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The Effects of Anthropogenic Activities on the Vegetation of Sokoto Metropolis, Sokoto State, Nigeria

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ABSTRACT

The activities of man to sustain life include: the destruction of vegetation. This activity includes the clearing of vegetation for construction of houses and roads among others. As the importance of vegetation is overemphasizing, the cause of its depletion and measures to prevent the vegetation has to be identified. This study aimed at identifying the major cause of vegetation depletion in Sokoto metropolis using questionnaire and base-line interview methods to generate primary data. Moderate-resolution Imaging Spectro-radiometer (MODIS) sensor as Enhances Vegetation Index (EVI) was used to capture images. The data was converted into IDRISI Raster format from Hierarchical Data Format (HDF) all the geospatial analysis were conducted using IDRISI-Taiga. However, from the results obtained, vegetation in the study areas were depleted to 97% in area "A" 89% in area "D", 87% in area "B" and 70% in area "C". The most woody plant species affected is *Azadirachta indica* to 90% as the highest percentage and lowest percentage of 11%. Among the four most affected herb species among *Trianthema monogyna*, *Ocimum gratissimum*, *Sida cordifolia* and *Digitaria debilis*, the highest percentage was found with *Ocimum gratissimum* with 43.87% while the least affected was found in *Digitaria debilis* with 12.62%. The researchers recommend to a call up duty to individuals to plant trees around their environs. People should protect the remaining vegetation to stop desert encroachment and fragmentation.

Keywords: anthropogenic activities, vegetation, depletion, urbanization, Sokoto metropolis.

1.0 INTRODUCTION

Human beings are into many anthropogenic activities to sustain their livelihood. These activities in one way or the other, directly or indirectly causes eliminations of vegetation. These human activities includes: indiscriminate felling of trees for agricultural activities, fire wood, medicines, domestic utensils and over grazing and browsing by livestock and poaching of wildlife (Atiku *et al.*, 2017).

The human activities include but are not limited to: deforestation, extensive cultivation, overgrazing, cultivation of marginal land, bush burning, faulty irrigation practices and management, urbanization, (Audu and Adie, 2018). Desert encroachment upon vegetation patches in Sokoto metropolis culminating in the violation of the Sokoto state Master Plan of 1983, causing desert encroachment as a result of multiple allocation of plots by civilian leaders, involvement of unauthorized agents/agencies in land allocation, poor land use, encroachment

service infrastructure, unplanned settlements proliferation and improper re-designation and subdivision of building plots, among others (Dantuni, 2012).

Human beings contribute to vegetation changes as a result of poor land use and the ever increasing pressure put upon the limited available resources by the population growth (Rakiya *et al.*, 2018). Anthropogenic factors are contributory to land use or land cover changes that impact on the vegetation within the Sokoto metropolis (Ismaila *et al.*, 2017).

Causes of Biodiversity lost are largely related to human factors and land management systems. These ranges from economic policies, rising demand for forest products due to increase in population and cultural practices. Other reasons may include: weak laws operating in Nigeria, poor law enforcement and rapid urbanization, which have collectively made forest dependence unbearable (Atiku *et al.*, 2017).

One of the major anthropological activities in Nigeria is the urbanization. Urban and agricultural expansions caused by the rapid population growth in the area, are among the major drivers of vegetation change in the area (Pooter *et al.*, 2004). As the human population increases and more people relocate to urban areas, anthropogenic factors are having a profound effect on the urban environment, thus redefining vegetation which has emerged new challenges and research opportunities (Rakiya *et al.*, 2018).

One of the major anthropological activities in Nigeria is the use of wood as fuel. Making alternative sources of energy more accessible and affordable, there would be a reduced demand for fuel-wood thus preserving forest resources (Oyetunji *et al.*, 2020). Abubakar *et al.*, 2018 stated that, urbanisation expressed the expansion of land uses including construction of residential areas, commercial and institutional buildings, roads and other infrastructures has led to fragmentation of such vegetation, and depletion biodiversity. This paper therefore, attempts to identify some areas affected by anthropogenic activities in Sokoto metropolis to identify some plant species in Sokoto state and determine their utilitarian services to the people.

