

## Communities Perception of the Causes and extent of deforestation in Niger south, Niger state, Nigeria

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### ABSTRACT

*The transformation of forested lands by human actions such as deforestation represents one of the great forces in global environmental change and one of the great drivers of biodiversity loss. The study aimed to examine the Causes and extent of deforestation in Niger south, Niger state, Nigeria. By using Landsat Thematic Mapper images of two decades 1990 and 2020. Geographical Information System (GIS) ArcGIS 10.6 was adopted and was used to analyze the Normalize Difference Vegetation Index (NDVI) to derive images of the study area aimed at classifying, producing maps and quantifying the vegetation changes. Information about the anthropogenic activities of the inhabitant was collected using a structured questionnaire and Focus Group Discussion (FGD). The data collated were analyze using Microsoft Excel and Statistical Package for the Social Sciences (SPSS). The result of NDVI analysis indicates a decrease of -0.1984 in the water bodies, while -0.0087 decrease on vegetal cover was recorded. Information from the respondents reviled that; the major causes of deforestation were charcoal production, fire wood collection, farm clearing and logging activities. The reports of the FGD reveals that majority of the stakeholder agrees that there has been a great number of hectares of forested land that has been deforested. The most attested man – made causes of deforestation in the study area was charcoal production. The research recommends that: Government and other agencies should introduce reforestation program to replace and regenerate the lost species in the forest reserve. Illegal cutting down of trees should be avoided and improve wood stoves should be introduced so as to reduce the level of wood consumption.*

**Keywords:** Forest, NDVI, Deforestation, Biodiversity, Niger state

### 1. INTRODUCTION

The transformation of forested lands by human actions such as deforestation represents one of the great forces in global environmental change and one of the great drivers of biodiversity loss (Aliyu *et al.* 2014). Forests are cleared, degraded, and fragmented by timber harvest, conversion to agricultural land, road construction, human-caused fire, and many other ways. The effort to use and subdue the forest has been a constant theme in the transformation of the earth, in many societies, in many lands, and at most times within the international, national, state, and local

government or communities' circles (Bamba 2015). For many developing countries like Nigeria and Niger State, the forest represents an important resource base for economic development. According to van Kooten and Bulte (2000), deforestation refers to removing trees from a forested site and converting land to another use, most often agriculture. In other words, deforestation is converting forest to an alternative permanent non-forested land use for agriculture, grazing, or urban development.

According to Aliyu *et al.* (2014), deforestation is the clearing away of forests. It is the process by which an area is deprived of existing natural

forest vegetation and resources. This can be brought about by systematic felling, indiscriminate logging, or total clearing of existing vegetation for arable farm or industrial purposes.

Forest loss in Africa is particularly troubling, and this is because; two-thirds of the continent's population depend on forest resources for income and food supplementation, and 90 percent of Africans use fuel wood and deforestation as sources of energy (FAO, 2010). Hence, the over-reliance on forest resources and Non-Timber Forest Products (NTFPs) has accounted for the huge change in forest cover; deforestation in Africa is estimated at around 3.4 million hectares per year (FAO, 2010). As environmental degradation and its consequences come clearly into focus, we are faced with the prospect that renewable forest resources may be exhausted and that man risks destroying his environment if all the causes of deforestation go unchecked. Therefore, it is important to conduct a periodic assessment of the causes and extent of deforestation in Niger south, Niger state, as it is the major reservoir of our natural resources, especially forestry resources.

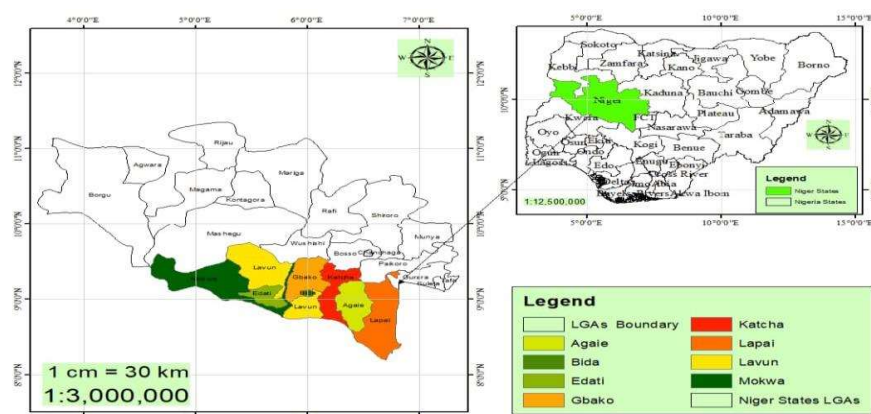
Deforestation in Niger south is an ongoing phenomenon. This is becoming more pronounced with the increasing population of its people, according to National population Commission (NPC 2006), which stood at 1,296,032. Such depletion has led to a decline in forest cover, forest degradation, soil impoverishment, and general deterioration in environmental conditions. For example, deforestation has often led to frequent erosion and flooding. This accelerating nature of deforestation also threatens the sustained resources based on the forest raw materials.

