

ASSESSING THE EFFECT OF URBAN GROWTH ON FOREST COVER OF GUGA FOREST RESERVE, GIWA - KADUNA (1986-2019)

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Abstract

Several factors are responsible for urban growth. Increasing urban employment opportunities is one of the factors. Rural- urban migration coupled with natural increase in population caused by improved living standard, are major causes of rapid growth of cities and towns. Rural poverty, search for better living standards, environmental degradation (deforestation and desertification), inadequate and lack of basic amenities and services among other factors are pushing rural inhabitants out of the rural areas. The aim of this research was to assess the effect of urban growth on forest cover of Guga Forest Reserve in Shika, Giwa Local Government Area of Kaduna State, Nigeria. The methodology adopted for this research includes classification technique using maximum likelihood algorithm in classifying the images into various classes (themes). This method is preferable due to its high level of accuracy and reliability in handling spatial data. This technique gives room to the researcher to generate training classes based on the land use/land cover themes present in the area. The result revealed that in 1990, about 665.3 ha of forest land was displaced by built-up while in 1999, about 653.3ha of forest was displaced by built-up areas. In 2019, a larger portion of forest land was displaced (479.1 ha) by built-up. The above overlay analysis shows a clear evidence of physical expansion encroaching into the forest land. Areas formally occupied by the forest land has almost being cleared completely giving room for physical development in the area. The research concludes that the period 1986-1990 recorded the highest annual growth (1.7%) while the average annual growth rate within the study period (1986 - 2019) was 0.9%. Unplanned expansion has led to conversion of forest and bare land into physical development. The study recommends that reforestation of degraded areas is also suggested in order to speed up the process of rehabilitation and regeneration of the forest. This entails more annual tree planting and provide tree seedling to farmers to encourage agro-forestry or better still, this will enhance resource management and reduce indiscriminate exploitation of forest cover.

Key Words: Urban growth, Forest cover, Change, Environment

Introduction

Urban concept varies from country to country and with periodic reclassification, can also vary within one country over time, making direct comparisons difficult. An urban area can be defined by an administrative criteria and political boundaries within the jurisdiction of a municipality or town committee. A threshold population size where the minimum for an urban settlement is 2,000 in habitat and this figure varies between 2000 and 50,000 people or where a significant majority of the population engaged in non-agricultural activities (Brenna, 1990; Cohen, 2016).

Urban growth refers to the relative or absolute increase in the number of people who live in towns and cities (Mathew, 2010). The pace of urban population growth depends on the natural increase of the urban population and the population gained by urban areas through both net rural-urban migration and the reclassification of rural settlements into cities and towns (Cohen, 2016). However, majority of the world's population today lives in urban areas thereby causing an unprecedented expansion of urban areas (United Nations, 2009; Cohen, 2016). Based on the United Nations report in 2008, more than 50 percent of the world population presently lives in cities of varying sizes and this will continue to increase particularly in developing regions of the world (Adesina, 2005; Daramola and Ibem, 2010; United Nations, 2009; Danburi, 2014).

Globally, the towns and cities of developing countries are growing rapidly in both population and areal coverage, due to great waves of distress migration from rural areas. Thus, the urban centre in developing countries are expected to double their total population from 2 billion

in 2000 to 4 billion by the year 2030, and triple their total built-up areas from about 200,000 km² to more than 600,000 km² within this same period, given an annual average density decrease of 1.7% to constitute 54.5% of the total urban built-up areas in the world by 2030 (Adesina, 2005; Shlomo *et al.*, 2005).

Expanding population has brought with them a range of problems for both the physical and built environment (Charles, 1989 and David, 2003). As our big cities have grown away from the centre to accommodate people's settlement needs, suburbs have mushroomed outwards, producing what is referred to as 'urban sprawl'. This process means that the natural environment suffers as more space is required for the construction of houses, roads, the development of industry among other. As more ecosystems are disrupted and habitats are destroyed, urban growth leads to an even greater reduction and distortion of biodiversity of proximal area (Skwirk, 2014; Danburi, 2014).

Forest Reserves and Urban Growth

Forest Reserves are areas designated by the government for the protection of timber and other forest resources. Harvesting of timber may be allowed under permit and under special concession to people in the surrounding community. Harvested timbers are mostly replaced with exotic trees species. Most of these Forest Reserves are also poorly managed by the various state ministries of Agriculture and natural resources (Malanima, 2000; Oyebo, 2006; Emmanuel *et al.*, 2006; Cohen, 2016). The first Forest Reserve in Nigeria is the Olokemeji reserve established near Ibadan around 1900. This was followed by the establishments of other Forest Reserve in various parts of what forms the present-day Nigeria.

