

Perception Study of the Drivers of Vegetation Changes in Selected National Parks in Northern Nigeria

Mustapha B. B^{1*}, Dadan-Garba A.², Oluwole, O.A² and T.O Adewuyi ²

¹Department of Geography, Kaduna State University, Kaduna

²Department of Geography, Nigerian Defense Academy, Kaduna

*Corresponding Author Email Address: Bashariyamustaphababa@gmail.com,

ABSTRACT

Changes in vegetation cover have a great impact on climate change and are responsible for a large fraction of global anthropogenic greenhouse gas emissions. This study investigates people's perceptions regarding the drivers of vegetation changes in Northern Nigeria. Utilizing Yamane's (1967) formula, a sample size of 400 respondents was determined, and questionnaires were distributed randomly. The research employed descriptive statistics, including frequency and percentage calculations, and Factor Analysis (FA) to unveil underlying patterns and relationships among factors influencing vegetation changes. Results revealed a predominantly male respondent group (90.11%), with a significant proportion having secondary education (38.53%), indicating a reasonable idea of environmental dynamics. Agriculture emerged as the primary livelihood (45.04%), with respondents boasting decades of farming experience. Findings reveal that 33.14% of respondents reported a moderately severe rate of vegetation changes, while 37.11% observed how rapidly vegetation grew back even with these changes. Factor analysis reveals that components 1, 2, 3, 4, and 5 accounted for 27.37%, 20.64%, 10.85%, 9.70%, and 8.16% of the total variability in the variables, respectively, cumulatively explaining 76.71% of the variance. In conclusion, rainfall/temperature variability, land use practices/deforestation (anthropogenic), and government project-based agricultural activities constituted the drivers behind vegetation changes. Therefore, this research indicates the importance of community-driven initiatives as far as sustainable land management and preservation are concerned within Northern Nigeria.

Keywords: Vegetation Changes, Northern Nigeria, Sustainable Land Management and Factor Analysis

1. INTRODUCTION

Vegetation changes continue to take place at unprecedented varying scales at the local, national, and global levels (Li et al., 2022). Therefore, studies related to vegetation changes are becoming popular worldwide (Zhang & Ning, 2023). Moreover, this change has had the attention and concern of researchers, policymakers as well as members of surrounding communities (Gomiero, 2016). Vegetation changes characterized by composition, structure and distribution have occurred as influenced by complicated interaction of factors

(Zhang et al., 2023). One of the key drivers affecting these vegetation changes is fast urbanization (Ding et al., 2020). This has been associated with the conversion of lands for infrastructure development within urban areas, residential settlements and commercial use. Urban expansion usually entails clearing natural vegetation leading to habitat loss, fragmentation and land-use change (Ruas et al., 2022). Similarly, demographic pressures in terms of population growth due to increased demand for agricultural products are having severe consequences on biodiversity because agriculture oriented towards productivity targets rather than

conservation perspectives is rapidly transforming habitats into farms, thus affecting the dynamics and compositions of local vegetation patterns (Jellason *et al.*, 2021).

Climate variation is another driver that makes plant cover fluctuate with irregularity in rainfall patterns commonly resulting from temperature extremities or periods of drought altering how vegetation grows, spreads out or adapts itself to new environments (Baba *et al.*, 2022). These climatic variations lead to changes in vegetation types, species composition changes, and ecosystem functions alterations. Moreover, extreme weather events such as floods, droughts, and heatwaves have profound impacts on vegetation health and productivity (Babati *et al.*, 2022). Vegetation changes are also significantly influenced by human activities (Simon *et al.*, 2021). Besides commercial logging, firewood burning, livestock rearing, and cultivation for farming or residential purposes have serious implications on the flora (Yenibehit *et al.*, 2024). Unsustainable exploitation of land resources also causes deforestation, soil erosion and extinction of various organisms (Baba *et al.*, 2022). Similarly, the introduction of alien species into the ecosystem, pollution and overharvesting degrade vegetation much more, resulting in disturbance in ecosystems. Natural disturbances, such as fires, pests and diseases and introduced species, also cause alterations in vegetation dynamics (Muluneh, 2021). Vegetation cover change is one of the key drivers of climate change with land-use change contributing about 23% of global anthropogenic GHG emissions (Berhanu *et al.*, 2023). Another concern is that besides global environmental problems that arise from changes in plants' life due to their disappearance are lack of food security, water resources, air quality among other crucial ecological services (Simon *et al.*, 2021). For instance, Africa is estimated to lose 2.8 million hectares of vegetation cover every year because of deforestation and land degradation, with Northern Nigeria being a hotspot for such losses (Tunde *et al.*, 2016). The drivers behind these shifts in vegetation are multifaceted and interrelated, which make comprehending them vital for proper conservation planning, land management programs as well as sustainable developments within the region of North Nigeria. With this knowledge, thus there is need to have a comprehensive approach that includes scientific research, indigenous knowledge, community perspectives and evidence-based decision-making process. This has been highlighted by factors such as surging population pressures, urbanization and agricultural expansion that necessitate an urgent adoption of sustainable land resource management techniques so as to alleviate their detrimental impacts on ecosystems and human well-being. Stakeholders can therefore identify appropriate land use plan strategies as well as targeted interventions

