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LAND USE AND LAND COVER MAPPING OF KUTA USING REMOTE SENSING AND GIS TECHNIQUES

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ABSTRACT

Mapping land use land cover (LULC) analysis of Kuta using remote sensing and GIS techniques is an area of interest that has been attracting increasing attention. The main objective of this study was to identify and analyze the land use change of Kuta using remote sensing. The images were classified using Maximum Likelihood classification method. This study revealed that in 2000, built-up area occupies about 227.07 hectares (Ha) of the land area constituting 8.85%, farmland occupying 863.73 hectare (Ha) which is 33.66%, vegetation occupying 1270.62 hectare (Ha) which is 49.51%, bare ground occupying 204.93 hectare (Ha) which is 7.99%. In 2010 built up covers 473.67 hectares (Ha) of the land area constituting 18.46%, farmland occupying 1192.68 hectare (Ha) which is 46.47%, vegetation occupying 636.84 hectare (Ha) which is 24.82%, bare ground occupying 263.16 hectare (Ha) which is 10.25%. In 2020, built up covers 765.18 hectares (Ha) which is 29.82%, farmland occupying 1072.53 hectare (Ha) which is 41.79%, vegetation occupying 433.98 hectare (Ha) which is 16.91%, bare ground occupying 294.66 hectare (Ha) which is 11.48%. The result also shows 12.82% increase
in farmland between 2010/2000 and -4.68% decreases between 2020/2010. All this leading to a cumulative change trend with built up having 20.97%, farmland having.14%, vegetation having -32.60% and bare ground having 3.50%. By implication, there is growth in population and increase in demand. There is a need for appropriate land management scheme and allocation of resources for sustainable land use in Kuta.

Keywords: Kuta, Remote Sensing, GIS, Land use and Land cover

Introduction

Land use is the way people utilizes and exploit material from the earth surface to carry out their socioeconomic activities. It also reflects land as an important resource for most human activities including agriculture, industry, forestry, energy production, settlement, recreation, water catchment and storage (Lillesand and Kiefer, 2010). The economic activities and systematic plan for development refers to land use. The term land use relates to the human activity or economic function associated with a specific piece of land, while the term land cover relates to the type of feature present on the surface of the earth (Lillesand and Kiefer, 2010).

Land cover is the physical characteristics covering the earth surface. Land cover comprises of vegetation, topography and relief, water etc. land cover signifies the spatial distribution of the different land cover classes on the earth's surface and can be directly estimated qualitatively as well as quantitatively by remote sensing. Land use and its changes require the integration of natural and social scientific methods to determine which human activities are occurring in different parts of the landscape, even when the land cover appears to be same (Lambin *et al.*, 2011). Land cover refers to the physical characteristics of earth's surface, captured in the distribution of vegetation, water, soil and artificial structures (Jijingi, Yuguda and Dauda, 2016).

Kuta is undoubtedly one of the most striking places to study of land use land cover due to its rural nature and agricultural land use. Rural areas are elastic and less intensive. Specifically, agriculture is the main feature of land cover in tropical regions. Lambin *et al.* (2011) indicated that degradation, agriculture and grazing are the major courses of land use land cover in a spatial environment. Kuta is a location for both agricultural activities and of the people living in them, therefore a centre for physical and human geography. Land use map is a valuable tool for agricultural and natural resources studies. It gives a better view and understanding of land utilization in areas like cropping patterns, fallow lands, forests, pasture lands, wastelands and surface water bodies which are important for planning and development of a place. Studying land use dynamics is essential in order to examine various ecological and developmental consequences of land use change over a space of time. This makes land use mapping and change detection relevant inputs into decision making for implementing appropriate policy responses (Garba and Mohammed, 2011).

Land cover mapping both by visual interpretation and digital analysis is possible with the aid of satellite remote sensing techniques. Using remote sensing technique to develop land use classification, and mapping i.e. in a useful and detailed way to improve the selection of areas designed to agricultural, urban and / or industrial areas of a region (Yohanna, Bulus and Alfred, 2015). Satellite remote sensing technology has found its acceptance worldwide for rapid resource assessment and monitoring, particularly in the developing world. Satellite images have been utilized for land use and land cover mapping. National Aeronautical and Space Administration (NASA) of USA has made most significant contributions with satellite based remote sensing techniques.

