

Changes in Land Use /Land Cover of Maiduguri Urban, Borno State Nigeria

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Abstract- Rapid urbanization has been considered one of the significant factor of urban studies in developing countries of the world since the emergence of population explosion in the 1960s and 1970s in larger cities (Barros, 2004). Land use/land cover change information is very essential in decision making process in urban planning implementation and management of urban areas to meet the increasing demands for basic human needs and welfare of the contemporary rapidly growing population. This paper is primarily focused on the changes occurred in landuse /land cover in Maiduguri urban area between 2000 and 2018. The study was conducted using Remote Sensing and GIS techniques. Landsat images of the Maiduguri Urban area for 2000 and 2018 were obtained and used for the study. Results from the study indicated that built-up area expanded from 51.81% in 2000 to about 64.57% in 2018, whereas agricultural area decreased by (- 4.98kmsq), bear surface by (-2.57kmsq) and grassland by (-11.48kmsq) respectively. The study noted that changes in land use and land cover could be an essential tool for monitoring urban activities and resolving the negative consequences of urban growth. It is recommended that special priority should be given to urban growth and continuous investigations are required for effective urban development and management of the study area.

Index Terms- Environment, GIS, Remote Sensing, Land use/Land cover change, Resources, Urban planning

I. INTRODUCTION

High urbanization rate has been the main reason for urban studies in developing countries since the expansion of rates of growth in the 1960's and 1970's in bigger cities (Barros, 2004). Like other man-environment interactions, urban land cover changes reacted to socioeconomic, political, cultural, demographic and environmental conditions, characterized by a concentration of humans (Masek *et al.*, 2000). In spite of its minor area coverage relative to the environment, changes in urban expansion processes, especially the expansion of urban population in a larger extent and urbanized area, have useful impact on natural and human environment at all geographic levels. (Herold *et al.*, 2005).

Urban growth is a general phenomenon and one of the most vital change processes affecting natural and human environment in many ecological and socio-economic situations (Mandelas, *et al.*, 2007). Currently, most communities worldwide need spatial data to compensate for and adapt to contemporary urban growth while planning for expected future change and its

consequences on infrastructure, as well as in the immediate environment. High rates of urban land use change and rate of urbanization are now at the front of local political chaos (Goetz, *et al.*, 2003).