for environmental preservation while meeting local needs through understanding vegetation changes and why they occur in the first place. Furthermore, engaging local communities in research and decision-making processes not only enhances their empowerment and ownership of natural resources but also fosters a deeper understanding of their knowledge, values, and priorities regarding vegetation changes. In essence, bridging the gap between scientific understanding and community perceptions of the driving forces behind vegetation changes within Northern Nigeria is essential for promoting ecosystem resilience, biodiversity conservation, and sustainable development in the region.

2. MATERIAL AND METHOD

Northern Nigeria, is a region in Nigeria among the West African countries located in the tropical zone of Africa, lies between latitude 6° and 14°N of the equator and longitude 3°E and 15° E of the Greenwich meridian with highest elevation of 2419m above sea-level. It shares boundaries with the Republic of Benin in the west, Cameroun in the east, Niger in the North and Chad to the Northeast and the southern part of the country in the South (Figure 1). The land area of northern Nigeria encompasses of 718645.200 square kilometre (Baba *et al.*, 2022), the study area covers the savannah zone which is found in the northern region covering about 79% of the entire landmass of the country. The regional climate is characterized by two seasons, a rainy season from May to October and a dry season for the remainder of the year (Musa *et al.*, 2022). Daytime maximum temperatures remain consistently high throughout the year with maxima during March-May (up to 47°C), while relative humidity is low during the dry season and increases during the wet season (Isa *et al.*, 2023). Northern Nigeria belongs almost completely to the Basement Complex. Majorly, the vegetation in northern Nigeria is savanna, which are majorly divided into Guinean, Sudan and Sahel savanna. The West Sudanian Savanna covers a broad swath of northern Nigeria, typically hot and dry, the savannah supports scattered trees ranging from tall to stunt once and a variety of grasses (Babati *et al.*, 2021). Areas of this vast plain are dotted with outcroppings of granite. The relief ranges from 300m to 750m around northwest provinces and about 1,600m in Jos and Adamawa highlands with an average slope of about 2°. Northern Nigeria is inhabited by over 50% of the country's population sparsely distributed across 79% of the country's total land mass (Pate & Dauda, 2013). With a population of about 104,458,581 which comprises of male population of about 53,273,875 and female population of about 51,184,703 (NPC, 2009) making it one of the most populated zones in the country, with the largest land mass. Abubakar *et al.* (2022) observed that despite Nigeria's physical and human resources, there had

been progressively worsening welfare and poverty conditions of its nationals. More than 4 out of every 10 Nigerian live in conditions of extreme poverty of less than three hundred and twenty naira per capital per month, which will barely provide for a quarter of

2.2 Sample and Sampling Technique

Views on the driving forces behind vegetation change was captured using Structured Questionnaire. Multistage sampling was applied in this study, there are five national parks in the study

