**CHAPTER ONE**

**INTRODUCTION**

**1.1 Background of the Study**

Deforestation is defined as the large-scale removal of forest cover, has emerged as a critical environmental issue globally, with pronounced effects in developing nations such as Nigeria. In Adamawa State, particularly in the Mubi region, deforestation has significantly transformed the natural landscape, leading to soil degradation, reduced rainfall, and loss of biodiversity. These environmental changes pose serious challenges to farmers who depend on arable crop production for their livelihoods.

Several factors contribute to deforestation in Mubi North, including agricultural expansion, logging, urbanization, and the demand for fuelwood. Musa *et al.* (2023) highlights that between 1978 and 1995, human activities such as extensive agriculture, animal grazing, intensive agriculture, and irrigation farming collectively reduced 34.10% of woodland areas in the Mubi region. The indiscriminate cutting down of trees has led to environmental and economic challenges, including soil erosion, which severely affects farming activities (HumAngle, 2021).

Arable crop production in Mubi North involves the cultivation of staple crops such as maize, sorghum, millet, and beans, which rely heavily on fertile soil, adequate rainfall, and favorable climatic conditions. However, the removal of forest cover often results in decreased soil fertility, increased soil erosion, and unpredictable weather patterns, thereby threatening agricultural productivity. Farmers have reported that deforestation leads to erosion, severely affecting their farming activities (HumAngle, 2021).

The relationship between deforestation and agricultural productivity is complex and multifaceted. On one hand, deforestation is often carried out to expand agricultural land to meet the food demands of the growing population. However, in the long term, it results in land degradation, loss of soil nutrients, and desertification, which negatively impact crop yields (Adeoye et al., 2022). The exposure of land to direct sunlight due to tree removal increases soil temperature, which can reduce the moisture content required for optimal crop growth. In addition, the destruction of forest ecosystems reduces the presence of pollinators, leading to a decline in crop productivity and biodiversity loss (Ibrahim & Musa, 2020).

The loss of forest cover also affects water availability, a critical factor in agricultural sustainability. Trees play a vital role in regulating the hydrological cycle by promoting water infiltration and preventing excessive runoff. With deforestation, rainfall no longer effectively replenishes groundwater reserves, leading to reduced water availability for irrigation and household use (Umar & Abubakar, 2021). This situation is particularly concerning for farmers in Mubi North, where water scarcity is already a challenge due to changing climate patterns and increased land degradation. Consequently, the frequency of droughts has increased, further worsening food insecurity in the region.

Despite various policies and initiatives aimed at curbing deforestation in Nigeria, the practice continues due to weak enforcement and economic pressures. Many rural farmers rely on tree felling for fuelwood and income generation, making deforestation a persistent issue. Addressing this challenge requires a multifaceted approach, including sustainable land management practices, afforestation programs, and increased awareness of the long-term consequences of deforestation. This study seeks to assess the impact of deforestation on arable crop production among farmers in Mubi North, Adamawa State, with the aim of providing recommendations for sustainable land management practices.

**1.2 Statement of the Problem**

Deforestation has become a pressing issue in Mubi North, Adamawa State, where forested lands are rapidly being cleared for agricultural expansion, fuelwood collection, and infrastructural development. This widespread tree removal has led to observable environmental changes such as declining soil fertility, reduced crop yields, and increased vulnerability to climate change. As trees play a crucial role in maintaining soil structure, regulating water cycles, and providing shade, their removal exposes the land to excessive sunlight, reduces soil moisture retention, and accelerates erosion (Ibrahim & Musa, 2020). These changes negatively affect arable crop farmers who rely on the land for their livelihood, leading to decreased farm productivity and economic instability.

Farmers in the region have reported difficulties in maintaining soil productivity due to continuous land degradation, loss of organic matter, and increased incidences of pests and diseases that were previously controlled by forest ecosystems. The removal of tree cover leads to a reduction in beneficial microorganisms and pollinators essential for crop production, further exacerbating the challenges faced by farmers. In addition, deforestation disrupts local rainfall patterns, contributing to erratic weather conditions that make farming increasingly unpredictable. These challenges have resulted in lower yields of staple crops such as maize, sorghum, millet, and beans, which are crucial for food security in the region.