1.1 Statement of the Problem

As major anthropological activities in Sokoto state involve elimination of vegetations, the vegetations may be over exploited and altered. The vegetations are feared unless proper steps are taken to conserve them on time, mankind and other organisms will be facing a tremendous hardship in future. Hence, the need to conserve our natural resources by taking a proper inventory is necessary (Rakiya *et al.*, 2018). In the attempt of man to clear his farm for cultivation, construction of buildings and roads among other anthropogenic activities; a large number of vegetation is been destroyed. Some human activities like charcoal production, herb medicines, and animals grazing among others cause destructions of many plants. The day by day human activities tends to affects the vegetation of the state hence the need to checkmate the anthropogenic activities within the Sokoto metropolis.

2.0 MATERIALS AND METHODS

2.1 Study Area

Sokoto state lies in the extreme north western part of Nigeria between Longitude 4° 8'E to 6° 54'E and latitude 12° 30'N to 13° 58'N with an attitude of 351m above sea level within Sudan Savannah Region of Nigeria. It is bordered by the Niger Republic to the North and West and the Nigerian states of Zamfara and Kebbi to the East and South respectively (Atiku *et al.*, 2017). Sokoto is the capital city of Sokoto state located between latitudes 12° 57' 25.65"N to 13° 6' 5.51"N and longitudes 5° 17' 8.44"E to 5° 11' 1.74"E (Bello and Bello, 2020). Based on the 2006 national population census records and the 3.04% annual population growth factor recommended by the national population commission (NPC), the population of Sokoto state at 2022 is 4,828,289 people (NPC, 2021).

The climate of the area is hot, semi-arid tropical type. It is characterized by a long and severe dry season lasting from October to May, and short but intensive wet season from September/October until May/June. The rainfall pattern is distributed with a peak in August with annual rainfall range of 550-700mm and mean annual temperature ranging from 38°C to 44°C or more around April. The lowest mean temperature is in December-January (Harmattan period) to about 13-15°C. The mean relative humidity reaches its peak of over 90% in August and lowest in December and January (10-30%) (Maishanu *et al.*, 2017). The area is also characterized by the Sudan Savannah type of vegetation, with abundant grasses and shrubs interspaced by short woody trees. Grasses looks green in the rainy season, but eventually withered and die during the dry season (Abubakar *et al.*, 2011).

Rearing of animal and crop cultivation are the major sources of livelihood. Dominant grains include millet, maize and sorghum, as well as legumes such as beans and groundnuts are cultivated in the upland areas. Dry season farming is usually restricted to the lowland areas and along the river banks and flood plains of the major rivers where crops such as tomatoes, onions, garlic, sugar cane, rice and many fruits are cultivated (Maishanu, *et al.*, 2017).