Several factors are responsible for urban growth. Increasing urban employment opportunities is one of the factors. Rural-urban migration coupled with natural increase in population caused by improved living standard, are major causes of rapid growth of cities and towns. Rural poverty, search for better living standards, environmental degradation (deforestation and desertification), inadequate and lack of basic amenities and services among other factors are pushing rural inhabitants out of the rural areas (Ajibola *et al.*, 2011; Danburi, 2014). Shlomo *et al.* (2005) are of the view that urban growth is caused by rural unemployment, increased rural poverty, deteriorating living condition, declining soil fertility and unchecked rural migration. According to them, all these are responsible for people's movement out of rural land to urban centre. Infrastructural development such as water, electricity, health, education, increases urban growth. Danburi (2014) remarked that growth depends on the natural increase on the part of the total population that is already in urban but it is affected more by the differences in the natural level between rural and urban areas. People respond to urban socio-economic opportunities by undertaking rural-urban and urban-urban migration.

Urban Growth Models

Concentric Zone Models

Based on the observation and interpretation of the land use structure of the industrial city of Chicago, Burgess in the 1930's proposed an ideal type of urban growth. According to him, cities constantly grow because of population pressures, which in turn trigger dual

process of central agglomeration and commercial de-centralization; thus, as they grow spatially, patterns of land use would reflect the successive phases of invasion and occupation. The resulting pattern will be one of a centralized business core surrounded by four principal zones in an annular fashion as: a zone in transition where newly arrived migrants would seek lodging, a zone of working – class housing, a settled residential zone, and a ring of commuter suburbs (Phil, 2006; Gottdiener and Leslie, 2005; Michael, 2009; Danburi, 2014). However, the city of Chicago as at the time of Burgess's observation was a new city, and had grown rapidly due majorly to industrialization, which might not be the order in other cities, and thus would not have explained growth of other cities then, and the growth of some urban place like the Giwa Local Government Area of Kaduna State which thought result from population pressure, but develop majorly in a linear pattern along a major transportation route (Tim, 2006; Danburi, 2014).

Research Methodology

Study Area

Guga Forest Reserve is situated 12.9 km (8 miles) west of Samaru along Zaria Funtua road in Giwa Local Government Area of Kaduna State, with an aerial extent of 4634 hectares. It is located on the plain of the northern part of Kaduna State. The forest reserve lies between Latitudes 11° 10'00" N and 11° 16'14" N of the equator and Longitudes 7° 30'34" E and 7° 37'06" E of the Greenwich meridian. It has a total land area of about 2,066 km².

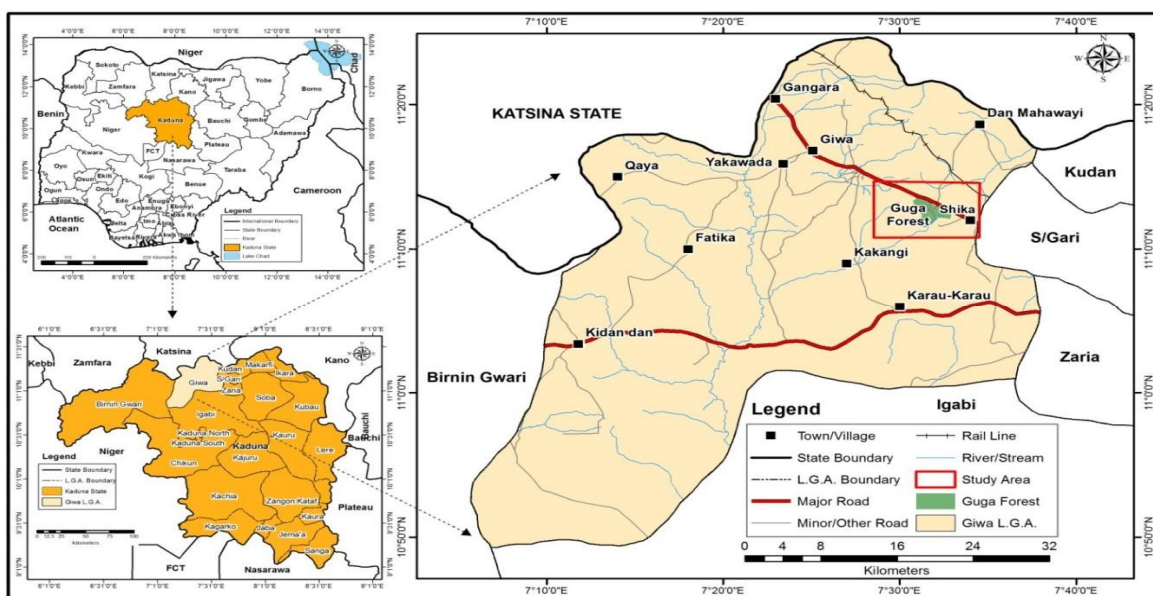


Fig. 1: Giwa Local Government Area.

