

Urbanization Effect on Landuse Changes in Parts of Bwari Area Council, Abuja, Nigeria

Bashir, M.S¹, Sangari, D.U¹ and Adamu, T. O¹

¹Department of Geography, Nasarawa State University, Keffi, Nasarawa State.

Corresponding author's e-mail: SA708LIM@yahoo.com

ABSTRACT

Urbanization is a worldwide phenomenon and doubled as a process of relative growth in a country's urban population, accompanied by an even faster increase in cities' economic, political, and cultural importance relative to rural areas. This paper assessed the urbanization effect on land use in parts of Bwari Area Council, Abuja, Nigeria. The specific objectives are an analysis of the dynamics of urban land-use changes within the selected times and an assessment of the effectiveness of land-use planning in the management of some towns in the Study area. Four multi-date Landsat imageries, TM of 1988 and 1999, ETM+ of 2009, and OLI of 2020 of the 30-meter resolution, were utilized to generate data and identify changes. The Structured questionnaire containing several questions was administered to elicit information from the respondent regarding the effectiveness of land use planning in the management of the satellite towns. Three hundred questionnaires were administered with one hundred each to the three locations of Kubwa – Dutse Alhaji, Mpape, and Dawaki. The classified Land sat imageries results indicate that land use distribution over the three satellites of Kubwa–Dutse Alhaji, Mpape, and Dawaki exhibited more concentration of built-up areas on a progressive basis compared to other land use categories. The built-up areas increased between 1988 and 2020 from 4.79 km² to 15.70 km², 0.98km² to 6.42km² and 4.85km² to 13.37km² for Mpape, Dawaki, and Kubwa-Dutse Alhaji respectively. The conclusion is that Spatio-temporal changes in land use across the study location show that the built-up areas increase resulted in the conversion of other land use types to the built-up environment due to population increase and continuous urbanization. Therefore, it is recommended that regulatory authorities' continuous monitoring of land use should be strengthened to avoid or reduce environmental degradation and ensure sustainability.

Keywords: Urbanization, Land use, Conversion, Concentration, Degradation, Sustainability

1. INTRODUCTION

Urbanization is a worldwide phenomenon. It is a process of relative growth in a country's urban population accompanied by an even faster increase in cities' economic, political, and cultural importance relative to rural areas. The term "urbanization" describes increased human habitation linked with increased per capita energy and resource consumption and extensive landscape modification (McDonnell and Pickett, 1990). Since the population becomes more prosperous, demand for goods and services is often driven by more than just pure

population growth. There is a worldwide trend toward urbanization. In most countries, it is a natural consequence and stimulus of economic development based on industrialization and post-industrialization (Ejaro and Abubakar, 2013).

Urbanization refers to a growth in the proportion of a country's population living in urban centers of a particular size (Abercombie *et al.*, 1988). Mayhew (1997) mentioned that urbanization is synonymous with the population increase in cities or towns through migration from rural areas because of social and

economic changes, or in other words, a transformation from rural to urban-based societies. From a demographic point of view, urbanization is measured by the percentage of the population living in urban areas (Davis, 1992). In some cases, urbanization has a strong relationship with the level of economic development, in which developed countries have a higher level of urbanization than developing countries. Since the industrial revolution in the late 18th century, the urbanization process was led in England and followed by many other countries. (Ejaro and Abubakar, 2013).

Land use is a general term for the human modification of the earth's terrestrial surface. Though humans have been modifying Land to obtain food and other essentials for thousands of years, current rates, extents, and intensities of land use are far greater than ever in history, driving unprecedented changes in ecosystems and environmental processes at local, regional, and global scale (Tsegaye, 2021). Due to the world population boom and advancement in science and technology, natural resources are over-exploited for economic activities with high severity in developing countries. Agricultural expansion into forest land, timber logging, charcoal production, and firewood harvesting are the major drivers of deforestation in Africa (Muhati *et al.*, 2018).

