. That of Nigeria sat X (2012) imagery was gotten from Nigerian Airspace Space Research and Development Agency Office (NASRDA) and has 23 meters resolution. Ground truthing and Global Positioning System (GPS) readings collection was carried out in the study area in order to check for accuracy.

Satellite imagery of the study area were geo-referenced, interpreted with the use of ground truth data for checking of accuracy, then map editing, finalizing of maps and extraction of the statistical data for the different land-use and land-cover types. Arc GIS 10.1 software was used for the analysis of the satellite imagery.

After completing a detailed delineation of each land-use, the area of each class was measured and converted to hectares and percentages. These data sets were classified based on the reflective colour values. Therefore, the imageries were classified into six major Land-use/Land-cover classes: agricultural lands, built-up areas, water bodies, open space, vegetation and rock outcrop. These are the various types of land-use in this study. The classified figures reveals that red colours depicts the built-up areas, dark blue for water body, dark green for agricultural lands; dotted green signifies vegetation, white and black for rock outcrops and yellow for open space.

## RESULTS

This study assessed urban and agricultural land-use and land-cover change in the study area over a period of thirty two years. Findings revealed that from 1980 to 2012, increased urbanization, socio-economic factors and human activities such as construction, deforestation, and agriculture greatly contributed over the years to produce different types of land-use/land-cover change in Kaduna metropolis, thereby altering the natural environment and creating a human altered environment. All these factors combined with lack of adequate urban planning either directly or indirectly contributed to the land-use/land-cover changes which have taken place in the study area.

Four sets of satellite imageries shown in (Plates 1 and 2) were classified and the maps were composed in Plates 3 and 4 to show the different types of land-use categories used in this study.

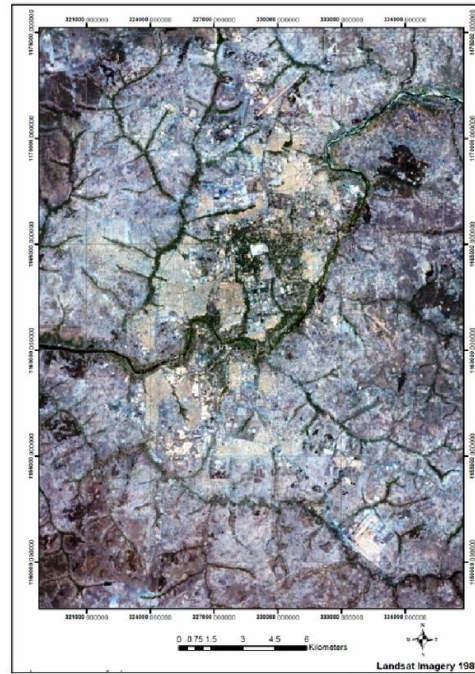
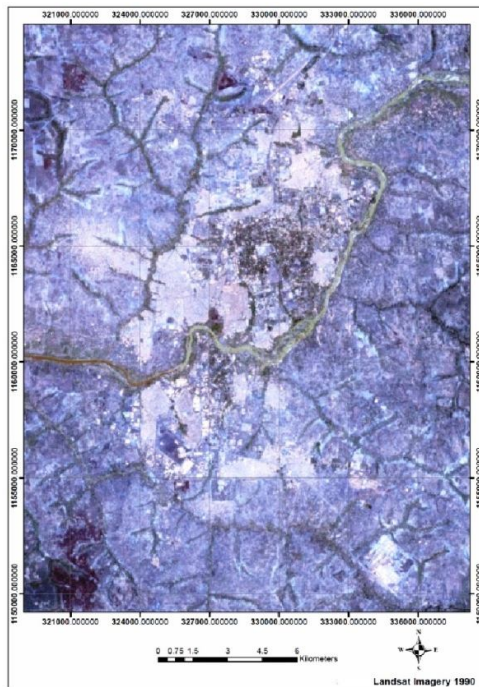


Plate 1: Land Sat TM (1980) and (1990)