Kuta is a distinctive area with agricultural activities like farming, grazing, and deforestation. It also includes buildings and population with a lot of human socioeconomic activities. This has resulted in heightened exploitation of land resources and altered its land use land cover over time without plans for growth. To evaluate this problem, there is need to identify the land use land cover to provide information for future developmental operation. Therefore, it is important to carry out this research to avoid associated problem of land degradation. The aim of this research is to identify the nature of land use in Kuta using remote sensing and geographical information techniques.

Materials and Methods

The study area is Kuta, the headquarters of Shiroro Local Government in Niger State Nigeria which lies between Longitude 6˚42'54.77" to 6˚42'21.24"E and Latitude 9˚52'54.62"N to 9˚52'59.92"N (see Figure 1), with an altitude of about 517 meters above sea level.

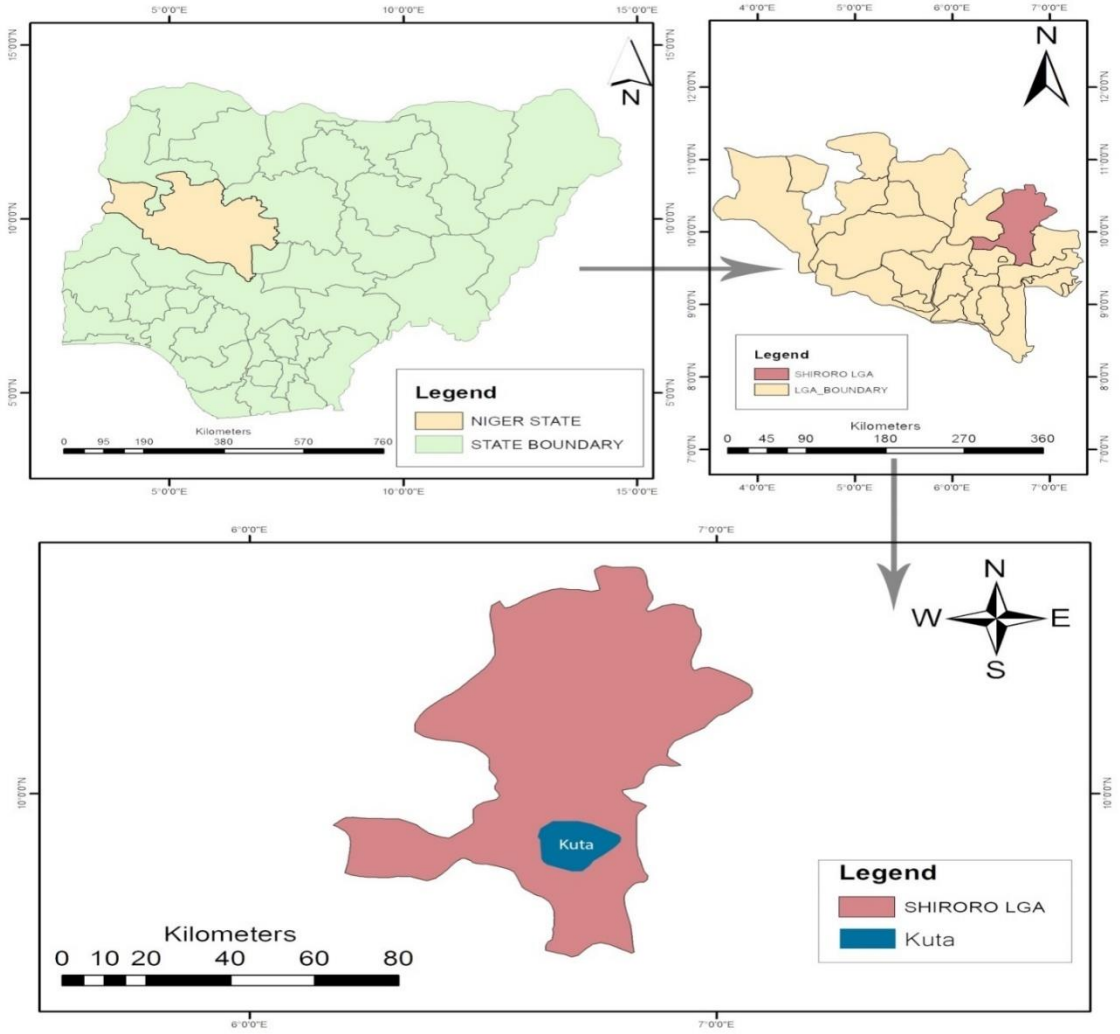

Figure 1: Locational Map of the Study Area

The data obtained for this paper was generated from primary and secondary data sources. The primary data include the field survey which was performed throughout the study area using Hand Held Global Positioning System (GPS) to take readings of the coordinates. This survey was performed in order to familiarize with the study area and acquire accurate location point data for each land use land cover class included in the classification scheme.

Also, the paper made use of qualitative method to collect field data. This involves geo-referencing, processing of satellite imagery and also enhancing the study area image using ArcGIS 10.2 software to produce land use land cover map. The secondary data used is the review of past research works from published materials such as textbooks, journals, conference papers, and other relevant articles from internet and also remote sensed imageries