II. STUDIES ON LAND USE/ LAND COVER CHANGE

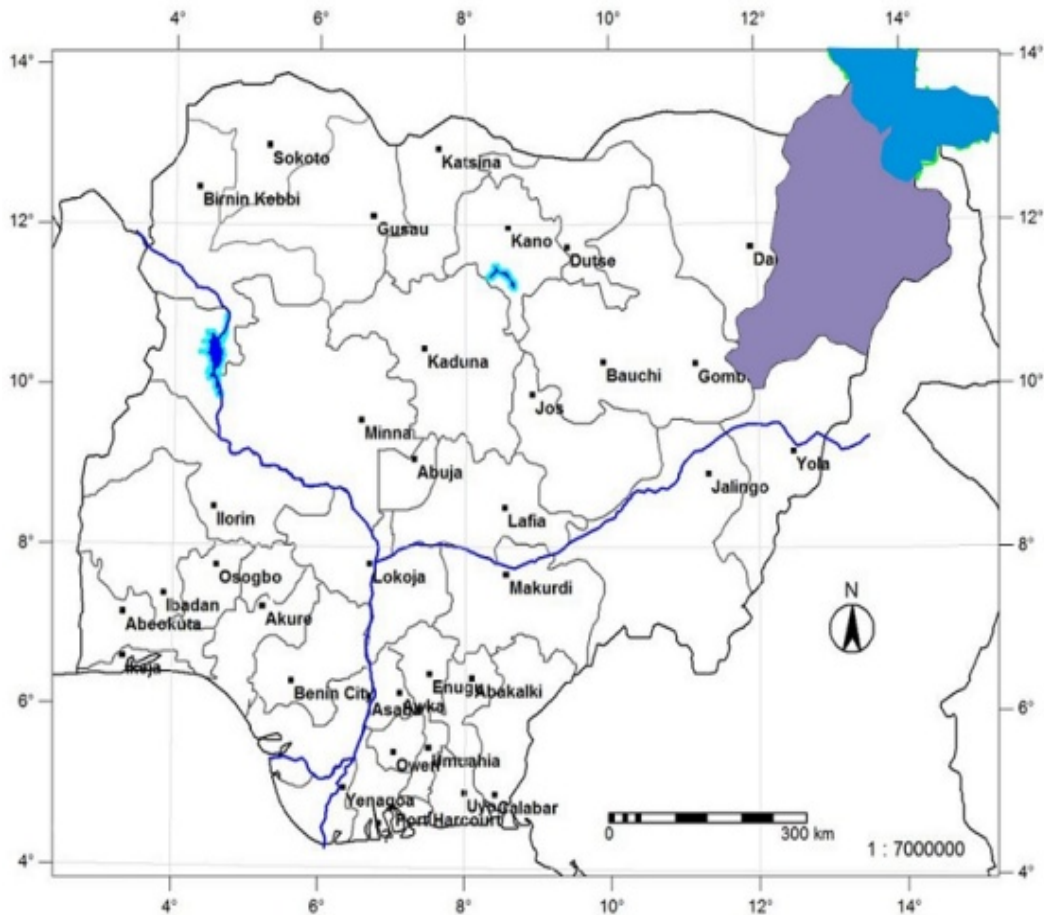
Change in land cover and the way people use the land have become interesting issue since the mid 1980s as essentials global environmental change in their own right (Turner, 2002). At the same time, International Geo-spatial and Biosphere Programme (IGBP) and International Human Dimension Programme (IHDP) organized a working group to introduce research agenda and enhance research activity for landuse and land cover change. The working group proposed three core subjects for land use/land cover change research, such as situation assessment, modeling, projecting and conceptual scaling. The primary aim of global change study was to assess the impacts under each possible scenario and suggest preventive actions against the adverse environmental implications. The main focus was the effects of these regional and global changes on society and the environment. Empirical studies by researchers from diverse disciplines indicated that land use /land cover and its change had become key to many area of study such as environmental science, geography, forestry, hydrology, agriculture, geology and ecology (Weng *et al.*, 2003). These various applications are known to the urban explosion, deforestation, water quality change, soil degradation, etc. At the same time, in the past decades, Lambin, (1997), opined that, a major international initiative to study land use change, land cover project had gained great impetus in its efforts to understand driving forces of land use change, developed diagnostic models of land use change and produce regionally and globally integrated land use models. These efforts have stimulated the interest of researchers to apply various techniques to detect and further model environmental change at different stages including local, regional and global scales.

Houghton (1994) pointed out that, the primary reason in land use change was to increase the small capacity of land to support the human economic thinking. Eventhough, together with the positive changes especially those that made land more productive, there were also unforeseen impacts that could reduce the availability of land to sustain the human enterprise. The techniques of GIS and satellite remote sensing had been widely used in the study land use /land cover changes especially urban expansion (Weng *et al.*, 2003).