The implications of rapid urbanization in Nigeria on employment, human and food

security, the economy, waste management, infrastructural facilities, and other things are alarming. The explosive growth rates in the study area have not only progressively complicated and exacerbated inter-related problems of human settlements and the environment but have also greatly accelerated poverty (Salau, 1992). Nigeria has one of the highest urban growth rates in the world, with its cities ranking among the fastest-growing in the world. Growing at the rate of around 5.5 percent annually from 1980 to 1993, and more recently, it has increased to the rate of 5.8 percent, which has resulted in a total urban population of 62.66 million people (43 percent of the national population) and by projection, this proportion is expected to increase to more than 60 percent by 2025 (UN, 2007). In reality, most Nigerian cities have not been able to resolve the problems of urban growth and development; rather than improving, the urban areas continue to experience a more pathetic situation in their physical and environmental conditions (Jiboye, 2009). Given these, this paper examines the effect of urbanization on land use in part of the Federal Capital Territory, Abuja, as one of the fastest-growing urban centers in Nigeria.

2. MATERIALS AND METHODS

2.1 The Study Area

Bwari Area Council is one of the six area councils in the Federal Capital Territory, Abuja (see Figure 1). The Area Council has more than 850 settlements, out of which more than 80

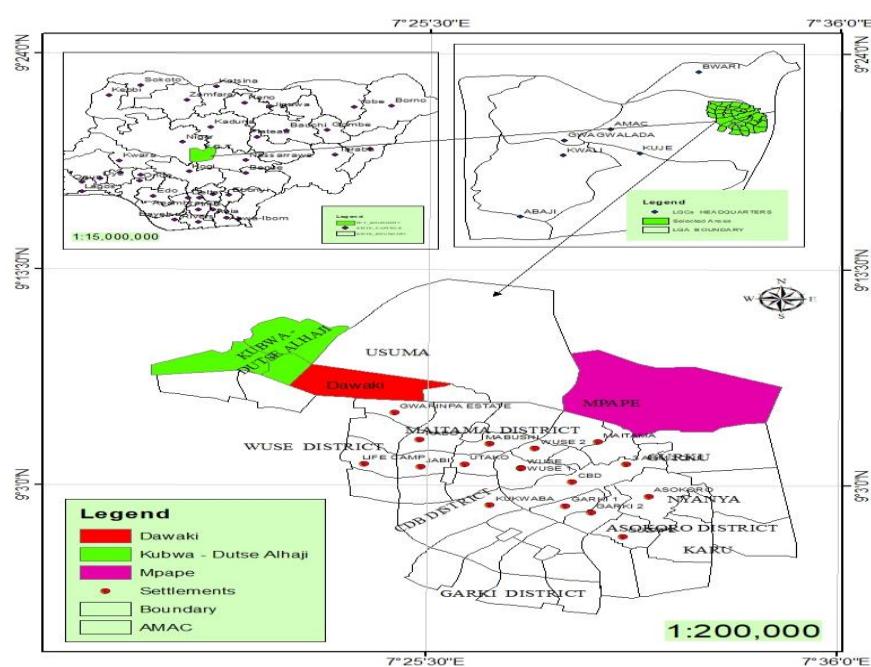


Figure 1: The Study Area Bwari Area Council, FCT, Nigeria

percent are rural (Dawam 2000). Apart from the Federal Capital City (FCC), Gwagwalada, Kwali, Kuje, Bwari, Yaba, Robochi, Karshi, Zuba, Kubwa, Gwagwa, Karmu, Idu, Lugbe, Nyanya and Karuare, all other settlements are villages and hamlets which are of the isolated nucleated pattern (Dawam, 2000). As of 1977, most of the settlements lacked basic infrastructure, and the inhabitants were engaged in farming and other extractive activities. However, today's urban areas are provided with basic amenities and infrastructure and have populations whose major occupation is in the secondary and tertiary sectors of the economy (Dawam, 2000).

2.2 Data used

Interview schedule was used whereby the respondents were asked different questions depending on the information needed in an interactive manner. The Structured questionnaire containing several questions was administered to elicit information from respondent regarding the effectiveness of land use planning in the management of the satellite towns.

Three hundred questionnaires were administered with one hundred each to the three locations of Kubwa – Dutse Alhaji, Mpape, and Dawaki. Focus group discussions also were carried out with relevant authorities in the field of land use planning and urban development in the study area. Focus group discussion and questionnaire were used to achieve this objective. A stratified random sampling approach was adopted in the administration of questionnaires. These entail stratifying the target population according to location, occupation, and proximity to the satellite town.

2.3 Data analysis

Descriptive statistics were used to analyze the questionnaires administered using the sample mean and percentages.