This study bears relevance to the Local, State, and Federal Governments by providing credible data on the extent and impacts of deforestation on the livelihood of communities in Niger South. This information could help governments at these levels to appropriately plan intervention measures. This study equally bears significance to the academic community by adding to the number of published sources on the issue of deforestation in Niger South. Meanwhile, the study will be useful for managing the state forest resources and providing necessary guidelines for their conservation.

## 2. MATERIALS AND METHODS

### 2.1 The Study Area

Niger South consists of eight (8) local government areas among the twenty-five (25) LGA in Niger State, namely: Mokwa, Edati, Lavun, Bida, Gbako Katcha, Agaie, and Lapai. The study area is located between Longitude 4°30'00" to 6°34'00" East and Latitude 8°30' 00" to 10°00' 00" North and covers a total land area of 17,364km<sup>2</sup>. The study area by the 2006 national population census is 1,296,032 people (National Population Commission of Nigeria). The study area is located in the southern part of Niger State, experiencing two distinct seasons, dry and wet seasons, with an annual rainfall of about 1000mm to 1,200mm (Adeniji *et al.* 2015). The rain duration is sufficient to cover the varying crop farming that is predominantly the people's occupation. The study area is bounded to the Northern axis by Bosso and Paiko local government areas, to its East are Federal Capital Territory Abuja. While Kwara and Kogi States are to the South, Mashegu, and Wushishi local government areas are to the western axis. Figure 1 shows the location of the study area.



**Figure 1:** Geographic location of Niger State south, Niger State, Nigeria

### Climate

Meteorological research confirms that the climate of the study area is well suited for agriculture as it is a Guinea Savanna climate. Rainfall is highly seasonal and controlled by the irregular movement of the Inter-Tropical Discontinuity (ITD). Rainfall usually starts in April/May and stops in October (Adeniji *et. al.* 2015). . It usually recorded an average of 200 days of rainy days per year with an average mean annual rainfall of 1,300mm (Adeniji *et. al.* 2015) . However, the temperature rarely falls bellows 20°C. The wet season temperature average is about 20°C. The peak is 38°C from February to March and 35°C from November to December. The mean relative humidity is 33-83%.

### 2.2 Research Design, Sources, and Types of Data

This study adopted a descriptive-survey research design whereby quantitative and qualitative data types were collected. Direct and indirect modes of inquiry were employed to seek opinions and knowledge of a sampled population of respondents on Deforestation in Niger South, Niger State. The data collection was specific to the set objectives of the study, which aimed to examine the perception of the communities on the Causes and extent of deforestation in Niger south, Niger state, Nigeria. The study drew from both primary and secondary sources of data.

Secondary data used for the study include satellite imagery, while publications, annual and quarterly reports, and books (hard and soft copies) that deal with the concepts and issues of deforestation extent and causes will serve as literatures for the study. Data for this study were collected from both primary and secondary sources.

The primary data were obtained by the use of a structured questionnaire. Reconnaissance surveys, desk studies, interviews, and on-field observations were undertaken in the study area to obtain first-hand information on the prevailing situation on the causes of deforestation.

A pilot test was conducted with a small group representative of the population to assess the face validity of the questionnaires. The questionnaires were pretested by ten (10) farmers. Respondents were asked to fill out the questionnaire accompanied by interviews in

order to refine the meaning, understanding, wording, and formatting of the questions.