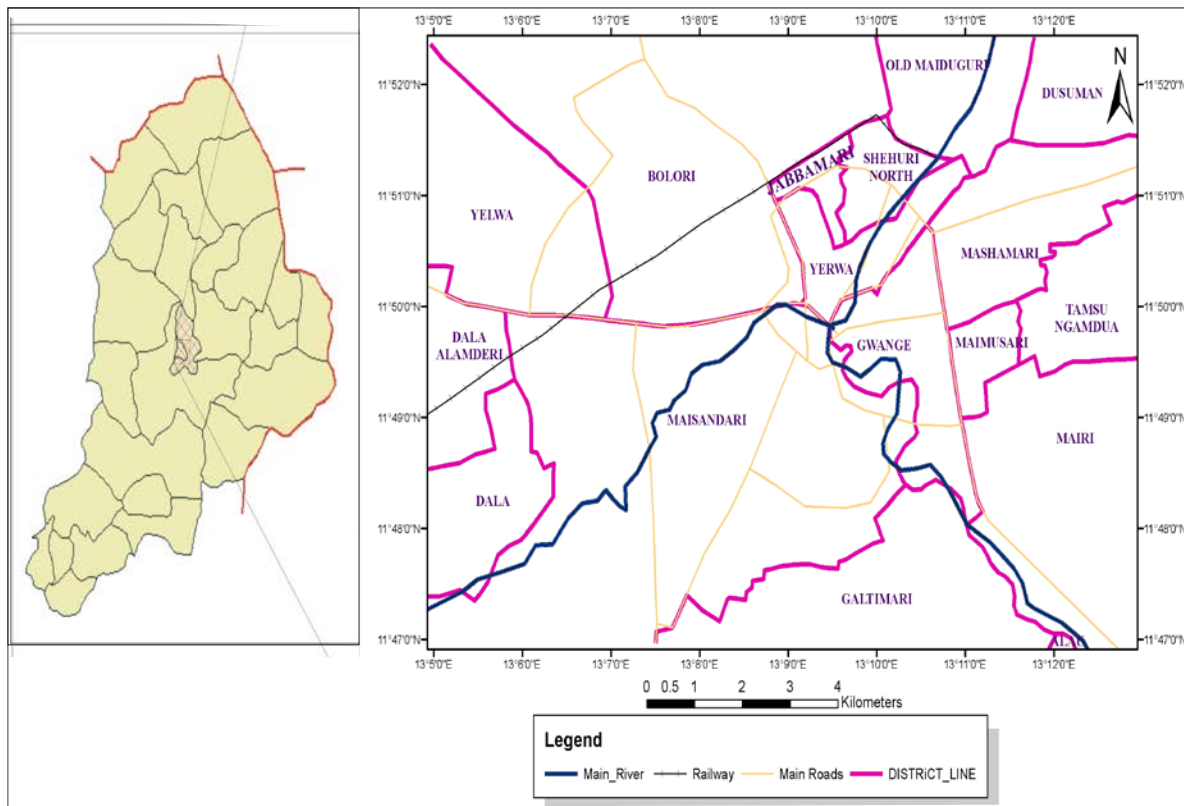
The reason behind the use of remote sensing data for change detection is that changes in land cover result in changes in measurement values which can be remotely sensed. Techniques to perform change detection with satellite imagery have become very common as a result of increasing adaptability in manipulating digital data and increasing computer power. Post-classification comparison and multi-date composite image change detection are currently the two most commonly used techniques in change detection (Jensen, 1996). GIS and remote sensing studies have predominantly geared on providing the knowledge of how much, where, what type of land cover change has occurred in an area.

III. STUDY AREA

Maiduguri is the capital of Borno state in the North-Eastern region of Nigeria. It is located on latitude [11°50'N](#) [11.83°N](#) and longitude [13°09'E](#) [13.15°E](#), lying on a relatively flat terrain of about 350m above sea level. The town has an area of 550 km² with a population estimated at 1,197,497 (World Gazetteer, 2009).



Source: GEONETCAST Spatial Database, CAZs UNIMAID, 2016
Figure 3.1: Nigeria Showing Borno State



Source: Modified from [UN Office for the Coordination of Humanitarian Affairs](#), (2017)