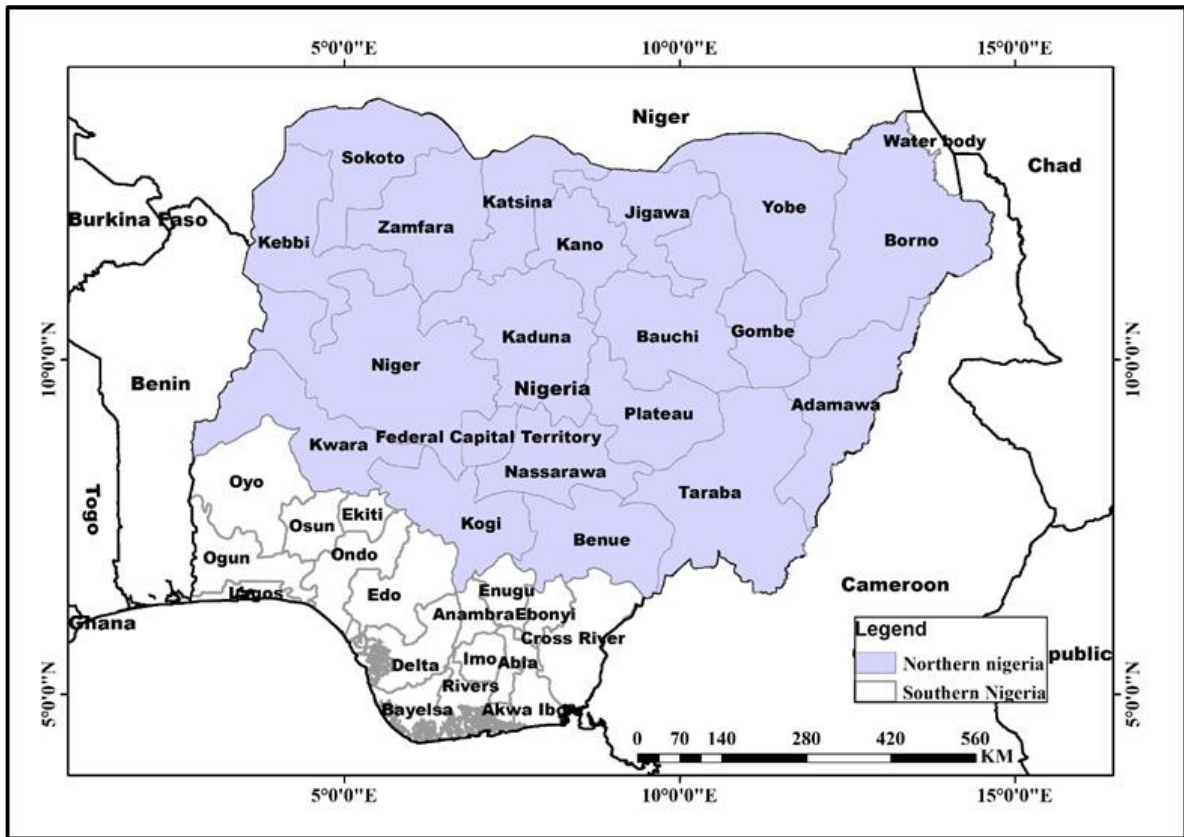


Figure 1: Map of Northern Nigeria

Source: Modified map of Nigeria from DIVA-GIS (2021)

nutritional requirements for healthy living.

2.1 Data Used and Purpose

Projected Population data of 2022 was used to draw a sample frame for the research study. The data was sourced from the National Bureau of Statistics in Nigeria, accessed through their official website (www.nigerianstat.gov.ng/download). This source is reputable for providing current and thorough demographic data, making it ideal for creating a sample frame that accurately depicts the population being studied. Using this population information allowed the research to employ a strong and representative sampling method, improving the credibility and applicability of the study's results. In addition to population data, the study employed questionnaires as a primary data collection tool during fieldwork. The questionnaire was designed by the researcher to gather specific information relevant to the research objectives directly from individuals within the study area. The use of questionnaire facilitated the systematic collection of data on various variables of interest, allowing for a structured and organized approach to data collection.

area (Table 1) and stratified sampling was used to select one state with national parks from each of the savanna vegetation, because it houses conserved vegetation with less disturbances in the region. In addition, they provide resources and livelihood to the community around them. Secondly, purposively, one Local Government Area where the national parks are located was selected from each state for sampling (Table 2). Lastly random sampling was used to administer the questionnaire because as long as a person lived at least 10 years in the area they have equal chance to be selected.