Source: Modified from the Administrative map of Kaduna State

Image Classification

Supervised classification technique was performed using maximum likelihood algorithm in classifying the images into various classes (themes). This method is preferable due to its high level of accuracy

and reliability in handling spatial data. This technique gives room to the researcher to generate training classes based on the land use/land cover themes present in the area.

Table 1: Land use/Land cover Classification Scheme

Landuse/Landcover Categories	Description
1 Built-up land	Residential, commercials, transportation and communication.
2 Forest land	Natural forest, natural vegetation like grasses, shrubs, grass- like plant.
3 Agricultural land	Farmlands, deforested area and clear forest land.
4 Water bodies	Rivers, streams, lakes.
5 Bare land	Exposed soil

Source: Modified from Jensen (2005)

This according to Liu *et al.* (2002) helps in curtailing ambiguity that is associated with the unsupervised techniques in image classification. With these techniques, sample sites (training pixels) were selected based on spectral signatures of the features on the images. The known land cover types (training

sites) were coded with names of the corresponding thematic features. Based on Jensen (2005), land use/cover classification scheme, the various land use land cover types within the area will be classified into five categories; built-up areas, forest/shrubs, bare land,

agricultural/farm land, water bodies as shown in Table 1.

The Extent to Which Urban Growth Has Affected the Forest Cover in the Study Area

The land use/land cover maps prepared from the images were used to assess changes in land use land cover. The built-up and forest categories were overlaid to show the level of urban encroachment into the forest reserve for the periods under study. The calculated changes between these land use classes

were used to determine the extent to which the urban growth has affected the forest land in the study area over the periods.

Result and Discussion

Extent to Which Urban Growth Has Affected Forest Cover in the Study Area

Using overlay analysis, the portion of the study area occupied by built-up for each study year was clipped on the forest cover to see the amount of the original forest land displaced by the built-up as shown in figures 1, 2, 3 and 4.