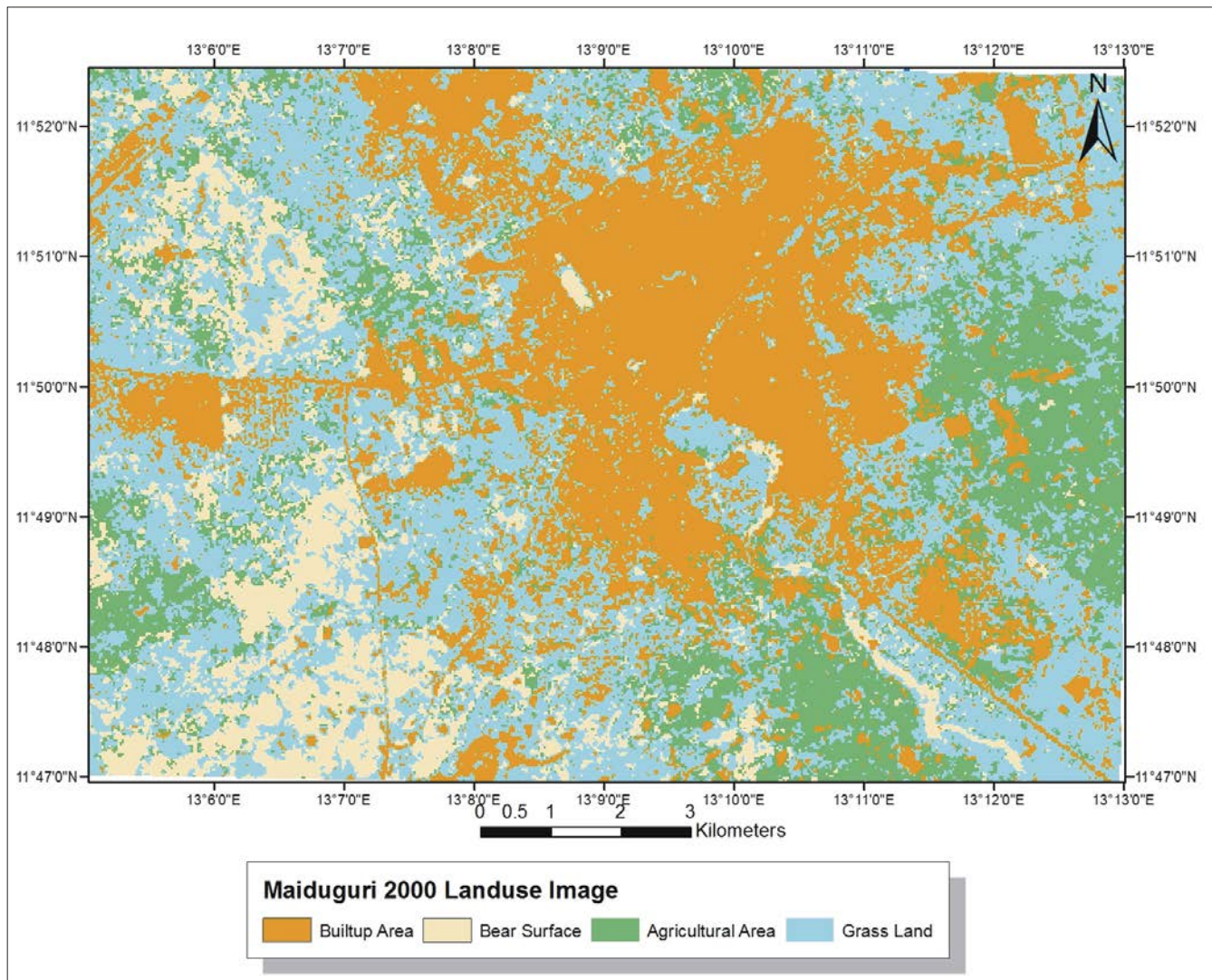
Fig. 3.3: The Study Area

IV. METHODOLOGY

Data acquired for the study includes information from Google images, GIS and remote sensing. The data for this study was collected via primary and secondary sources. Primary data was gathered through the use of the satellite images, GIS and Remote sensing soft ware. Five (5) districts were purposively selected for the study mainly due to high rate of physical development of these areas. These areas are Bolori districts, Dala Alamderi districts, Maisandari districts, Galtimari districts and Mairi district respectively. Data collected for the study was presented using maps, charts, and the frequency distribution table.

V. RESULTS AND DISCUSSION

The study revealed that from 2000 to 2018 built up area comprised of buildings, roads, and other infrastructures and facilities dominated the land area of Maiduguri urban with about 51.81% in 2000 to 64.57% in 2018 which was mainly due to increased demand of housing resulted from population explosion in the study area. The results also indicated that in the year 2000, agricultural area covered about 14.64%, bare surface covered 13.50% and grassland covered 20.05% of the total area where these percentages of area covered by agriculture, bare surface, and grassland declined in 2018 to about 11.77%, 12.36% and 12.36% as shown in Table 4.3.



Source:

LANDSAT IMAGE,2018
Figure 4.1: Maiduguri Land use image 2000

Source: LANDSAT IMAGE, 2018
Figure 4.2: Maiduguri Land use image 2018

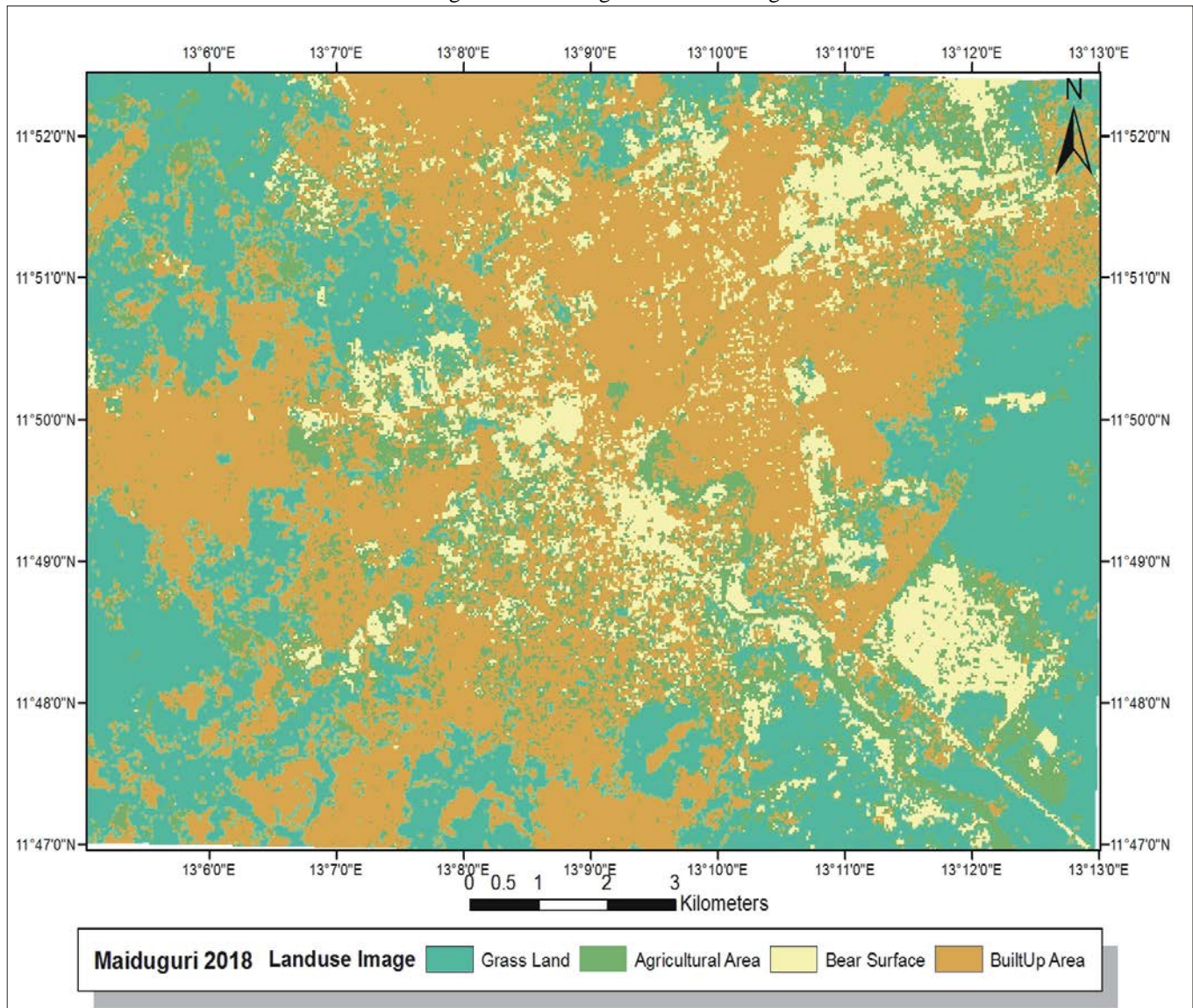
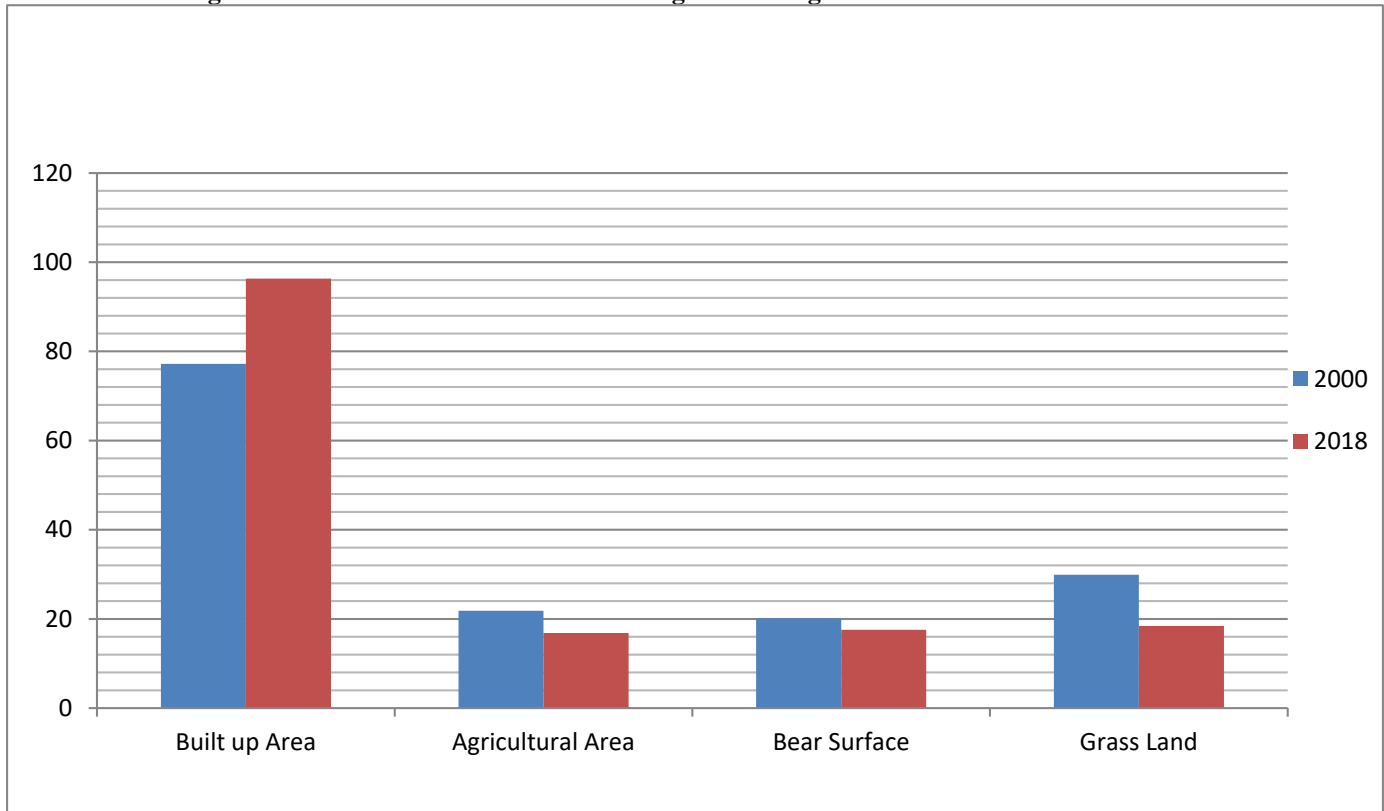