The secondary source of data used for the study include: Satellite Imagery with the following characteristics, b LandSat5 image Thematic Mapper (TM) for 1990 and LandSat8 Operational Land Imager (OLI) 2020 all with 30metre Resolution were used. The data were sourced from United State Government via [www.usgs.gov](http://www.usgs.gov). Table 1 summarizes the characteristics of the satellite imagery used.

**Table 1 characteristics of the satellite imagery**

System	Sensor	Resolution	No of Bands	Acquisition date/ Source
LandSat -5	TM	30m	3, 4	1990 <a href="http://www.usgs.gov">www.usgs.gov</a>
LandSat -8	OLI	30m	3, 4	2020 <a href="http://www.usgs.gov">www.usgs.gov</a>
Google Earth				2020 <a href="http://www.google.com">www.google.com</a>

### Sample size and procedure

The population of the study area was derived from the National Population Commission census of 2006, which put the figure as 1,296,032. Hence, the total population of the study area was used as a sample frame for this research. The sample size was calculated from the projected total population of the study area using the formula  $PF = PP(1+r)^n$  at the growth rate of 3.5% for 12 years up to 2019.

Exponential population projection formula  $P_n = P_o(1+r/100)^n$  (1)

Where;

$P_n$ = projected population,

$P_o$ = base population,

$r$  = growth rate (3.5%)

$n$ = projected number of years

From the projected population of 1,355,685 the sample size was calculated using a simplified formula:

$$n = N/1 + N(e^2) \quad (2)$$

Where:

$n$ = Sample size,

$N$ = Population size of the sample unit

$e$ = Level of precision which is  $\pm 5\%$  (0.05), at 95% confidence level.

Hence, a sample size of 264 respondents was sought from Mokwa, Edati, Lapai and Agaie LGA. Based on this, a total number of 264 questionnaires were randomly administered and returned.

### Sampling techniques

In the sampling techniques, both purposive and random sampling techniques were employed to

ensure a good spread of respondents for the study. The following communities were visited during the field survey: Mokwa, Labozhi, Duma, Enagi, Agaie, Nami, Lapai, and Gulu Vatsa. The respondents were selected at random for the interview.

### **Focus Group Discussion (FGD)**

Focus Group Discussion is a technique where a researcher assembles a group of individuals to discuss a specific topic, aiming to draw from the complex personal experiences, beliefs, perceptions, and attitudes of the participants through a moderated interaction.

Focus Group Discussions (FGD) were held with ten (10) major stakeholders (forestry officers, community heads, religious heads, and heads of various community trade unions) to seek vital information and to validate, or otherwise, the issues that arise during the interview.

### **2.3 Methods of Data Analysis**

NDVI analyses of the vegetation condition in the land cells of the study areas were computed to examine the extent and rate of deforestation in the Study Areas. NDVI was calculated as the difference between reflectance in Near Infrared and Visible radiation by using Equation 3.

$$NDVI = \frac{NIR - VIS}{NIR + VIS} \quad (3)$$

Where Near Infrared is the fourth band of landSat images and visible is the third band.

The final NDVI product was depicted in the geographic grid with equal latitude and longitude intervals. The NDVI values range from -1 to +1. The negative index value can be recorded over the water bodies without seaweeds and vegetation, while values are close to 0 over the land without vegetation. The index value equal to 1 indicates perfect growing vegetation conditions as shown in Table 2 (Aliyu, *et. al.*, (2014).

$$NDVI = NDVI(2020) - NDVI(1990) \quad (4)$$

These techniques are used to compare two or more images of different dates. The individual normalize vegetation index (NDVI) was generated using a range of values that is -1 and +1, and this means that values from negative mean there is a reduction of vegetation, and value from +1 and above shows positive change, which is an increase in the vegetation of the targeted area. This is as adopted by research conducted by (Wada *et al.* 2019).

The second objective was achieved using descriptive statistics, such as frequency tables, percentages, graphs, and charts. The Statistical Package for Social Sciences (SPSS) and Excel were employed to process and analyze the data.

## **3. RESULT AND DISCUSSION**

### **3.1 The result of Normalize Difference Vegetation Index (NDVI)**

#### **The analysis of normalize difference vegetation index for 1990**

The NDVI map of 1990 shows a value range of - 0.44 representing the lowest value, and 0.56 representing the highest value. The result indicates that the study area has a water body representing a negative value. Also represented are the low vegetation areas with values above 0.1. The value range from 0.1 to the highest value of 0.56 here represents the different vegetation covers in the study area. Although the vegetation covers here are not perfect, there is evidence of good vegetation cover in the area representing the few forest reserves in the study area. The NDVI map of 1990 is represented in Figure 2.