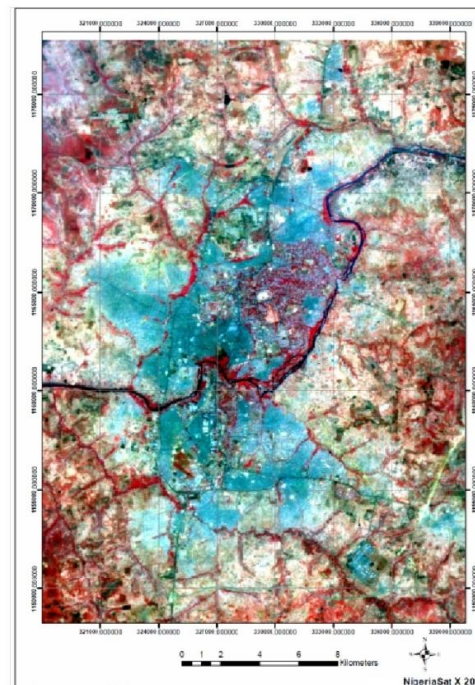
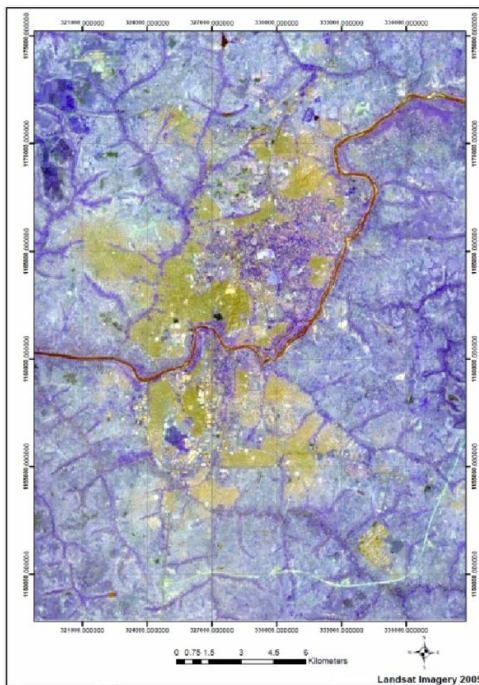
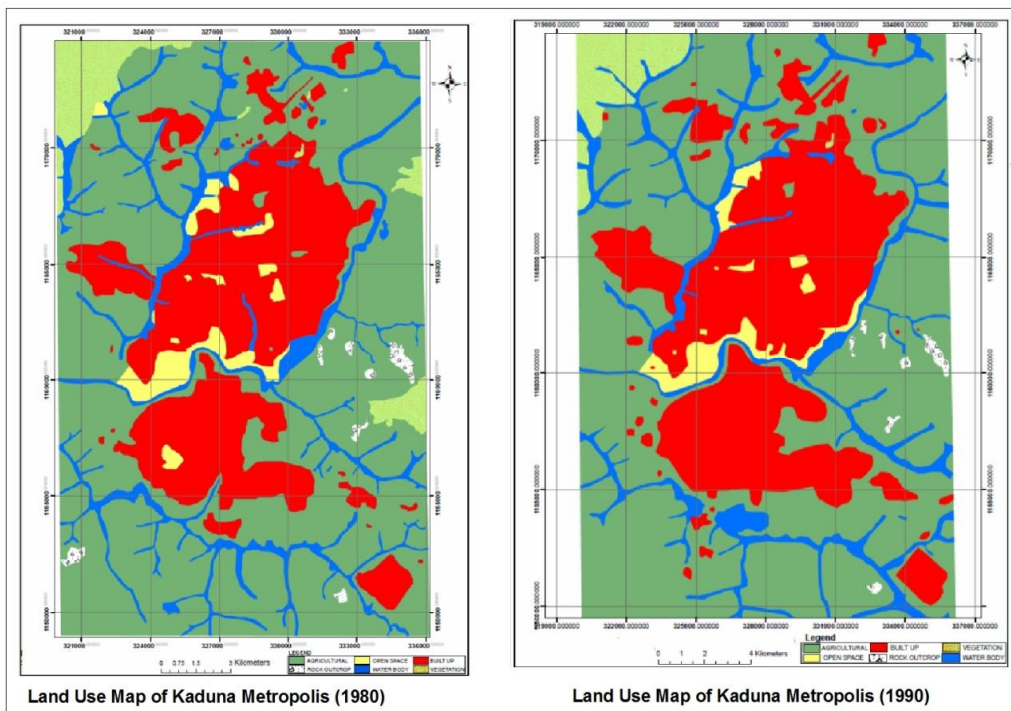
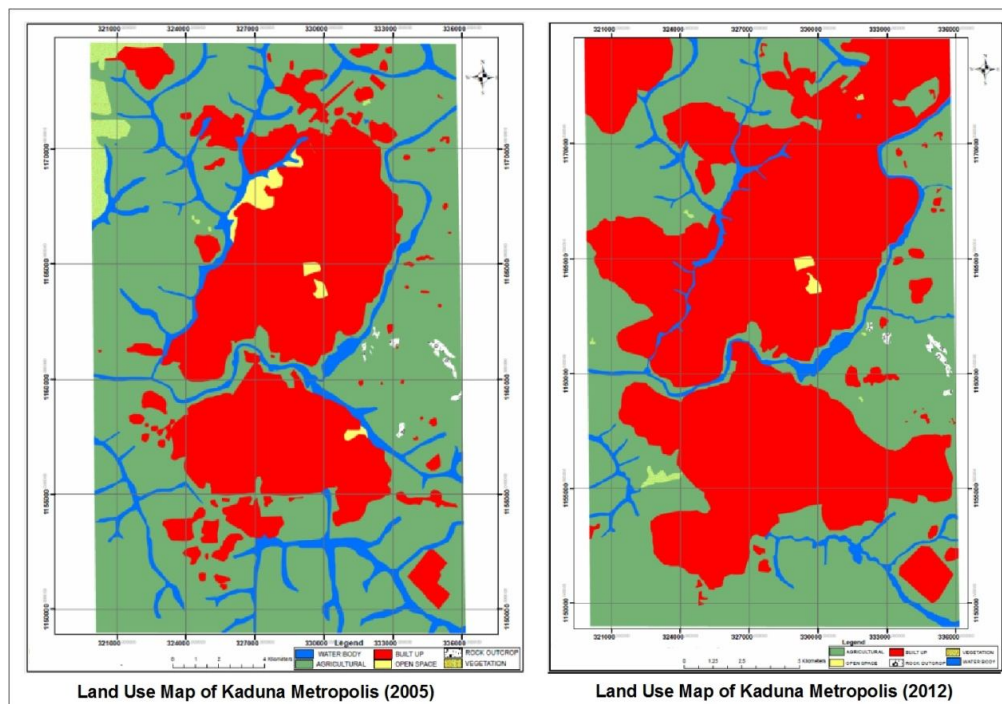