The mean is expressed as:

$$\bar{X} = \frac{\sum_{i=1}^N x_i}{N} \quad \dots \dots (1)$$

Where:

$$\bar{X} = \text{The value of the observed parameter}$$

$$\sum = \text{Summation symbol}$$

$$N = \text{Number of observations}$$

The extent of land-use change detection was analyzed using ArcGIS and IDRISI software. To achieve this, the first task was developing a table that showed the area in hectares and the percentage change from each year measured against each land use type. Percentage change to determine the trend of change was calculated by the preceding year's value and multiplied by 100. The equation is given as:

$$(Trend) \text{ Percentage change} = \frac{\text{Observed change} \times 100}{\text{Value of the preceding year}} \quad (1)$$

In obtaining the rate of change, the percentage change was divided by 100 and multiplied by the total number of years 1988– 2020 of the study period.

The extent of land use change was analyzed by subtracting the reference year (2020) from the base year. It is represented mathematically as:

$$E_T = B - A \quad (2)$$

Where: A = the base year (1988)
 B = the reference year (2020)
 E_T = total extent of forest land

Histograms of the classified images were used to provide the information on the total area coverage of each class theme from the different images. Simple percentage tables were used for the statistical analysis. In addition, change analysis was carried out to examine the change in a built up area between 1988– 2020 in order to determine the extent of land-use change.

Three main change detection methods which have been previously applied by (Ikusemoran *et al.*, 2013) were employed, they are:

Change detection by area calculation

There are three steps in calculating change detection by area calculation

a) The first step is the calculation of the magnitude of change, which is derived by subtracting the observed change of each period of years from the previous period of years.

b) The second step was calculating the trends, that is, the percentage change of each land use, by subtracting the percentage of the previous land use from the recent land-use divided by the previous land use and multiplied by 100 (B-A/X100).

c) The last is calculating the annual rate of change by dividing the percentage change by 100 and multiply ingby the number of the study years 1988-2020.

3. RESULTS AND DISCUSSION

Table 1 depicts the magnitude and percentage of change in land use from 1988 to 2020 in Kubwa-Dutse Alhaji. It indicates that built-up areas continue to increase as it gains 8.52 km^2 (43.74%) from other land cover classes with an annual rate change of (13.99 %). This implies that the area has gained 10% of forest land annually for 32 years. This indicates that rapid population growth remained the major factor that prompted and stimulated environmental resource degradation. Agricultural Land also decreased by -3.89 (19.97 %) between 1988 and 2020 at an annual rate of 6.39 %, the second-highest. This result indicates that 6.39 % of agricultural Land is being converted yearly for

increase in urban areas implies that in no distant time, other land use and land cover categories will be converted to urban areas, which will lead to increased temperatures, a decline in biodiversity, and increased soil erosion and degradation.

Table 2 shows the magnitude of the change from 1988 – 2020 in Mpape. It indicates that built-up areas continue to increase as it gains 10.91 km^2 (36.17%) from other land use classes with an annual rate of change of (11.57 %). This implies that 10% of forest land decreased annually for 32 years. This shows that rapid population growth has remained the major factor that has prompted and stimulated environmental resource degradation. Grassland also decreased by -9.68 (32.09 %) between 1988 and 2020 at an annual rate of 10.26 %.

Table 3 shows the magnitude and percentage of change in land use between 1988 and 2020 in

Table 1: Magnitude and Percentage of Change in Land Use 1988 – 2020 in Kubwa-Dutse Alhaji

Land use Class	1988 Extent (Sq. km)	2020 Extent (Sq. km)	Magnitude of Change (Sq. km)	Percentage of change	Annual Rate of Change %
Built up	4.85	13.37	8.52	43.74	13.99
Forest cover	2.84	0.27	-2.57	13.19	4.22
Grassland	8.43	5.17	-3.26	16.74	5.36
Agricultural Lands	5.61	1.72	-3.89	19.97	6.39
Bare surface	3.45	4.49	1.04	5.34	1.71
Water body	0.04	0.24	0.2	1.03	0.33
Total	25.22	25.22	19.48	100	

Table 2: Magnitude and Percentage of Change in Land Use 1988 - 2020 in Mpape

Land use Class	1988 Extent (Sq. m)	2020 Extent (Sq. km)	Magnitude of Change (Sq. km)	Percentage of Change	Annual Rate of Change %
Built up	4.79	15.70	10.91	36.17	11.57
Forest cover	7.30	1.87	-5.43	18.00	5.76
Grassland	21.40	11.72	-9.68	32.09	10.26
Agricultural Land	10.04	11.97	1.93	6.40	2.05
Bare surface	7.65	9.86	2.21	7.32	2.34
Water body	0.11	0.11	0	0	0
Total	51.29	51.24	30.16	100	32