#### **The analysis of Normalize Difference Vegetation Index for 2020**

The NDVI map of 2020 shows a value range of - 0.25 representing the lowest value and 0.55 representing the highest value. The result indicates that the study area has water body

**Table 2** shows the range of NDVI and their Interpretation

NDVI Values	less than -0.1 to 0	0.00 to 0.5	0.5 to 1.0
Interpretation of the Value	Water Bodies	Non Vegetation	Vegetation

However, Normalized difference vegetation index (NDVI) was used to examine the vegetation of the study area for the years 1990 and 2020 to see the level of forest change in terms of reduction or increase in vegetation index.

which represents the negative value. Also represented are the low vegetation areas with values above 0.1. The value range from 0.1 to the highest value of 0.55 here represents the different vegetation covers in the study area. The NDVI map of 2020 is represented in Figure 3.



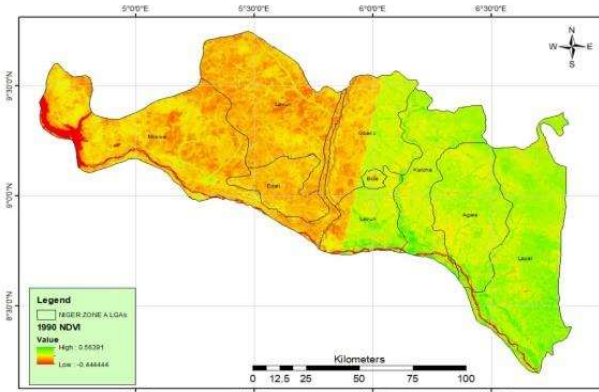


Figure 2: The NDVI map of 1990

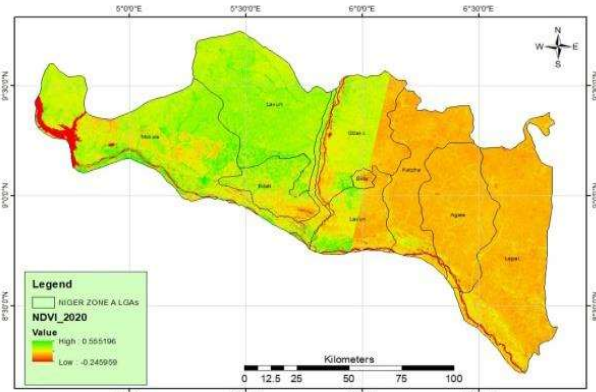


Figure 3: The NDVI map of 2020

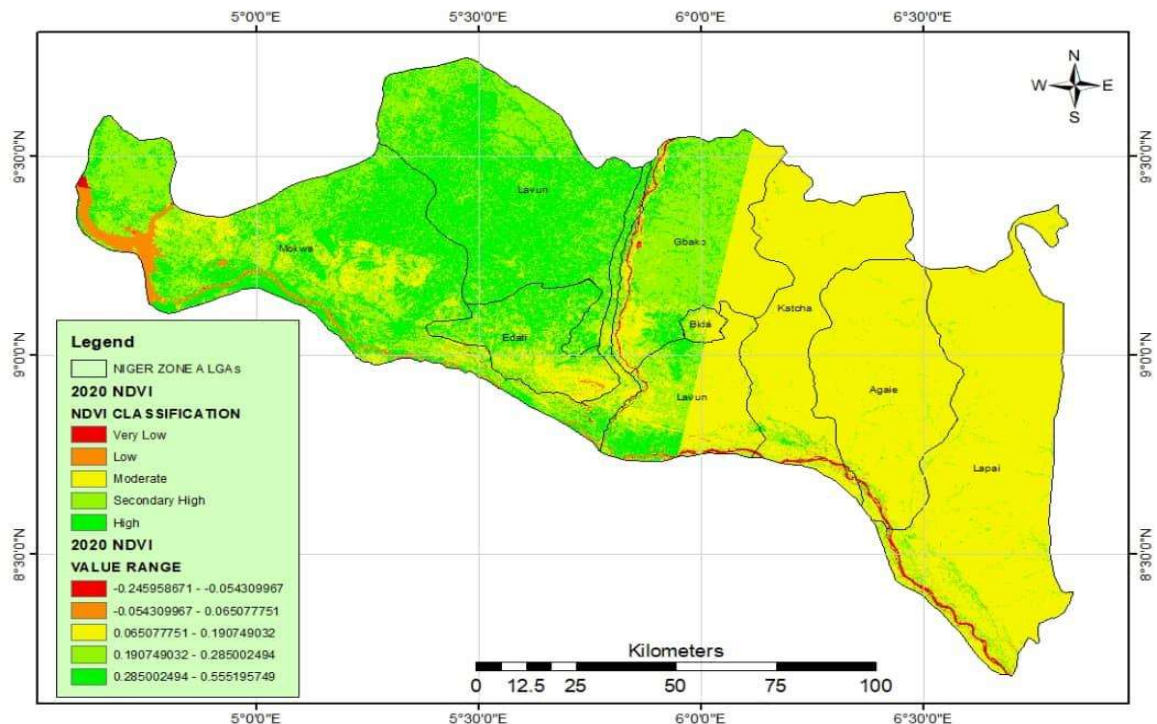


Figure 4: The classification of NDVI for 2020

### *The classification of NDVI for 2020*

Analysing the classification map in Figure 4, it shows that very low-value class (red colour) representing water bodies are clearly found at the western part of Mokwa LGA, the said water body is the Jebba dam that flows into river Niger. The next class is a low value class (orange colour) representing other small water bodies (rivers) scattered all over the study area on the map. Figure 4 the classification of NDVI for 2020.

Moderate vegetation class (yellow colour) is the next class, and it includes some small patches of vegetation alongside bare surfaces (land). The secondary high class (green colour) is scattered all over the map and represents pure vegetation mostly covered with grasses with the