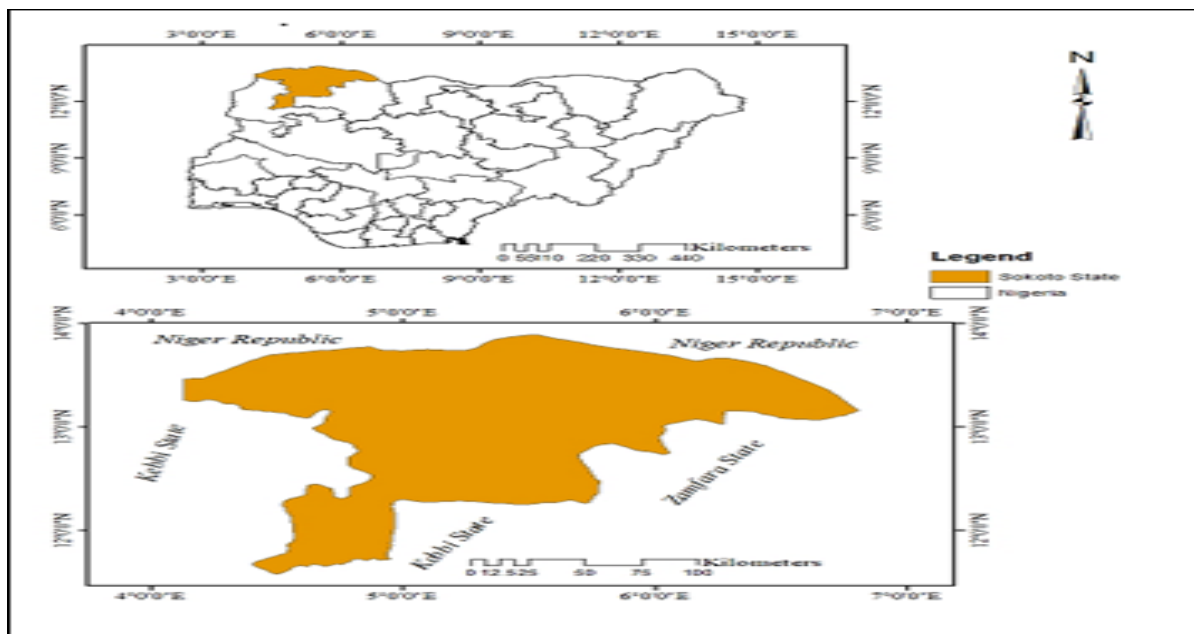


Figure 1: Map of Sokoto State. Source: Abubakar *et al.*, 2019

2.1.1 Description of the Study

Site

The study was conducted in 4 selected areas in Sokoto city, the capital of Sokoto state, Nigeria (figure 1). The areas are; New quarters Gidan Man'ada area (area "A"), Usman Faruk Secretariat (area "B"), In front of Federal Government College (area "C") and More area (area "D"). The area "A" is a new quarter under construction along Kalambaina road, the area "B" is along Garba Duba road, area "C" is along Gusau road adjacent to NNPC mega station and area "D" is along Illela road in front of Federal Science College, Sokoto.

2.2 Methodology

The methods used in this study were broadly classified into field work and data collection, pre-processing of satellite images, images processing and analysis. These presents the sequential processes involving acquisition of data, pre-processing of images and post processing analysis (Atiku *et al.*, 2017).

2.2.1 Data Collection

A questionnaire and base-line interview methods were used to generate primary data. Images were obtained from freely from Google Earth. The study was conducted between April 2011to October 2022, using 200 pre-prepared questionnaire and oral interviews. Details of the

plants cited by the respondents were documented including species family, common names and local names were obtained. (Kashani *et al.*, 2022).

2.2.2 Data Processing

The images used were corrected based on metadata subjected to haze suppression and cloud free. Dark Object Subtraction (DOS) were observed using PANCROMA environment. The images were sub sampled to a resolution of 50m for image integration and co-registration using a new Landsat data. The study areas were then sub-mapped. Global Positioning System (GPS) devise and Google Earth were used with the help of hand-held devices. Areas marked A, B, C and D were identified for ground truthing where each location was photographed as presented in figures 2-9.

The data was converted into IDRISI Raster format from Hierarchical Data Format (HDF) all the geospatial analysis was conducted using IDRISI-Taiga. Microsoft Office Excel (2010 edition) was used to create graphs.

2.2.3 Data Analysis

Abundance indices of plant species reported by respondents were calculated using the formula as
$$\text{Abundance index} = \frac{NL}{TR} \times 100$$
 where: NL is the number of individual plant species listed by the

respondents and TR stands for a total number of the respondent. The data for this study used to measure

vegetation changes due to anthropogenic activities in Sokoto metropolis are from satellite observations obtained from Moderate-resolution Imaging Spectroradiometer (MODIS) sensor as Enhances Vegetation Index (EVI). Abdullahi *et al.*, 2022, achieved positive result in monitoring vegetation changes time-series analysis using EVI. This study is between April 2011 to October 2022 covering a period of about a single decade. There are two images per a study area, and a total of 8 images per area were captured and used. This images was accessed free from Land Processes Distributed Active Archive Centre (LP DAAC) from the United States Geological Survey (USGS) website on Earth Explorer tool (<https://earthexplorer.usgs.gov>) using Google Earth and downloaded. The images used were

selected at irregular intervals to avoid cloudy images.

2.3 Determining Vegetation Relative Changes

The EVI data was subjected to the measurement of relative variability to determine the change in vegetation across the study areas using Coefficient of Variation (CV). The CV equation was applied on IDRISI software using Image Calculator.

$CV = \frac{\delta}{\mu} \times 100$ equation 1
 where:

- CV = Coefficient of Variation
- δ = Standard Deviation
- M=Mean(average).