Table 3: Magnitude and Percentage of Change in Land Use 1988 – 2020 in Dawaki

Land use Class	1988 Extent (Sq. km)	2020 Extent (Sq. km)	Magnitude of Change (Sq. km)	Percentage of change	Annual Rate of Change %
Built up	0.98	6.42	5.44	35.48	11.35
Forest cover	4.35	0.52	-3.83	24.98	7.99
Grassland	4.60	2.23	-2.60	16.96	5.42
Agricultural lands	4.22	2.87	-1.35	8.81	2.82
Bare surface	0.37	2.48	2.11	13.76	4.40
Total	14.53	14.52	15.33	100	

farming and other activities during the study period. Also, grassland, bare surface, and water were found to be -3.26 (16.74%), 1.04 (5.34%), 0.2 (1.03%), respectively, with the annual rate of change of 5.36%, 1.71%, and 0.33. This

Dawaki. It indicates that built-up areas continue to increase as it gains 5.44 km^2 (35.48%) from other land use classes with an annual rate of change of 11.35%. That 8.81 % of agricultural land was converted yearly to farming and other

activities during the study period. Also, Forest cover, grassland, and bare surfaces were found to be -3.83km^2 (24.98%), 12.60km^2 (16.96%), and 2.11km^2 (13.76%), with an annual rate of change of 7.99%, 5.42%, and 4.40% respectively. This increase in urban areas implies that other land use categories will be converted to urban areas in no distant time.

Land-use change detection attributes

Land-use change analysis using Land Change Modeler (LCM) on the study locations (Mpape, Kubwa-Dutse Alhaji, and Dawaki) for the period (1988 -2020) indicates that almost all the land use classes underwent losses and gains in coverage and conversion. Built-up areas and bare surfaces across the study locations witnessed net gains, while forest Farmland/agricultural land and grassland witnessed net losses (See Figures 2, 3, and 4).

Figure 2 depicts forest and grassland with the highest area coverage due to the growth in the urban areas, followed by farmland and bare surface, while water bodies contributed negatively to urban growth. The net loss in the forest came from agricultural/farmlands, grassland, and deforestation, as depicted in Figure 3. Bare surface and built-up areas were responsible for decreasing forest cover and other land use categories consequent upon increased urbanization activities.

Figure 5 illustrates people's perception of the percentage distribution of Land use types. It shows that farming is the least dominant land-use type in the study location at 9.84%, forestry at 27.62%, and fallow Land at 22.85%, while built-up is the most dominant land-use type in the study location at 39.68%, which is an indication of the continuous influx of people across the study locations.