Table 1: National Parks in Northern Nigeria

S/N	VEGETATION ZONE	LOCATION OF NATIONAL PARKS	STATE
1	Sahel	Chad basin	Borno
2	Guinea	Gashaka Gumti	Taraba
3	Sudan	Yankari	Bauchi
4	Sudan	Kamuku	Kaduna
5	Guinea	Kainji	Niger

Source: Author's Compilation (2022)

To determine the sample size for this study, the Yamene (1967) formula for sample size determination was used. Thus;

$$\text{Sample size} = \frac{N}{1+N(e)^2} \dots\dots\dots 1$$

Where N= Total number of populations, e = error margin = 0.05

Therefore, using the projected population of the study area 933181 by 2022, (NPC, 2009) the sample size was 374; as such, 400 samples was administered.

The projection of the population is based on Nigerian population growth rate of 3% (NPC, 2009) using the formula: $P_{t+n} = P_t e^{r \cdot n}$

Where:

P_{t+n} = future population (2022)

P_t = base year population (2006)

r = growth rate (3%)

n = interval between future population and base year population

(2022 – 2006) = 16 years

e = exponential

descriptive analysis, factor analysis (FA) was conducted to investigate deeper into the driving forces behind vegetation changes. In FA, Eigenvalues play a crucial role in determining the significance of each principal component. Eigenvalues represent the amount of variance explained by each component. Higher Eigenvalues indicate that the corresponding component explains more variance in the data.

In the study, Eigenvalues were calculated for each factor component derived from the FA. The Eigenvalues were then used to determine which components should be retained for further analysis. Typically, components with Eigenvalues greater than 1 are considered significant and retained, as they explain more variance than a single variable. Moreover, % of Variance is another important metric in PA, representing the proportion of total variance explained by each factor component. This metric helps in understanding the contribution of each component to the overall variability in the data.

Table 2: Selected LGA and their Sample Size

S/N	VEGETATION ZONE	STATE	NATIONAL PARKS	LGA	POP 2006	Proj pop 2022	SAMPLE
1	Sudan	Bauchi	Yankari National Park	Alkalari	328284	485860	194
2	Guinea	Niger	Kainji National Park	Borgu	172835	255796	103
3	Sahel	Borno	Chad basin	Marte	129409	191525	77
TOTAL					630528	933181	374

Source: Author's Compilation, (2022)

2.3 Questionnaire Administration:

In selecting the respondents, a random sampling technique was employed for residents (farmers and non-farmers) who lived in the area or have cultivated land in the study area for at least 10 years or more. It is believed that any person lived in the area for at least 10 years, the person has a well knowledge and experience on the vegetation dynamics and changes occurring in the area. A total of 400 copies of questionnaire was administered to the respondents. The questionnaire was design based on the background knowledge of the study area, previous research work and discussion with key informants.

2.4 Method of Data Analysis

The study on people's perceptions of the driving forces behind vegetation changes within Northern Nigeria employed a methodological approach that combined descriptive statistics and factor analysis (FA). Descriptive statistics, including frequency and percentage calculations, were utilized to analyse the perceptions of the driving forces behind vegetation changes. This involved quantifying the frequency of responses and calculating the percentage distribution of different factors influencing vegetation dynamics as perceived by the respondents. These statistical measures provided a quantitative overview of the dominant perceptions among the study participants. Following the

Higher % of Variance indicates that the component captures a substantial amount of information from the original variables.

Additionally, Cumulative % is calculated by summing up the % of Variance for each retained component in descending order. Cumulative % represents the total amount of variance explained by the retained components. A higher Cumulative % recommends that the retained components collectively capture a significant portion of the total variability in the data. By considering Eigenvalues, % of Variance, and Cumulative % in the FA analysis, the study was able to identify and retain the most relevant factor components that best explain the driving forces behind vegetation changes in Northern Nigeria.