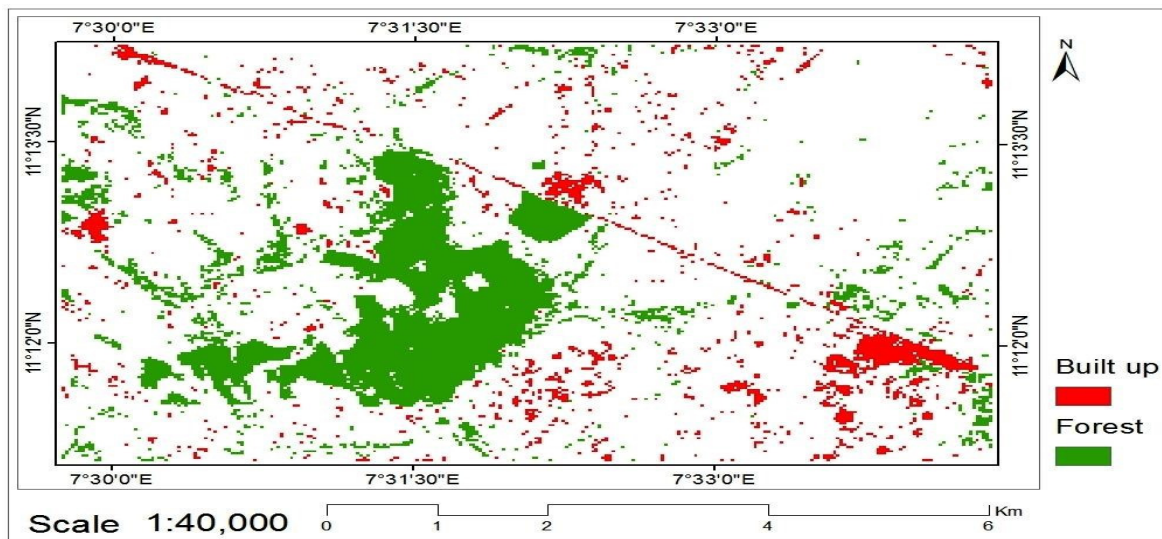


Fig. 1: 1986 Overlay Map of Built-up on Forest land of the Study Area

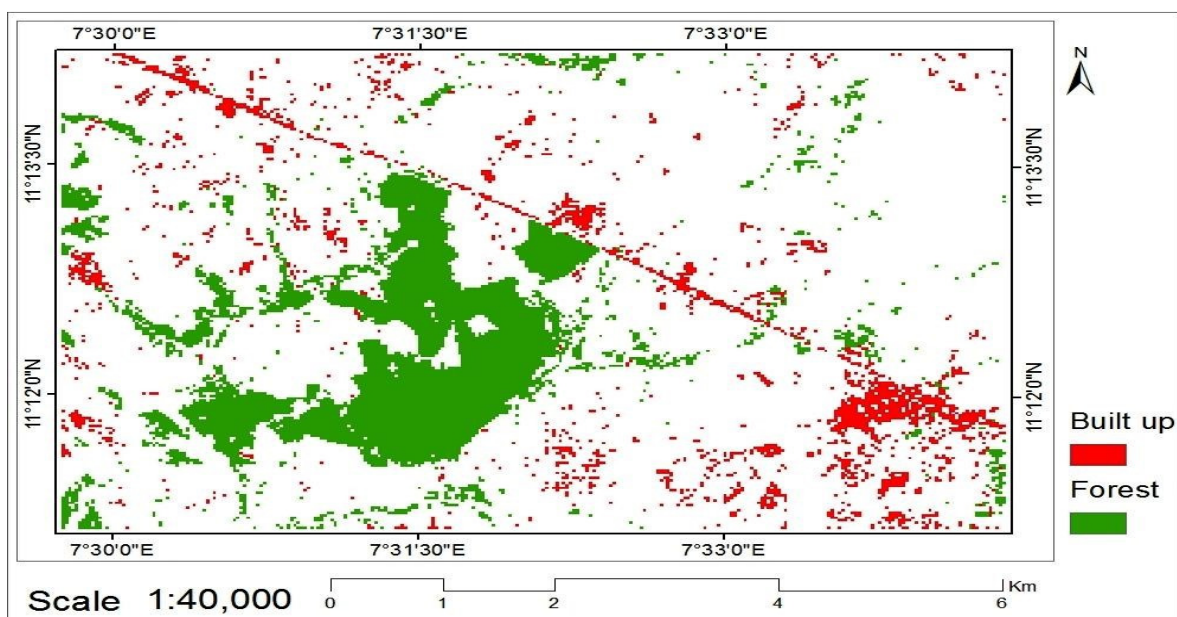


Fig. 2: 1990 Overlay Map of Built-up on Forest land of the Study Area

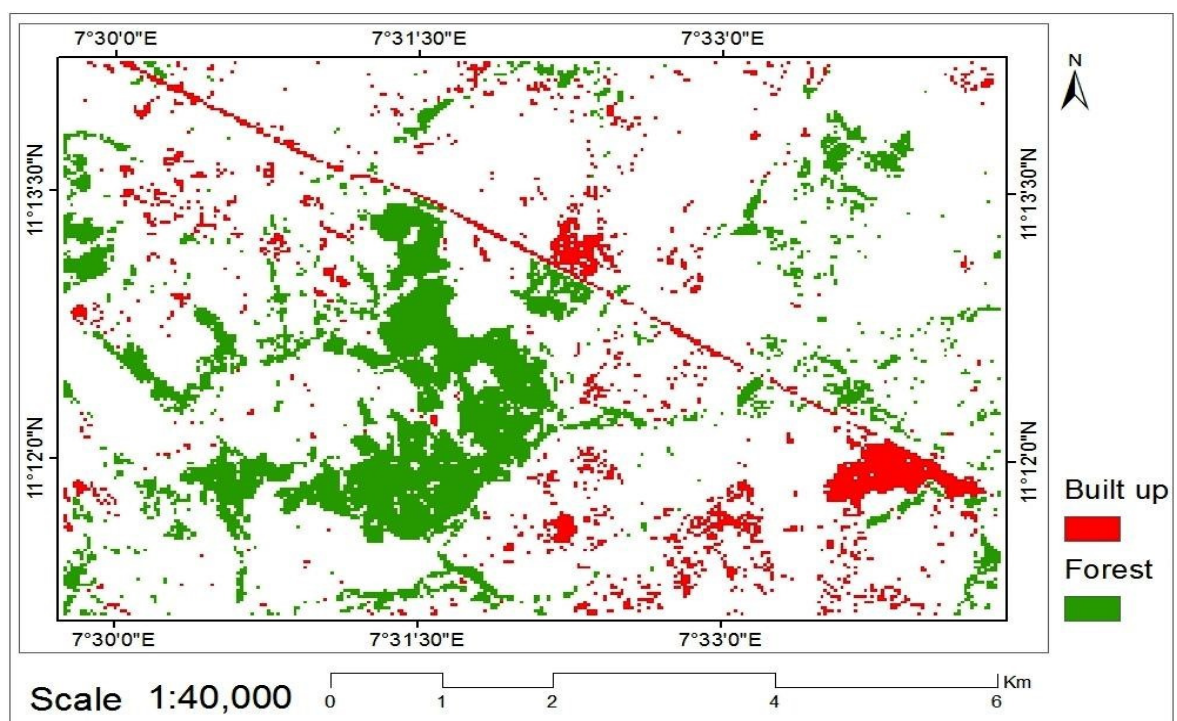


Fig. 3: 1999 Overlay Map of Built-up on Forest land of the Study Area

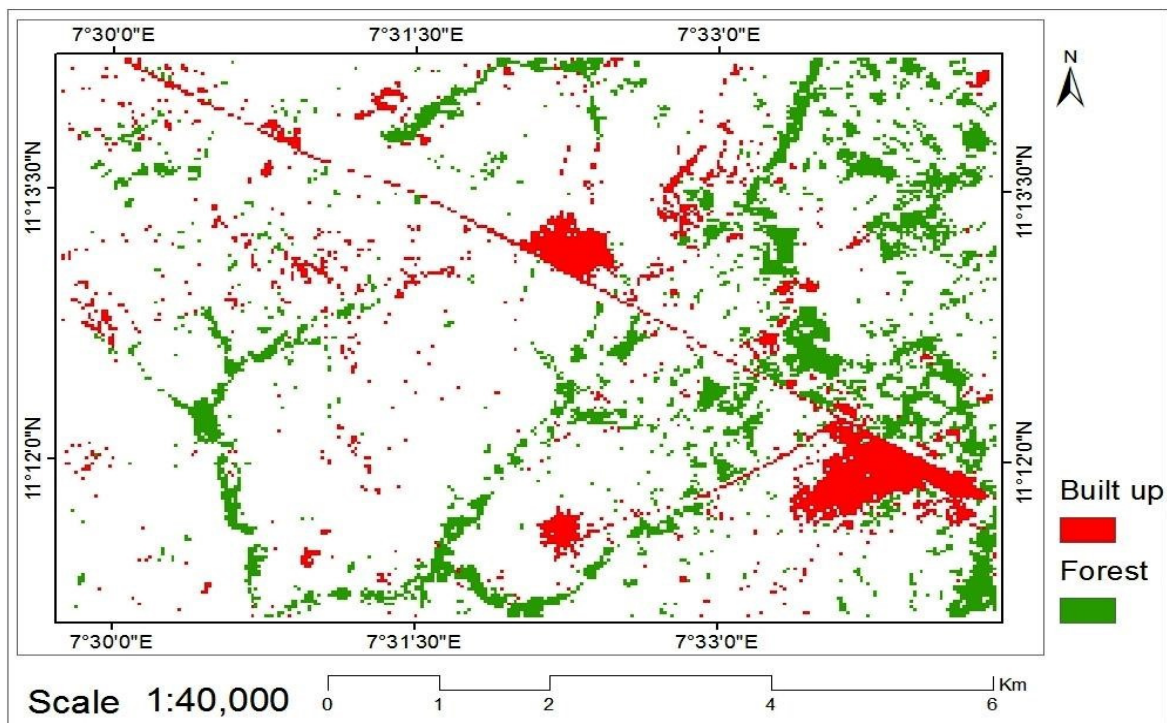


Fig. 4: 2014 Overlay Map of Built-up on Forest land of the Study Area

Table 2: The Extent of Built-up and Displaced Forest land

Land use	Forest Displaced(ha)	Built Up Extent(ha)	Encroachment (ha)
1990	665.3	402.5	2.25
1999	653.3	260.1	2.16
2014	479.1	279.5	11.07

From Table 2, it was observed that in 1990, about 665.3 ha of forest land was displaced by built-up while in 1999, about 653.3 ha of forest was displaced by built-up. In 2019, a larger portion of forest land was displaced (479.1 ha) by built-up. The above overlay analysis in Figure 1, 2, 3 and 4 shows a clear evidence of physical

expansion encroaching into the forest land. Furthermore, the period 1999-2019 experienced rapid urban encroachment, areas formerly occupied by the forest land has almost being cleared completely giving room for physical development in the area.