Plate 2: Land Sat ETM+ (2005) and Nigeria Sat X (2012)



**Plate 3: Land-Use Classification of 1980 and 1990**  
 Source: Land Sat TM (1980) and (1990)



**Plate 4: Land-Use Classification of 2005 and 2012**  
 Source: Land Sat ETM+ (2005) and Nigeria Sat X (2012)

The calculations of the land-use categories of the Kaduna (1980-2012) were extracted from Plate 3 and 4 and are tabulated and presented in Table 2.

Figure 1 shows the summary of the percentages of land-use classes from 1980-2012. The land-use/ land-cover distribution pattern in the year 1980 shows that agricultural land-use occupies almost two-third (59%) of the land-use category in the study area. That means urban farming forms a very important occupation and it is widely practiced by occupying the largest percentage of land-use in the study area. This is followed by built-up areas which is the second largest land-use and occupies one fourth (25%) of the land-use categories. Water bodies occupy an important position (9%) in the study area.

Open space and vegetation land use occupies 2.5% and 4% respectively. Rock out crop occupies the least land-use with 0.5%.

The land-use/land-cover distribution for 1990 also shows that agricultural land-use still occupy a very important position by occupying over half of the land-use distribution (57%) but with a little reduction from the 1980. This is followed by built-up areas with 27% of the land-use distribution, which shows an increasing prominence together with water body (9.5%). However, the remaining land-use categories of open space (2.25%), rock outcrop (0.42%) and vegetation (3.3%) show a general decrease due to increase in built up areas.

**Table 2. Land-Use Distribution Of Kaduna Metropolis (1980-2012)**

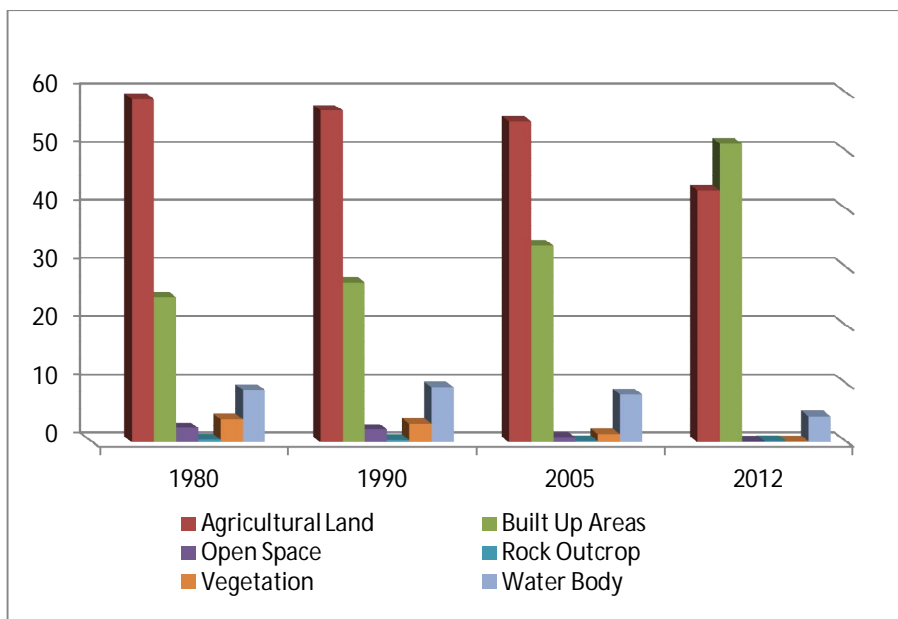
Land-use/ land Cover Classes	1980		1990		2005		2012	
	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)	Area (Ha)	Area (%)
Agricultural Land	24,282.93	59	23,312.9	57	23,158.16	55.2	17,856.5	43.4
Built Up Areas	10,189.25	25	11,350.75	27.5	14,243.8	33.9	21,178.25	51.4
Open Space	1,052.39	2.5	926.39	2.25	344.05	0.82	77.61	0.18
Rock Outcrop	245.60	0.5	174.36	0.42	109.1	0.25	107	0.26
Vegetation	1,652.5	4	1,395.89	3.3	598.11	1.42	87.03	0.21
Water Body	3,598.65	9	3,890.979	9.5	3,478.02	8.2	1,843.16	4.5
Total	41021.32	100	41051.26	100	41931.24	100	41149.55	100