3. RESULT AND DISCUSSION

3.1 Socio- economic characteristics of the respondents

From the result on table 3 it revealed that majority of the respondents in Sudan savanna region were male (47%), Guinea (25%) and Sahel (19%). The overall result revealed that the majority of the responders were male (90.11%), while female respondents were the least during the survey participation. The distribution of age categories revealed that in the Sudan 2/3 of the responders were

below 54 years of age out of $\frac{1}{2}$ of the responders in the entire study area. Similar findings were reported by (Oleribe *et al.*, 2020). In addition, 17.5 % of the responders in guinea savanna region were below 17.5%, while there were 13.1% responders in the Sahel region out of 48% responders in the study area. Therefore, the entire northern Nigeria showed that the majority of the respondents were less than 54 years of age (63.74%), while above 54 years of age were the least. This implies that the majority of the responders are old enough to have the experience on the vegetation dynamics and how climate variability plays a role in shaping the dynamics of the vegetation in the study area. The findings agree well with that of (Reuben *et al.*, 2021) who reported a similar findings.

In addition, table 3 revealed that majority of the respondents in the study area were married with 81.58% followed by single (9.35%) while those that were divorced had the least number on marital status with 2.83% of the respondents. The result revealed that 3 out of every 4 responders in the Sudan region were married in the $\frac{1}{2}$ proportion of the responder in the study area. Similarly, in guinea savanna region the majority of the responder are married. This implies that $\frac{3}{4}$ of the responder out of $\frac{1}{4}$ of the responder are married comparatively with the total population of the responder in the study area. In addition, in Sahel 16.5 of the responder are married out of 21% of the total responder in the study area. Similar findings were reported by (Oguntunde *et al.*, 2019) who ascertained that majority of respondents in his studies are married.

The result in table 3 revealed that majority of the respondents had a family size of more than 9 (38.24%), followed by 7 – 9 with 32.58 percent, while less than 5 member of family size was least number of dependence (5.10%) in the study area. It was also revealed that majority of the respondents are having more than 9 dependents in their household. The 19.8% out of 52% of respondents in Sudan region are having more than 9 dependents, in guinea is 10.5% out of 27% while in Sahel is 7.9% out of 21% of the entire respondents in the study area. This shows that the respondents in the region are having more dependents in their household which might be as a result of their polygamous household nature that is warranted by their religion that are dominant Muslim. Therefore, they depend heavily on agriculture and firewood as sources of livelihood and energy in turn affect the dynamics of vegetation in the study area. The household expectedly have acquainted knowledge on the changes and dynamics of vegetation that happen over long period of time and its relation to climate variability.

It also revealed that the respondents attended secondary school with about 38.53%, while 22.955 attended tertiary education. Those with non-formal education were about 18.13%, while those with

neither formal nor informal education were about 7.93%. The result of level of education revealed that in Sudan savanna region 2 out of 5 respondents have secondary education, similar in guinea savanna region. This implies that in the Sudan and guinea savanna region the majority of the respondents have secondary education. In Sahel savanna region one out of three respondents have tertiary education. From the result it can be deduced that the majority of the respondents are well educated. Therefore, it is expected that they have knowledge on the changes and dynamics of vegetation, climate variability and contribution of climate variability on vegetation dynamics. The findings are inline with that of (Yahaya *et al.*, 2022) who ascertained that majority of the respondents attended secondary school.

In terms of their source of livelihood, table 3 revealed that about 45.04% of the respondents depended solely on farming, this was the major source of livelihood, followed by trading of about 25.50%, while artisanship was the least source of livelihood (7%) in the study area. This has shown that in the Sudan region two third of the respondents depended on farming, in guinea one second of the respondents while in Sahel region about 9.2% out of 21% of the respondents depend on the farming as sources of their livelihood. Similar findings were reported by (Eze, 2018) who ascertained that farming is the major source of livelihood in Northern Nigeria.

From table 3, it can be deduced that the years of farming experience by the respondents in the study area. The result revealed that in Sudan region the respondents that have more than 31 years of experience in farming. In guinea the majority of the respondents (16.5% out of 27%) have a farming experience between 21-40 years, while in Sahel region 11.2% out of 21% of the respondents have more than 30 years of farming experience. These results revealed that majority of respondents in northern Nigeria spent 31 or more years (53.82%) in farming in the study area followed by 21 -30 years of experience (25.78%), while less than 20 years of experience was the least period spent by the respondents in farming activities in the study area. Furthermore, table 7.5 revealed that majority of the respondents earned between 2000 and 4000 per month (31.16%), followed by less than 2000 (28.9%), Then 24.08% of the respondents earned 40000 – 50000 per month while those that earned more than 50000 per month were the least among the respondents in the study area. In addition, the result revealed that in Sudan majority of the responder (31.2% out of 52%) earn less than 40000 per month, similarly, in guinea (16.6% out of 27%). In Sahel the majority of the responder (6.1% out of 21%) earn between 40000– 50000 as monthly income.