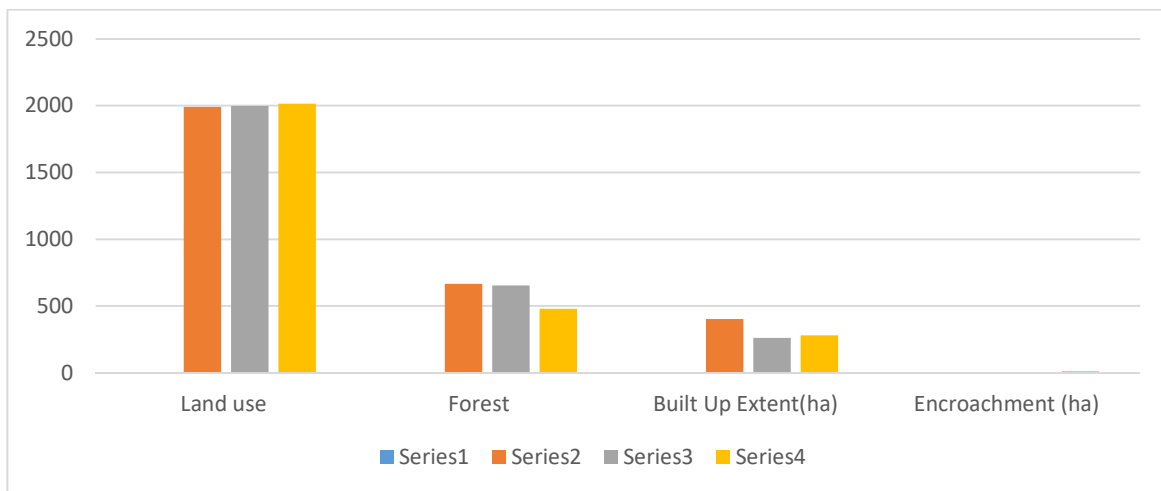


Fig. 5: The Extent of Built-up and Displaced Forest land

This succession could also be attributed to the movement of the Ahmadu Bello University Teaching (ABUTH) from Kaduna, Malumfashi and Tudun-Wada, Zaria to its present permanent site in the year 2005 as well as the creation of Giwa Local Government Area in September 1991 which has triggered increased in human population, physical development as well as urban expansion in the area. This increase in population growth as well as urban expansion has therefore led to a gradual elimination of forest land in the study area as shown in the Map of the overlay analysis above. This result is not in complete agreement with the work of Brenna, 1990 and Cohen, 2016, however a larger part of the study is in agreement with the work of Danburi 2014, this is most likely to be as a result of same study area in question.

Conclusion

The study provided an insight on the effect of urban encroachment on Guga forest reserve in Giwa Local Government Area of Kaduna State. The finding of this research revealed evidence of gradual urban expansion over the study period as the land cover had percentage coverage of

4.7% in 1986, 5.0% in 1990, 5.4% in 1999 and 5.08% in 2019. The built-up area and agricultural land have shown a continuous increase within the period of study while forest/vegetation and bare land declined. However, the analysis revealed that built-up and agricultural land has eating up the forest land, most part of the study area is still rural as most people within the study area still engage in agricultural activities.

The period 1986-1990 recorded the highest annual growth (1.7%) while the average annual growth rate within the study period (1986 - 2019) was 0.9%. Unplanned expansion has led to conversion of forest and bare land into physical development. The highest proportion of forest loss was noticed between 1990 - 1999 with an annual rate of 0.2%, within this same study period, about 19.6 hectares of land which amounted to about 8.2% was added to built-up land.

Recommendations

Based on the identified changing nature and rate of various land-use/land-cover types identified in the study area especially from 1986 to 2019, the following are recommended:

- Afforestation and reforestation should be encouragement and adopted by the ministry of forest in the State especially around the study areas in order to resuscitate lands that are devoid of vegetal cover.
- Reforestation of degraded areas is also suggested in order to speed up the process of rehabilitation and regeneration of the forest. This entail more annual tree planting and provide tree seedling to farmers to encourage agro-forestry or better still, this will enhance resource management and reduce indiscriminate exploitation of forest cover.

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