presence of trees. The last class is high vegetation class (Dark green), representing good vegetation cover. Though, few of these areas are seen majorly around the forest-reserved areas in Gulu Vatsa, Labozhi, Agaie, Lapai, and Mokwa.

### *NDVI change detection*

NDVI change detection was done between 2020 and 1990, as shown in Table 3. The table shows negative changes for both low and high vegetation classes between 2020 and 1990. It indicates a decrease of -0.1984 in the water bodies, while a -0.0087 decrease in the vegetal cover was recorded. This implies that there are differences between the vegetated area and water bodies. The result indicates a reduction in both water bodies and vegetation cover. This

**Table 3:** NDVI Change Detection

NDVI Class	2020	1990	Change	Remark
Low	-0.2460	-0.4444	-0.1984	Water body decrease
High	0.5552	0.5639	-0.0087	Vegetation decrease

resembles the finding by FAO that from 2000 to 2005, the country (Nigeria) lost 55.7% of its primary forests. Table 4 present the various parameters analyzed on the causes of deforestation in the study area.

This result agrees with the study of Bishir, *et al.* (2018) on impact of desertification on livelihoods in Katsina state, Nigeria using a similar methodology, which find out that firewood is the most common energy source for

**Table 4:** Parameters Analyzed on the Causes of Deforestation

Parameters	Frequency (264)	Percentage (%)
<b>Source of Energy for Cooking</b>		
Fire wood	161	61
Charcoal	64	24
Kerosene	32	12
Gas	07	3
<b>Method of land preparation</b>		
Slash and burn	221	84
Ecological	12	4
Tillage	31	12
<b>Major Causes of Deforestation</b>		
Charcoal production	164	62
Farm Clearing	62	24
Lumbering/Logging	38	14
<b>Household size</b>		
1 – 3	07	3
4 – 5	16	6
6 – 7	38	14
8 – 9	32	12
Above 10	171	65
<b>Cultural practices</b>		
Irrigation	14	5
Fertilizer application	139	53
Pesticide application	111	42
<b>Level of education</b>		
Never been to formal school	82	31
Primary	102	39
Junior Secondary school	32	12
SSS/Vocational or technical	27	10
Tertiary	21	8
<b>Source: Field Survey, 2021</b>		