Table 3: Socio economic characteristic of the respondents in northern Nigeria

	Sudan		Guinea		Sahel		Total	
Sex	Freq	%	Freq	%	Freq	%	Freq	%
Male	175	47	93	25	69	19	337	90
Female	19	5	10	3	8	2	37	10
Total	194	52	103	28	77	21	374	100
Age distribution								
<45	57	15.2	30	8.0	22	6.0	109	29.3
45-54	67	17.9	36	9.5	27	7.1	129	34.5
55-64	50	13.5	27	7.1	20	5.3	97	25.9
>65	20	5.3	10	2.8	8	2.1	38	10.2
Total	194	52	103	27	77	21	374	100
Marital Status								
Single	18	4.9	10	2.6	7	1.9	35	9.4
Married	158	42.3	84	22.5	63	16.8	305	81.6
Divorced	6	1.5	3	0.8	2	0.6	11	2.9
Widowed	12	3.2	6	1.7	5	1.3	23	6.1
Total	194	52	103	28	77	21	374	100
Number of Dependent								
Less than 5	10	2.6	5	1.4	4	1.0	19	5.1
5-7	47	12.5	25	6.6	25	6.7	96	25.8
7-9	63	16.9	34	9.0	19	5.1	116	31.0
More than 9	74	19.8	39	10.5	29	7.9	143	38.2
Total	194	52	103	28	77	21	374	100
Level of Education								
Primary	24	6.5	13	3.5	10	2.6	47	12.6
Secondary	75	20.0	40	10.6	20	5.3	134	35.9
Tertiary	44	11.8	24	6.3	27	7.2	95	25.3
Non-formal Education	35	9.4	19	5.0	14	3.7	68	18.2
None	16	4.2	8	2.2	6	1.7	30	8.0
Total	194	52	103	28	77	21	374	100
Source of Livelihood								
Farming	87	23.3	46	12.4	35	9.2	168	44.9
Trading	49	13.2	26	7.0	20	5.2	95	25.4
Civil Service	29	7.8	15	4.1	12	3.1	56	15.0
Artisanship	14	3.7	7	1.9	5	1.4	27	7.1
Others	15	3.9	8	2.1	6	1.5	28	7.5
Total	194	52	103	27	77	21	374	100
Farming Experience (years)								
Less than 20years	39	10.5	21	5.6	16	4.2	76	20.3
21-30years	50	13.3	34	9.1	20	5.3	104	27.7
31-40years	52	14.0	28	7.4	21	5.6	101	27.0
More than 40years	52	14.0	20	5.3	21	5.6	93	24.9
Total	194	52	103	27	77	21	374	100
Monthly income								
Less than 20000	56	15.0	30	8.0	22	5.9	108	28.9
20001-40000	61	16.2	32	8.6	20	5.3	113	30.2
40001-50000	47	12.5	25	6.6	23	6.1	94	25.3
More than 50000	31	8.2	16	4.3	12	3.2	59	15.8
Total	194	52	103	28	77	21	374	100

3.2 People's perception on vegetation changes

In this sub section the result of people's perception on the vegetation is presented on table 4. The majority of the respondents had noticed changes of vegetation density with about 95.47%. The majority of the respondents revealed that there is moderate

rate of deforestation (43.91%), followed by slow rate of deforestation with 41.08%, and while the fast rate of deforestation was 15.01% in the study area. Similar findings was reported by (Borysiak & Stępniewska, 2022) who ascertained a changes of vegetation density in his study. In addition, table 4 revealed that the 28.33% of the respondents agreed

that overgrazing is the major indicator of vegetation changes followed by over cultivation with 27.2% and urbanization with about 25.2% as the indicators of vegetation changes. The findings is inline with that of (Suleiman et al., 2017) who reported overgrazing is the major indicator of vegetation changes in his study.