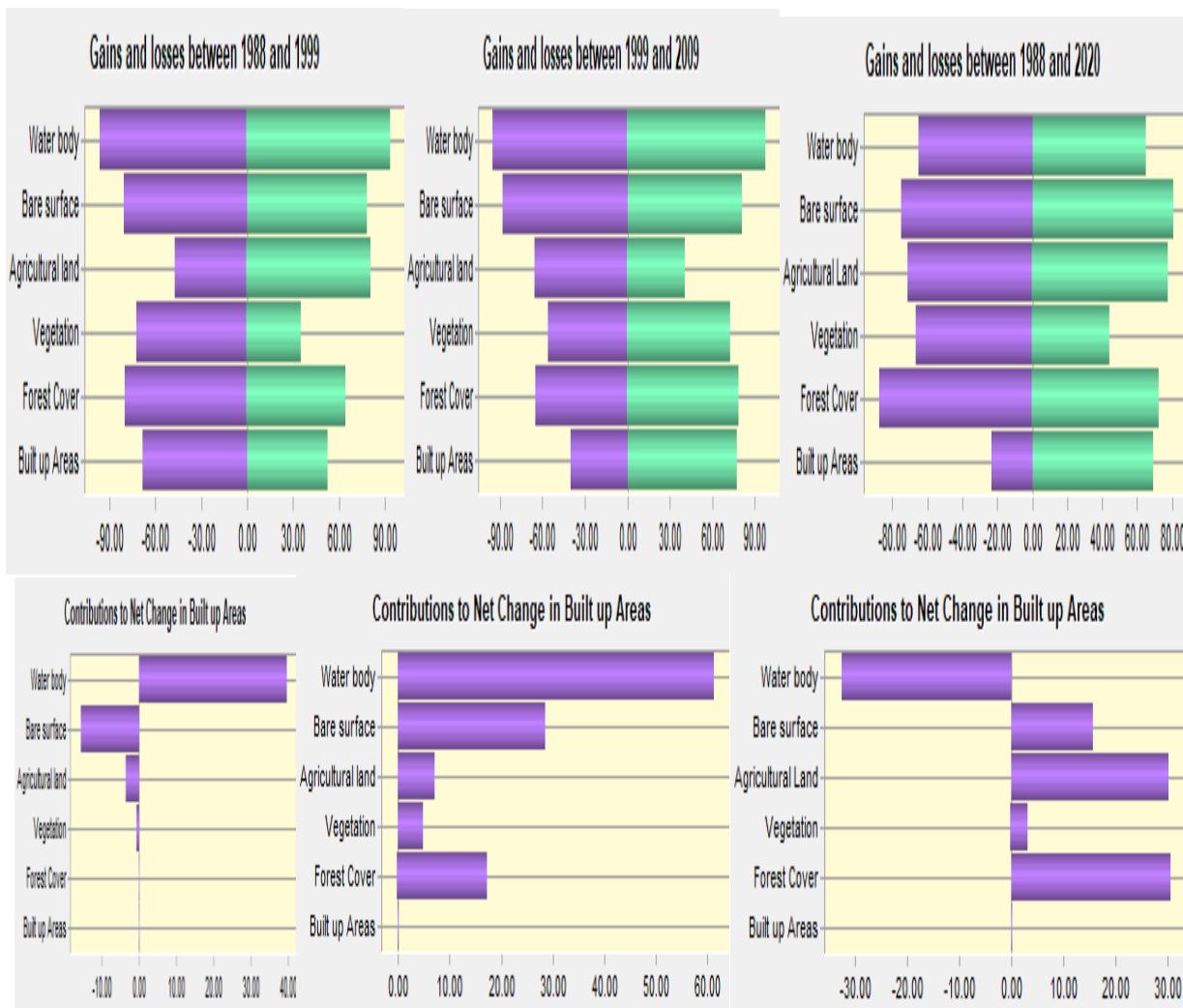


Figure 2: Contribution to Net gains/losses in Land use attributes in Mpape



Figure 3: Contribution to net gains/losses in Land use attributes in Kubwa- Dutse Alhaji



Figure 4: Contribution to Net gains/losses in Land use attributes in Dawaki

Figure 6 shows changes noticed concerning vegetation, and it revealed that vegetal cover

increased by 24.76%. This is attributed to the effort of FCDA to monitor and control the

environment and ensure the beautification of the area. However, 68.25% of the population admitted to a decrease in vegetal cover as the rate of urbanization continued from the year 2000.

Figure 7 shows the effects of population and the expansion of the community as it affects the environment. 26.34% strongly agreed that the expansion of the community affected the environment in the study location, 22.85% agreed that the expansion of the community has also affected the environment, 18.73% strongly disagreed, 27.61% disagreed, and 4.44% were indifferent.

Figure 8 shows how an increase in build-up affects the environment. 26.66% of the

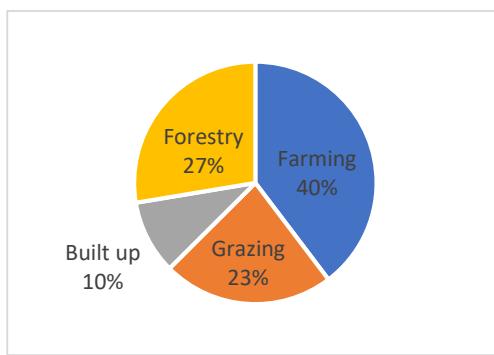


Figure 5: People perception of percentage

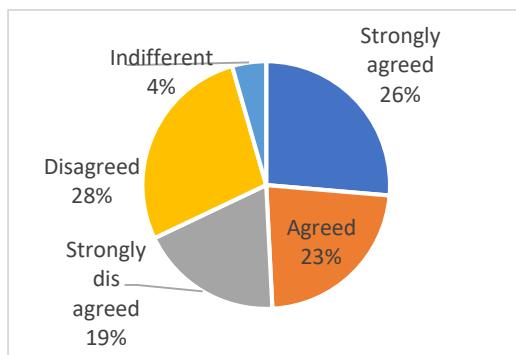


Figure 7: Community Expansion impact.

population attested that an increase in built areas diminished vegetal cover, with 28.25% of the population agreeing to an increase in waste generation and disposal and subsequently increased occurrence in wetland depletion.