3.0 Result



Figure 2: Area A, January 2011.



Figure 3: Area A, April 2022.

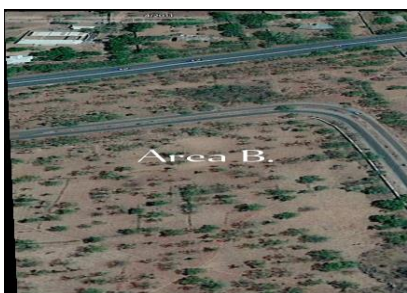


Figure 4: Area B, April 2011.

Figure 5: Area B, April 2022.



Figure 6: Area C, April 2011.





Figure 7: Area C, April 2022

Figure 8: Area D, April 2013.



Figure 9: Area D, May 2022

Table 1: Estimated Percentage of the Abundant Woody Species in the Study Areas.

Estimated population of <i>Azadirachta indica</i>				
Year	Area A %	Area B %	Area C %	Area D %
2011	89	78	81	87
2013	77	56	81	87
2015	11	23	34	90
2017	11	22	28	90
2019	13	24	23	88
2021	13	25	25	69
2022	13	26	27	64

Table 2: Possible causes of vegetation depletion

Possible cause	Area A %	Area B %	Area C %	Area D %
Urbanization	98	84	71	87
Natural death	0	4	0	0
Indiscriminate felling of trees	2	12	29	23

Table 3: Percentage (%) of Herbs Affected Per Area

Botanical names	Common names	Vernacular (Hausa) names	Area A %	Area B %	Area C %	Area D %
<i>Trianthema monogyna</i> L.	Desert purslane	horse Gadon maciji	31.12	27.55	20.40	19.38
<i>Ocimum gratissimum</i> L.	Scent leaves	Doddoya	50.0	52.04	53.57	19.89
<i>Sida cordifolia</i> L.	South Indian bala	Garmani	10.20	16.32	24.49	24.48
<i>Digitaria debilis</i> (Dest.) Willd.	Finger grass	Harkiya	08.67	04.08	01.53	36.22

Table 4: Average Percentage of Vegetation Depletion in the Study Areas

Study areas	Area A %	Area B %	Area C %	Area D %
Average percentage	97	87	70	89

4.0 DISCUSSION

4.1 Fieldwork

During an interview with the residence in the study areas, the areas were experiencing decrease

in the number of plants particularly the woody plants in those areas, which most of the interviewers related it to urbanization.

4.1.1 Field Inventory

For each of the areas, plant assessment was carried out. Field assessments were carried out to determine the faunal compositions of the study areas. A baseline study was conducted for area the study areas followed by qualitative inquiries from the local people who helped to identify the Hausa (vernacular) names.

4.2 Vegetation Cover and Change Detection

The vegetation patterns of all the study areas were compared and indicate the changes in the

vegetation of Sokoto metropolis. Figure 2 and 3 indicate a downwards trend in the vegetation cover of the study area A. The figure shows a depletion of vegetation possible in less than a decade. It recorded 97% losses of vegetation in area A between 2013 and 2022, while area B, C and D recorded 87% and 70% and 89% losses respectively.

Table 1 shows that, *Azadirachta indica* species is the most dense woody plant species in all the four study areas throughout the nine years period of the study. Having *Azadirachta indica* as the densest species, this shows that the species is the affected by the anthropogenic activity in the study areas from year 2011 to year 2022.