Furthermore table 4 it is revealed that 33.14% of the respondents reported that there is moderate severe rate of vegetation changes, followed by 30.59% of the responder agreed that there is very severe rate of vegetation changes, while less severe rate of vegetation changes was the least (22.95%) in the study area. Despite the rate of vegetation changes 37.11% of the responders reported that there is fast

Ogbemudia, (2023) who ascertained that there is regeneration of vegetation in savanna region of Nigeria even though climate variability affects the rate of the process.

3.3 Drivers of Vegetation Changes in the northern Nigeria

It can be observed on Table 5 that the number of factors that met the cut-off criterion of greater than one eigenvalue is under the rotation sums of squared loadings. In this case, there were five components with eigenvalues greater than 1. The total variability (in all of the variables together) can be accounted for by each of these summary scales or components 1, 2, 3, 4 and 5 accounts for 27.37%, 20.64%, 10.85%, 9.70% and 8.16% respectively of the variability in

Table 4: People Perception on Vegetation Changes

	Sudan		Guinea		Sahel		Total	
Rate of Deforestation	Freq	%	Freq	%	Freq	%	Freq	%
Fast	80	21	15	4	12	3	107	29
Moderate	85	23	45	12	34	9	164	44
Slow	29	8	42	11	32	8	103	28
Total	194	52	103	28	77	21	374	100
Vegetation Change Indicators								
Over Cultivation	56	15	29	8	21	6	106	28
Urbanization	49	13	26	7	19	5	94	25
Over Grazing	55	15	29	8	22	6	106	28
Others	34	9	19	5	15	4	68	18
Total	194	52	103	28	77	21	374	100
Rate of Vegetation Change								
Less severe	45	12	24	6	18	5	86	23
Moderately severe	64	17	34	9	26	7	124	33
Very severe	59	16	31	8	23	6	114	30
Not Severe	26	7	14	4	10	3	50	13
Total	194	52	103	28	77	21	374	100
Rate Vegetation Regeneration during normal rainy period								
Fast	72	19	38	10	29	8	139.0	37
Moderate	49	13	26	7	19	5	94.4	25
Slow	41	11	22	6	16	4	79.2	21
No regeneration	32	8	17	5	13	3	61.2	16
Total	194	52	103	28	77	21	374	100

regeneration of vegetation followed by 23.21% of the respondents agreed that there is moderated rate of regeneration and slow rate of regeneration was 21.12%, while 16.435 of the respondents agreed that there is no regeneration of vegetation in the study area. The result of this study is in line with of Baba et al. (2022) who reported that there is regeneration of vegetation in the guinea savanna especially in protected areas such as Kamuku National Park. Also this result is in line with the result of Ita &

all the 23 variables. Variances (eigenvalues) of the components 1, 2, 3, 4 and 5 are 6.568, 4.953, 2.603, 2.328 and 1.959 respectively. The cumulative percentage of variance accounted for by the current and all preceding components is 76.71. This means that the five components together account for 76.71% of the total variance.

The rotated component matrix of the respondents' opinion on the drivers of vegetation change in the

study area which explained the factor loadings for each variable (table 5). The highlighted rows show

household size, deforestation, mining, bush burning and over grazing.

Table 5: Drivers of Vegetation Changes in the Study Area

Drivers of Vegetation Change	Factors				
	1	2	3	4	5
Onset of rainfall is now coming late compare to last 30years	0.906				
The number of rainy days is increasing	0.872				
Temperature around this community is increasing	0.417	0.854			
The community is experiencing early cessation of rainy season	0.715	0.487	0.360		
Amount of rainfall is increasing every year compared to last 30years	0.680				
Annual rainfall is not enough for crop production as before	0.679	0.403	0.342		
Extreme indices and events such flooding and drought have been increasing every year	0.355	0.637	0.401		
Climate change has led to crop infestation by pest and diseases	0.431	0.536	0.359		
We experience long period of dry spell within rainy season	0.426	0.513	0.399		
There has been change in wind intensity (increase/decrease)	0.320	0.658			0.329
Increase of household size		0.464	0.764	0.330	
Land preparation and land cultivation with regular or occasional use of tractors	0.480	0.326		0.726	
Frequently used agricultural area (mainly bush farming)		0.419		0.719	
Using water from rivers, lakes or dams with hydraulic equipment,	0.354	0.459	0.659		
Use of hybrids and/or genetically modified plants	0.615	0.335	0.635		
Cutting and collecting branches and other tree parts for household purposes		0.309	0.609	0.447	
Extraction of sand, gravel, stones and other resources for mining affect vegetation change			0.717		
Bush fires as result from slash and burn; intentional bush fires for hunting also affect vegetation change		0.307	0.594		
Human activities (especially grazing)			0.565	0.435	
Soil type have lower capacity for nutrient storage and they are more prone to soil degradation				0.761	
Soil is more water-logging in valleys	0.491			0.704	
Income of rural farmers is the potential to buy fertilizer, chemicals, tools and other things for crop input	0.380	0.470	0.590	0.490	
Improved crop type develops new strategies of land use practice, new land use systems and possible value chains are put in place				0.899	0.399
Laws for land use-related issues,			0.482		0.589
Projects and programmes for developing agriculture in Northern Nigeria are provided by the Government.					0.899
Eigenvalues	6.568	4.953	2.603	2.328	1.959
% Of Variance	27.37	20.64	10.85	9.70	8.161
Cumulative %	27.37	48.01	58.85	68.55	76.71