Figure 4.3: Land use/ land cover area change of Maiduguri Urban between 2000 and 2018



Source: LANDSAT IMAGES, 2018

Table 4.3: The Land use/ land cover area percentages of Maiduguri for 2000 and 2018

Land use/ Land Cover	2018 Land Area (km²)	2000 Land Area (km²)	2018 Land Area (%)	2000 Land Area (%)
Built up Area	96.31	77.28	64.57	51.81
Agricultural Area	16.85	21.83	11.30	14.64
Bear Surface	17.56	20.13	11.77	13.50
Grass Land	18.43	29.91	12.36	20.05
Total	149.15	149.15	100	100

Source: LANDSAT IMAGES, 2018

Table 4.4 clearly showed the rate of change in land use/land cover between 2000 and 2018 in Maiduguri urban. The study revealed that the highest change noted between 2000 and 2018 in a single land use was observed to be the built up area, where an increase of about 19.03km² was observed. Not surprisingly, decreased in land areas was the case between 2000

and 2018 in agricultural area (- 4.98km²), bear surface (-2.57km²) and grass land (-11.48km²) respectively. Hence, the total land area consumed by built up area from agriculture, bear surface and grass land between 2000 and 2018 is about 19.03 kilometer square.

Table 4.4: The Land use/ land cover area change rate of Maiduguri area between 2000 and 2018

Land use/ Land Cover	2018 Land Area (km²)	2000 Land Area (km²)	Area Change rate (km²)	Remark
Built up Area	96.31	77.28	+ 19.03	Increase
Agricultural Area	16.85	21.83	- 4.98	Decrease
Bear Surface	17.56	20.13	- 2.57	Decrease
Grass Land	18.43	29.91	- 11.48	Decrease
Total	149.15	149.15		

Source: LANDSAT IMAGE 2000 & 2018

VI. CONCLUSION AND RECOMMENDATIONS

Maiduguri Urban being a very fast growing city in North Eastern Nigeria was chosen as the study area primarily to assess the rate of changes that occurred in the land use/ land cover between 2000 and 2018. It was concluded that from 2000 to 2018 only the built-up area experienced an increase within the Maiduguri Urban from about 51.81% in 2000 to 64.57% in 2018, but decreased was noted in agricultural area, bare surface and grassland area respectively. The driving factors for the resulting spatial extent of these land use/land cover changes could be attributed to the rapid population growth in the study area which led to high demand of buildings for residential purposes. The study observed that changes in land use and land cover could be a vital tool for monitoring urban activities and resolving the negative consequences of urban growth. Hence, it is recommended that special attention and continuous investigation are required for effective monitoring; urban planning, development and management of Maiduguri Urban for sustainable development

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