The 2005 land-use distribution of Kaduna metropolis shows continued reduction in agricultural land-use to 23,158.16 Ha (55.2%) and built up area (33.9%) shows further increases gaining from agriculture and other land-uses. Also, the remaining land-use categories of open space (0.82%), rock outcrop (0.25%), vegetation (1.42%) and water body (8.2%) show a general decrease due to urban encroachment.

In 2012, the land-use distribution shows increased in built up area which occupies over half of the land-use

distribution with 51.4% making it the highest land-use/ land-cover category in the study area. Agricultural land-use has shown a decrease occupying 43.4% of the total area. The remaining land-cover categories of rock outcrop (0.25%), vegetation (1.42%) and water body (8.2%) show a further decrease due to urban encroachment. Open space (0.18%) occupies the least

among all the land-use due to land-use conversion for other urban activities and increased population pressure.



**Figure 1. Percentage Distributions of Land-Use/Land-Cover Changes Trend (1980-2012)**

Agricultural land-use category occupy the largest area of land-use class but keeps on decreasing in the study area from 1980 to 2005 and with the greatest agricultural loss experience between 2005 and 2012. This trend may continue if not controlled and it will drastically leads to loss of productive agricultural areas.

Other land-uses such as vegetation, open space, water body and rock out crop has shown a significant decreased over the period studied from 1980-2012. These are cause as a result of urban encroachment on the different land uses.

#### DISCUSSION

The process of urbanization has continued to impact on the land-use pattern of urban areas, thereby changing the existing land-use which affects agricultural areas. The implication of land-use change on agriculture varies from one place to another.

UPA requires access to land which is very scarce in an urban environment. This is caused as a result of lack of provision for urban farming in the metropolis, as was observed in the Kaduna master plan. This results to farming in any available space within Kaduna metropolis as it was observed during the ground truth and as shown in Plates 3 and 4. This has led to farming in places such as residential areas, working places (both public and semi-public institutions), industries, vacant lands, eroded areas, river valley/banks, road/railway verges and on barren land areas. This informal arrangement of farmlands and improper usage of available spaces has resulted in farmlands arranged haphazardly without any plan in the study area. Although, farming in vacant land serves as means of preserving it for future use, in most instances, there is little effective control over land-use changes from agriculture to non agricultural uses in the study area.

Therefore, the practice of UPA is largely an informal economic activity in the study area. Even though evidence has shown that farming has been a principal economic activity in some of the major Nigerian traditional cities of Kano and Zaria in North-western and Ibadan in South-western Nigeria (Morgan, 1983).

Furthermore, the pressure put on land and water by the urbanization process puts urban and peri-urban food production increasingly at risk (Eaton & Hilhorst, 2003 and FAO, 2000) as well as threat to food security and reduction in the livelihood of those that depend on these farmlands. The socioeconomic impact is the lost of livelihood.

UPA affects the aesthetic beauty of the metropolis where it is used as parks and gardens. It beautifies the environment but where crops are grown, it makes urban areas look more like rural areas. This is why some researchers (Drescher, 2003) and municipal governments do not support its practices.

In conclusion, this study has shown the integration of both remote sensing and GIS based on temporal and spatial assessment of the agricultural land-use changes in the study area. The results of the study revealed that Kaduna metropolis experienced a significant reduction and disappearance in agricultural land-use and in other land-uses such as open space, rock-outcrop, water body and vegetation. The loss of prime agricultural land has some significant impact that leads to loss of livelihood by small-scale urban farmers, reduction in urban food supply and food security. These changes are attributed to urban expansion, population growth, socio-economic factors, politico-administrative changes, environmental variables and other natural factors.

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