### 3.2 Sources of energy for cooking.

Figure 5 (a) shows the source of energy for cooking, and the result indicates that 161 household interviewees use firewood for cooking and other domestic purposes representing 61 percent. 64 household representing 24 percent uses charcoal as a source of energy for cooking. 32 household representing 12 percent uses kerosene for cooking, while seven (7) household representing 3 percent uses gas for cooking and other domestic purposes.

cooking and other domestic purposes in the study area. In the study area, as in most parts of Nigeria, firewood constitutes the major source of fuel. This is a result of the rampant, usual, and high cost of kerosene and cooking gas, leading to much pressure on the forests. It becomes difficult to prevent people from cutting down the forest for firewood when there are no cheap and available alternatives. The country substantial gas reserve is underdeveloped and mismanaged. Hence, it flares constantly, causing serious economic and

environmental problems.

### **3.3 Methods of farmland preparation.**

Figure 5 (b) presents the methods of farmland preparation by the respondents, the analysis shows that 221 households interviewed adopt slash and burn methods of farmland preparation representing 84 percent. 12 households adopt ecological farm clearing representing 4 percent, while 31 household practices tillage methods of farmland preparation representing 12 percent.

This result agrees with the report of Jeminiwa *et al.* (2020) also reported that farmers' slash-and-burn methods of farmland preparation contributed to deforestation and forest degradation in the study area. Fires are a major tool used in clearing the forest for shifting and permanent and developing pastures. However, in the dry season, the forest is very much prone to fire, and continuous burning of the forest leads to derived grassland as most of the trees, including their seedlings, are destroyed. The herders and hunters set fire to the forest to have fresh shoots for their animals and drive out wild animals, respectively. Taking into consideration the fact that it takes years for a forest to reach its climax, therefore, bush burning should be avoided.

### **3.4 Major causes of deforestation**

Figure 5 (c) presents the major causes of deforestation, 164 of the household interview representing 65 percent agree that charcoal production is the major causes of deforestation. 62 household attributes cause of deforestation to farm land clearing representing 24 percent. While 38 household representing 11 percent agrees that lumbering and logging are the causes of deforestation in the study area. This result agrees with the report of Jeminiwa, *et al.* (2020) who submitted that charcoal production by the farmers is one of the major trigger causes of deforestation and forest degradation in the study area.

### **Household size.**

Figure 5 (d) shows the Household size of the respondents, the analysis shows that seven (7) household representing 3 percent has between two (2) to three (3) family members. 16 household representing 6 percent has between four (4) to five (5) family members. 38 household representing 14 percent has between six (6) to seven (7) household. Just as 32 household representing 12 percent has between eight (8) to nine (9) households. While 171

households, representing 65 percent has ten (10) household and above.

This result implies that most of the household in the study area has more than ten people as their family member. This result agrees with the study of Bishir *et al* (2018) using similar method, which finds out that population growth as a result of an increased number of a family member by each household head trigger deforestation in the study area.

### **Cultural practices.**

The cultural practices of the household interview, as shown in Figure 5 (e), reveal that 14 households representing 5 percent, practice irrigation farming; 139 households representing 53 percent, practice fertilizer application. While 111 households representing 42 percent, practice pesticide application.

The result implies that fertilizer application is the most cultural practice of the farmer's interview, confirming the infertility of the soil as a result of the effect of deforestation. This agrees with the reports of Jeminiwa *et al.* (2020), affirming that fertilizer application is the most cultural practice by the farmers.

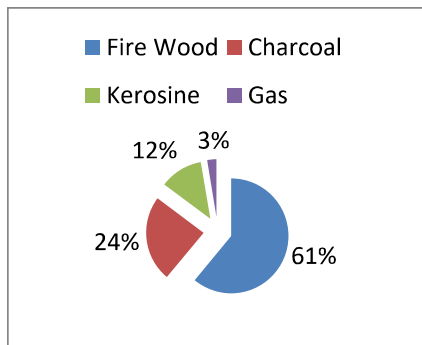
### **Education background of the respondents.**

The analysis in Figure 5 (f) shows the educational background of the head of household interview in the study area. The result indicates that 102 household representing 39 percent had only primary school education. 32 household has up to Junior Secondary School education, representing 12 percent. 27 household heads have Senior Secondary School or Vocational/Technical education representing 10 percent. While 21 household heads representing 8 percent obtain tertiary education. However, 82 household heads interview representing 31 percent never attended any formal education.