Note: yellow colour (factor I), red (factor II), green (factor III), blue (factor IV), pink (factor V), and maroon colours (factor VI).

the most highly correlated components that each variable loaded most strongly on. It revealed that factors I was strongly correlated with onset of rainfall, number of rainy days, early cessation, increase amount of rainfall and rainfall variation. The factors II were strongly correlated with increase in temperature, extreme event, and climate change, dry spell and wind intensity. In addition, the factor III was strongly correlated with increase in

The factor IV was correlated with land preparation over cultivation, soil characteristics and land use practice. The land tenure system and agricultural project by government was strongly contributed to the fifth factor (factor V). The first factor (factor I) was categorized as rainfall variability driver, while factor II was categorized as temperature variability drivers. The factors III and IV was categorized as anthropogenic driver, while factor V was categorized as agricultural driver. This suggests that

the climate drivers were part of the major factors behind vegetation change in the study area. Similarly (Ijeomah *et al.*, 2011) found that the respondents have knowledge of vegetation changes. Naibbi & Healey, (2013) Naibbi, reported a greater percentage of population rely on vegetation as sources of energy which degrade the dynamic of it resources and environment at large. Similarly, Ogunrinde *et al.* (2021), revealed a significant expansion of cultivation in the west Africa region. the result of this study is consistence with that of Jibrillah *et al.*, (2019) who reported that anthropogenic and climate variability contributed significant tot the depletion of vegetation resources. Also Borisade & Odiwe, (2023) found that stages of ecological succession and regeneration of the vegetation in the Nigerian riparian forest ecosystems. The findings of this study align with that of Muhammed *et al.* (2023), who verified the actual condition of riparian vegetation in the River Gongola basin. They study observed dynamic changes in vegetation within the study area, noting a notable increase in forest cover attributed to the regeneration of the vegetation.

4. CONCLUSION

This study conducted a comprehensive study to examine people's views on driving forces of vegetation change in northern Nigeria. The research findings were also discussed through descriptive statistics and factor analysis, which revealed important information regarding the respondents' demographics, educational background, livelihood pattern and perception. Most of the respondents were male, married with more than nine dependents in their families as indicated by their household structure. A significant percentage had secondary education thus indicating a fair level of comprehension about environmental dynamics and climate variability. Most respondents engaged in agriculture as their main source of income with many years of farming experience which implies a strong connection between them and the vegetation dynamics on that land. The finding also noted that among other factors such as overgrazing, over cultivation and urbanization; participants are aware that they are reasons for vegetation changes. The factor analysis showed that rainfall/temperature variability, land use practices/deforestation (anthropogenic), government project based agricultural activities constituted definitive clusters of drivers behind vegetation changes. In light of the study's findings on people's perceptions of the driving forces behind vegetation changes within Northern Nigeria, the study recommends that community-led efforts are essential for managing land and conserving vegetation. The study recommends prioritizing initiatives that empower local communities through education, capacity building, and participatory decision-making. These efforts should focus on implementing sustainable

agricultural practices, supporting reforestation, and addressing human activities that are causing changes in vegetation. Community involvement and ownership are key for ensuring environmental sustainability and building resilience to climate change in the region.

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