of three different years. These are the fundamental techniques used for the paper. The knowledge of method of data analysis helps to understand the general procedures of land use land cover images and to conduct land cover classification from the Landsat 7 ETM and Landsat 8 satellite imagery. This involves ground truthing, geo-referencing, interpretation, data base creation, map production, map classification. To identify the land use land cover, an image classification was carried out. This procedure follows the supervised image classification scheme. The types of land use and land cover features identified in this project include Bare surface land, Built-up land, Natural vegetation and Farmland.

For this paper, supervised classification was applied using the known ground truth points by connecting ArcGIS software with Google Earth and synchronizing the images. This method will also involve the spectral characteristics of the classes defined by identifying training sample. The classification process has been controlled by creating, managing, evaluating, and editing signatures using the Signature Editor. Names are assigned to specific areas by signature for supervised classification. Signatures are used to break the different classes i.e. vegetation, farm land, built up and the classes into as many subclasses required for the classification. The supervised classification is the most common method in obtaining land use cover information using Maximum Likelihood Classification system.

Results and Discussion

The results and discussion presented in this section covered the aim of the study.

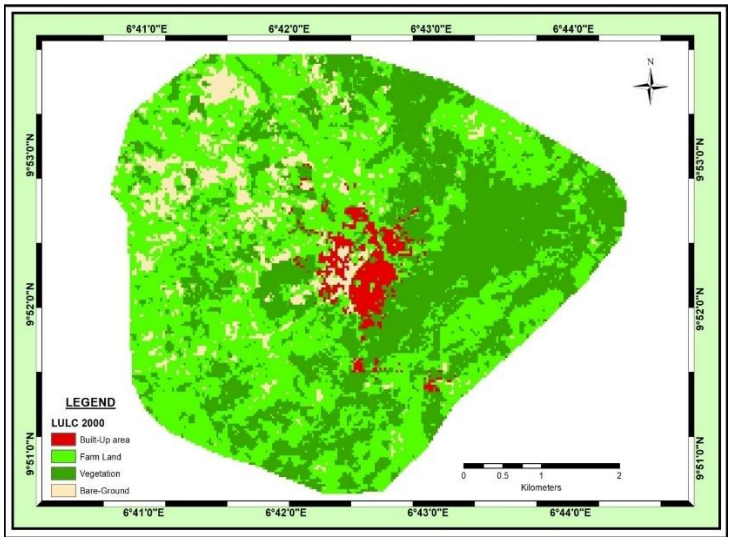

Figure 2: **Land use and land cover map 2000**
Source: Author's Analysis, 2021

Table 1: Statistical Land Use and Land Cover for 2000

LULC 2000	COUNT	AREA (Ha)	Percentage (%)
BUILT UP	2523	227.07	8.85
FARM LAND	9597	863.73	33.66
VEGETATION	14118	1270.62	49.51
BAREGROUND	2277	204.93	7.99