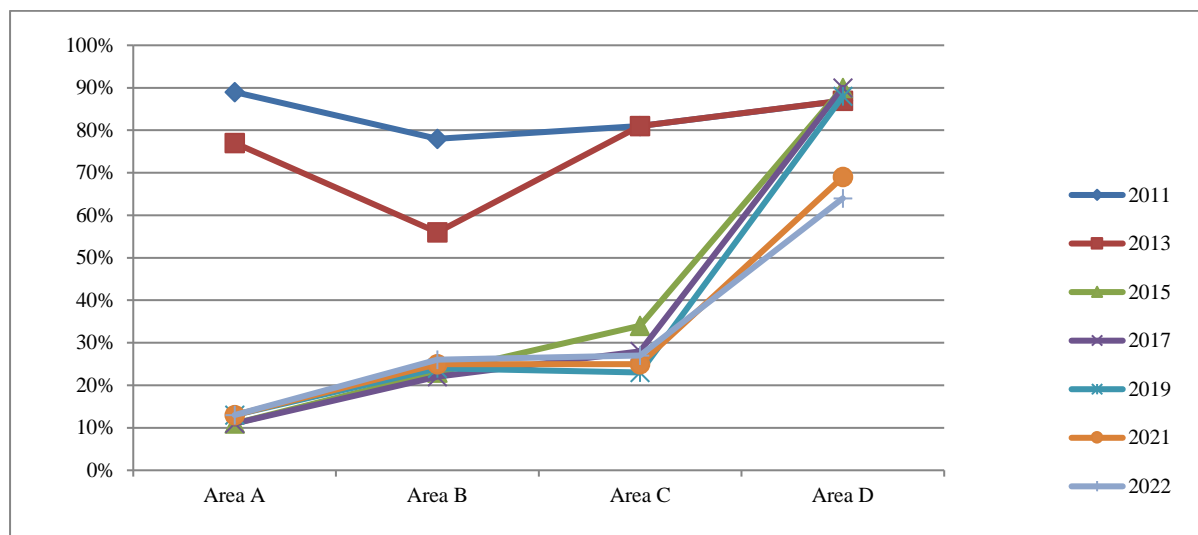


Figure 10: Percentage Depletion of *Azadirachta indica* in the Study Areas from year 2011 to 2022.

Table 2 shows that, urbanization is the most anthropogenic activity affecting the vegetation of Sokoto metropolis having the highest percentage from the respondents. The table indicates that, 98% of vegetation depletion is caused by urbanization in study area A and 84%, 71% and 87% to area B, area C and Area D respectively.

Table 3 indicates the average percentage of the most affected herb species in the study areas. In area A, *Trianthema monogyna* recorded 31.12%,

Ocimum gratissimum 50.0%, *Sida cordifolia* 10.20% and *Digitaria debilis* 08.67%. In area B, *Trianthema monogyna* recorded 27.55%, *Ocimum gratissimum* 52.04%, *Sida cordifolia* 16.32% and *Digitaria debilis* 04.08%. Area C recorded *Trianthema monogyna* 20.40%, *Ocimum gratissimum* 53.57, *Sida cordifolia* 24.49%, and *Digitaria debilis* 01.53%. In area D, *Trianthema monogyna* recorded 19.38%, *Ocimum gratissimum* 19.89%, *Sida cordifolia* 24.48% and *Digitaria debilis* 36.22%.

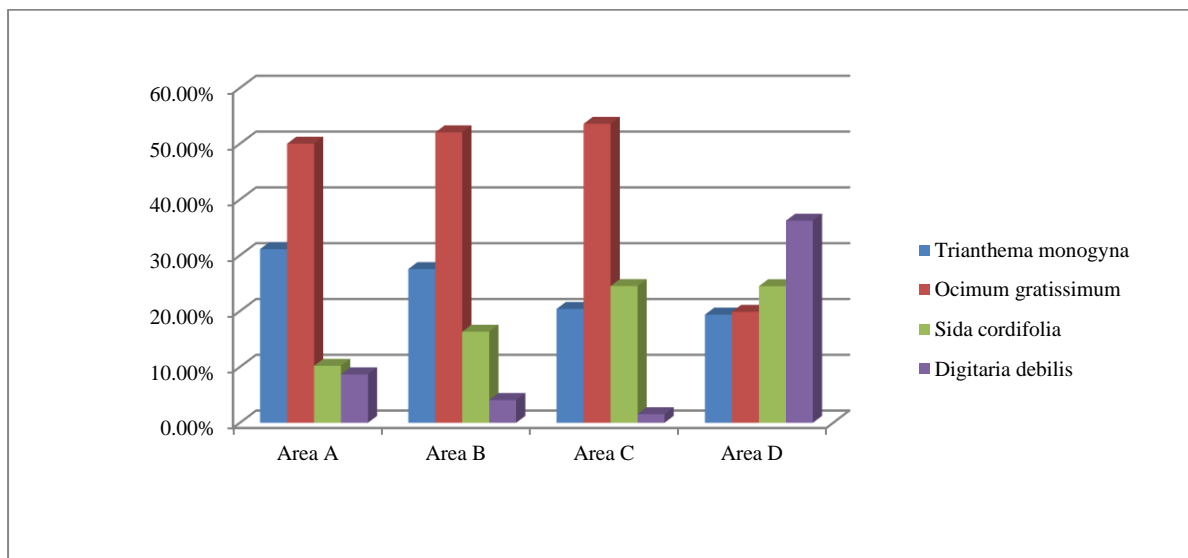


Figure 11: Percentage of most abundance herbaceous species in the study areas.