On the official visits of Development Control officials from the FCDA to the study area, 39.04% of the population attests to the fact that they often come around to ensure compliance with Development Control guidelines and the Abuja Master Plan (see Figure 9).

Table 4 shows the distribution of questionnaires in the study locations. A total of four hundred (400) questionnaires were administered in the three satellite towns that constitute the study area. 315, representing 78.8%, were returned.

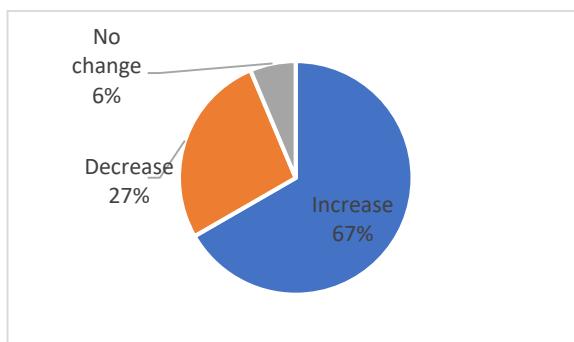


Figure 6: Changes in Vegetation Cover distribution of Land use types

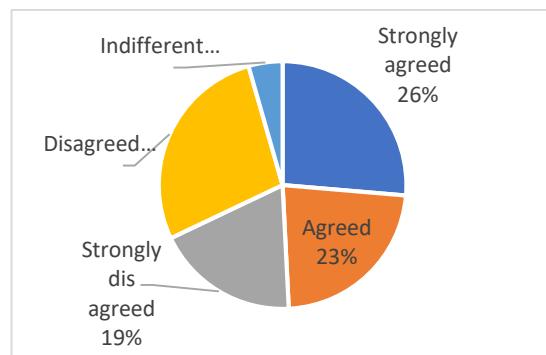


Figure 8: Population impact on Land use on the environment

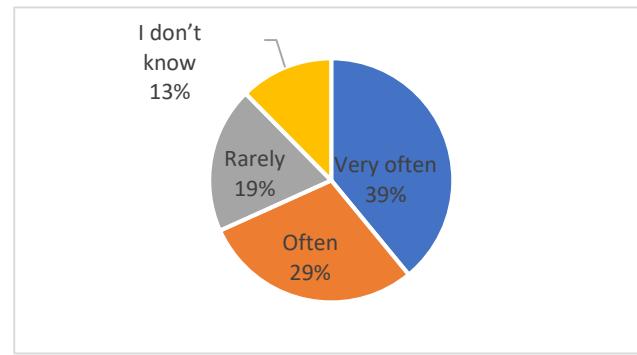


Figure 9: Percentage number of visits by Development Control Officials

Table 4: Field survey responses on land use planning in the management of the Satellite Towns

Wetland areas	Number of questionnaires administered	Number of questionnaires returned	Response rate (%)
Mpape	150	128	85
Kubwa – Dutse Alhaji	150	110	73
Dawaki	100	77	77
Total	400	315	78.8

Source: Field survey, 2021

Mpape has the highest percentage of response rate (85%), while Kubwa – Dutse Alhaji and Dawaki recorded 73% and 77% response rates, respectively.

A cursory look at the land-use changes due to urbanization in the Kubwa -Dutse Alhaji, Dawaki, and Mpape revealed that the satellite towns are expanding sporadically due to the continuous influx of population, businesses, administrative and commercial ventures. This has led to the settlements losing their rural nature and the conversion of various land use classes such as agricultural lands, open spaces, forests, and vegetal covers to a continuous built-up environment-a signpost to the urbanization effect.

4. Conclusion

The effect of urbanization on the land use in these satellite towns is quite visible as one enters the Federal Capital Territory from Zuba. The picture is a continuously built-up landscape almost fused with the Capital city. The settlements can rightly be classified as greater Federal Capital city. Also, the satellite towns now bear imprints of highly urbanized areas. These can be seen in the superhighways, tarred road networks, flyovers, and widespread soft and hard infrastructures. These include water and electricity supply, education and health service institutions, banks and other financial outfits, services such as fuel stations, eateries, and supermarkets, and a blossoming informal sector of the economy. These services and infrastructures are responsible for converting various land use classes to more of a built-up environment.

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