The land use and cover of the study area is considered to be in a stable position where there were little influence on the area due to low population of built-up area occupying about 227.07 hectares of the land area, constituting 8.85% of the land total land area. On the other hand, man survival is dependent on the available resource on the environment, which makes farming activities one of the agricultural practices which influences the terrestrial characteristics of land surface occupying about 863.73 hectares of farm land with a percentage total of 33.66% of the area. The natural vegetation at this state occupied about 1270.62 hectares of land, making it the highest land cover in the area of about 49.51% of the total area. Human activities as a result of farming, deforestation, over grazing and over exploitation of land has significant

impact at this stage leaving the land bared with less vegetation cover. The bare ground occupied about 204.93 hectares of land which is attributed to anthropological activities in the area, (Table 1).

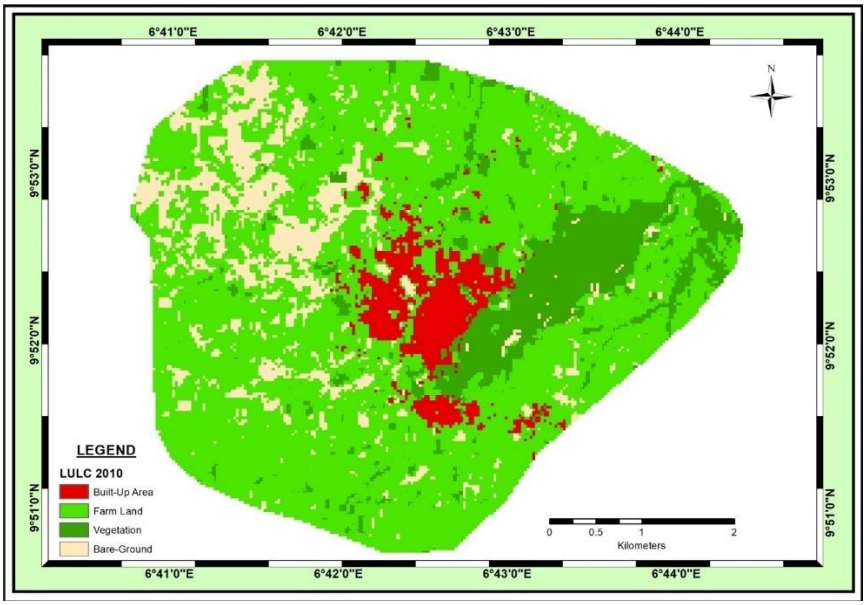

Figure 3: **Land use and land cover 2010**
Source: Authors Analysis, 2021

The land use land cover of the study area has shown significant changes to the total area, Built up area has increased occupying about 473.67 Hectares of land with a total of 18% of the total land area. The increase in population growth (Built Up) has led to significant increase in the stress on the existing resource which in other words put pressures on the farm lands as residents engage on agricultural for food production. The community engages in subsistence and commercial agricultural practices for family use as well as for sale to the urban area. The farm land at this stage occupies about 1192.68 hectare (Ha) with the land use at this year. This shows that natural vegetation area have been covered to farm land and also as built up area.

In developing community like Kuta whole solely depends on wood as source of fuel for domestic usage. This has increase the deforestation in this region leaving the land bared, the bare ground now occupies about 10.25 % of the land area, and this is as a result of human induces process e.g. over grazing, farming, deforestation, bush burning as well as over cultivated area tends to leave the land with little or no vegetation cover and insufficient soil nutrient which does not encourage vegetative growth.

Table 2: Statistical Land Use and Land Cover for 2010

LULC 2010	COUNT	Area (Ha)	Percentage (%)
BUILT UP	5263	473.67	18.46
FARM LAND	13252	1192.68	46.47
VEGETATION	7076	636.84	24.82
BAREGROUND	2924	263.16	10.25
		2566.35	100.00