Table 4 indicates the average percentage of vegetation depletion in the study areas. Base on

the responses of the respondents, the average vegetation depletion in area A is 97%, area B 87%, area C 70% and area D 87%.

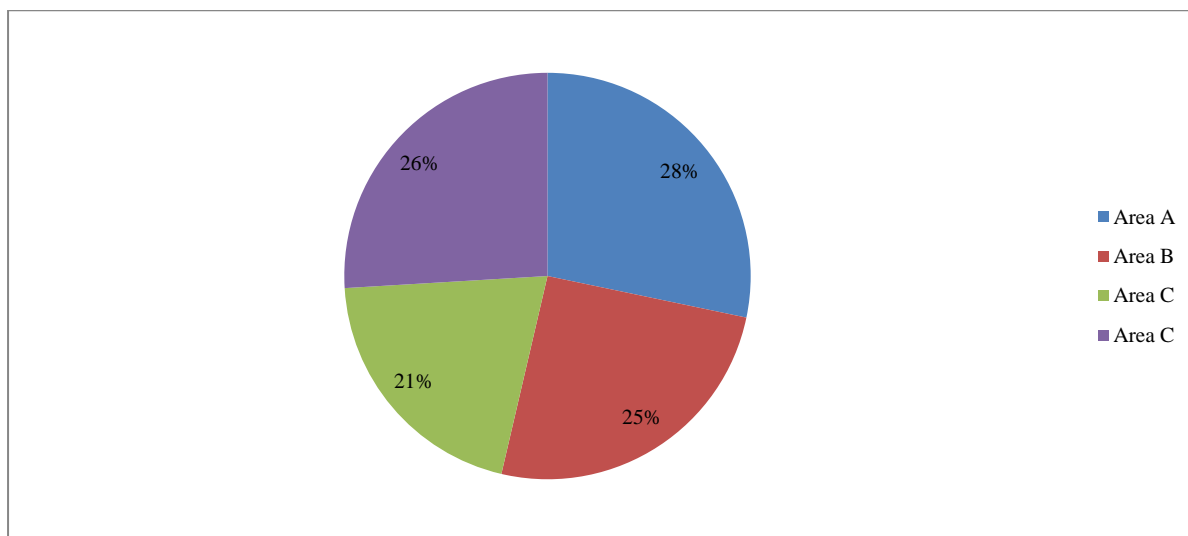


Figure 12: Percentage of vegetation depletion per study area from year 2011 to 2022

This study found that, urbanization causes depletion of vegetation in Sokoto metropolis and no measure is taken by neither the government nor the citizens to replace the vegetation especially the vegetation patches in the metropolis. We agree with Ismaila *et al.*, 2017 when they recommended that, consequent upon biodiversity resource degradation in Sokoto metropolis, fragmented patches should be protected and the already destroyed ones should be replicated in the neighbourhood lands. We

have find out that Eniolorunda *et al.* (2012) are right by stating that, between year 2005 and 2020 residential land use would expand by 31% and non-residential land uses within the built-up area.

CONCLUSION

This study has shown that the vegetation of Sokoto metropolis have been degraded in the study area. The most affected woody plant species is *Azadirachta indica* and *Ocimum*

gratissimum is the most affected herb species. Neither the government nor the residents are taking proper measures to replace the degraded vegetation in Sokoto metropolis. We therefore recommend that there should be a clarion call to plant trees and vegetation patches should replicated in the metropolis. Government should protect the remaining vegetation to stop desert encroachment and fragmentation. This will help to continue enjoying environmental services/products in Sokoto Metropolis and maintain environmental quality.

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