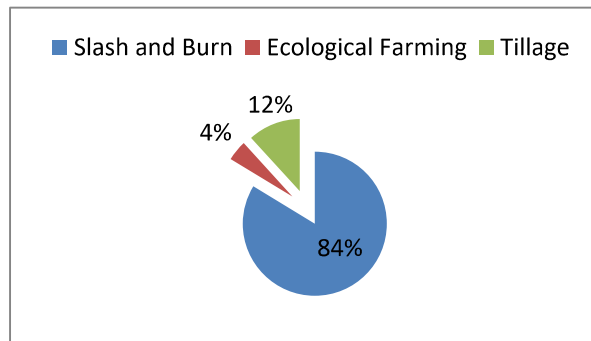
This result implies that most household head interview stops at primary school education. Wada *et al.* (2019) pointed out that farmers' education level will directly affect their ability to change and accept new ideas.

## **4. CONCLUSION AND RECOMMENDATION**

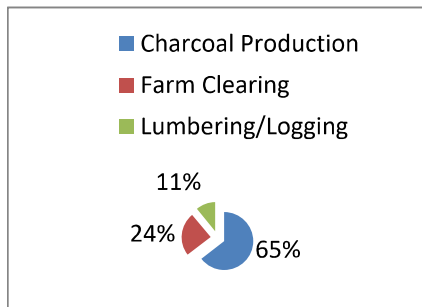
In conclusion, the result of NDVI analysis indicates a decrease of -0.1984 in the water bodies, while a -0.0087 decrease in vegetal cover was recorded between 1990 and 2020 in the study area. The reports of the FGD and



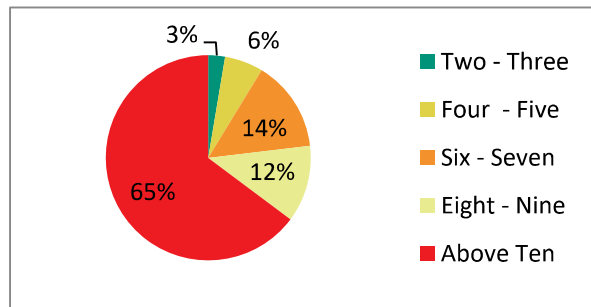
**Figure 5 (a):** Sources of energy for cooking



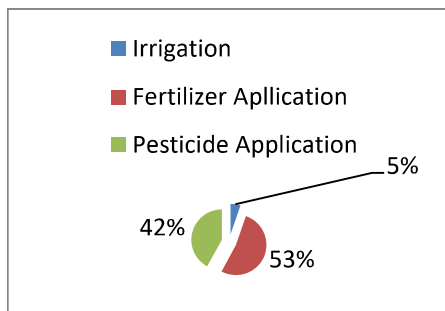
**Figure 5 (b):** Methods of farmland preparation



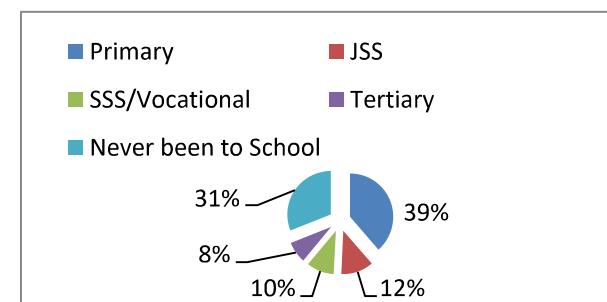
**Figure 5 (c):** Major causes of deforestation



**Figure 5 (d):** Household size of the respondents



**Figure 5 (e):** Cultural practices of the household



**Figure 5 (f):** Education background of the respondents.

questionnaire respondents reveal that most of the stakeholder agrees that a great number of hectares of forested land has been deforested. Charcoal production was the most attested man-made cause of deforestation in the study area.

The study recommends that:

- Due to vegetation decreased and water bodies decreased over the study period. The government should implement policies and programs that are aimed at preserving and sustaining vegetal cover and their bi-products in the study areas.
- Training of personnel, organizing sensitization programs for farmers, and supporting farmers to acquire modern and adaptable varieties of crops should be strengthened. This will help improve crop production and productivity immensely in the region and the country at large.

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