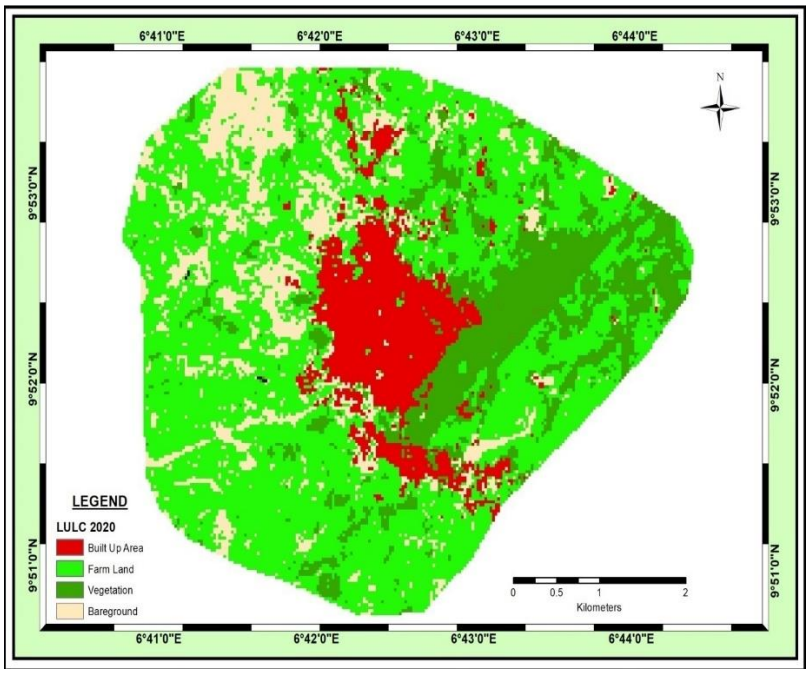

Figure 4: Land use and land cover map 2020
Source: Authors analysis, 2021

The land use land cover of the study area has shown significant changes to the total area, Built up area has increased occupying about 765.18 Hectares of land with a total of 29% of the total land area. The increase in population growth (Built Up) has led to significant increase in the stress on the existing resource which in other words put pressures on the farm lands as residents engage on agricultural for food production. The farm land at this stage occupies about 1072.53 hectare (Ha) with the land use at this year. This shows that vegetation area have been covered to farm land and also as built up area.

Kuta is an area of high agricultural activities due to high demand of food from increasing population. The land has been used for several years without proper management and a method of conservation. Deforestation and land degradation has left the land with little or no vegetation giving rise to increase in bare ground which now occupies about 11.48 % of the land area and causing a reduction in vegetation to about 16.91% (Table 3).

Table 3: Statistical Land Use and Land Cover for 2020

LULC 2020	COUNT	Area (Ha)	LULC
BUILT UP	8502	765.18	29.82
FARM LAND	11917	1072.53	41.79
VEGETATION	4822	433.98	16.91
BAREGROUND	3274	294.66	11.48
Total		2566.35	100

Conclusion

The built up area extended from 9% in 2000 to 18% in 2010 to 30% in 2020. Bare ground increased from 8% in 2000 to 10% in 2010 and 11% in 2020 and also farmland increase by 13% in 2000-2010 but later experienced a -5% decrease in 2010-2020. This progressive development in built up areas, bare ground and farmland was to the detriment of vegetation areas. Vegetation areas which have the most noteworthy inclusion with 50% in 2000, 25% in 2010 and 17% in 2020 saw diminishing pattern all through the

investigation time frame (2000 – 2020). This steady decrease of vegetation land and characteristic farmland can be ascribed to the consistent success of built up land and bare ground surfaces.

This research work demonstrates the ability of Remote Sensing and GIS in capturing geospatial location data. Attempt was made to capture as accurate as possible four land use land cover classes as they change through time: built up areas, farm land, vegetation and bare ground. These four classes were distinctly produced for each study year but with more emphasis on farmland and built-up land as it is a combination of anthropogenic activities that make up this class and it also affects the other classes. The result of the work between 2000 and 2020 shows a rapid growth in built-up land and gradual increase in bare ground which contribute to the change in farm land and vegetation.The land use land cover changes that had occurred were obtained using geospatial analysis in the study area. These changes were caused by increase in the population which results to the spread of settlement across the study area; intensive agricultural activities for food production which has influenced the characteristics of land; cutting down of trees, bush burning, improper management and conservation of land has led to deforestation and land degradation and increase in built up areas which has led to other developments in the area in terms of education, social and economic activities.

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