Despite these alarming trends, there is limited empirical research assessing the direct impact of deforestation on arable crop production in Mubi North. While several studies have explored the broader effects of deforestation on the environment, few have specifically examined how it affects soil quality, water availability, and agricultural productivity in this region. Without a comprehensive understanding of these dynamics, it is difficult to develop effective policies and interventions to mitigate the adverse effects of deforestation on farmers. This study seeks to fill this research gap by assessing the impact of deforestation on arable crop production among farmers in Mubi North, Adamawa State, with the aim of providing recommendations for sustainable land management practices.

**1.3 Objectives of the Study**

The broad objective of this study is to assess the impact of deforestation on arable crop production among farmers in Mubi North, Adamawa State. Specific objectives are:

1. To Describe the socio-economic characteristics of deforestation on farming households in Mubi North.
2. To examine the causes and extent of deforestation in Mubi North and how it affects soil fertility and crop yields.
3. To assess farmers’ perceptions of deforestation and its impact on their agricultural practices and productivity.
4. To identify and recommend sustainable strategies that farmers and policymakers can adopt to mitigate the adverse effects of deforestation on arable crop production.

**1.4 Research Questions**

To achieve the objectives of this study, the following research questions will be addressed:

1. What are the socio-economic characteristics of deforestation on farming households in Mubi North?
2. What are the major causes of deforestation in Mubi North?
3. What are the perceptions of farmers regarding the impact of deforestation on their agricultural activities?
4. What sustainable strategies can be adopted by farmers and policymakers to reduce the negative effects of deforestation on arable crop production?

**1.5 Significance of the Study**

This study is significant in several ways. Firstly, it will provide valuable insights into the relationship between deforestation and agricultural productivity, helping farmers understand the long-term consequences of forest depletion. By identifying the specific ways in which deforestation affects soil fertility, water availability, and crop yields, farmers will be better equipped to adopt sustainable land management practices such as agroforestry, crop rotation, and soil conservation techniques. The findings of this study will empower local farmers with knowledge on how to mitigate the negative effects of deforestation on their farms, thereby improving agricultural resilience and productivity.

Secondly, this research will be beneficial to policymakers, environmental agencies, and government institutions involved in land use planning and agricultural development. By providing empirical data on how deforestation is impacting arable crop production in Mubi North, the study can serve as a guide for the formulation of policies aimed at promoting afforestation, reforestation, and sustainable farming practices. It can also inform the development of environmental conservation programs that balance the need for agricultural expansion with the preservation of forest ecosystems. Additionally, the study’s findings can contribute to climate adaptation strategies by identifying measures to enhance soil conservation and water management in deforested areas.

Lastly, this study will contribute to the existing body of knowledge on deforestation and its effects on agriculture, serving as a reference for future research in similar areas. Given the increasing threats posed by deforestation in Nigeria and other parts of Africa, this research will provide a case study that can be used for comparative analysis in other regions experiencing similar environmental challenges. It will also help bridge the knowledge gap regarding the socio-economic implications of deforestation on smallholder farmers, offering recommendations that can be adapted to various agricultural and environmental contexts. By shedding light on the intricate link between deforestation and food security, this study aims to support efforts geared toward sustainable environmental management and agricultural productivity in Nigeria.

**1.6 Scope of the Study**

The study focuses on the assessment of deforestation and its impact on arable crop production among farmers in Mubi North, Adamawa State. It will cover the major causes of deforestation, its effects on soil fertility and crop yields, and the perceptions of local farmers regarding the resulting environmental degradation, declining soil quality, and reduced agricultural productivity. The study will be limited to selected farming communities within the study area and will rely on data collected through surveys, interviews, and secondary sources.

**1.7 Definition of Key Terms**

To enhance clarity, the following key terms are defined:

**Arable**: Land capable of being plowed and used to grow crops. In this study, it refers to land that is suitable for the cultivation of food crops such as maize, millet, sorghum, and beans.

**Arable Crop Production:** The cultivation of crops such as maize, millet, sorghum, and beans that require plowing and soil preparation.

**Deforestation:** The process of clearing or removing forests for agricultural, industrial, or urban development purposes.

**Erosion:** The gradual removal of the topsoil due to water, wind, or human activities, leading to reduced soil productivity.

**Soil Fertility:** The ability of soil to provide essential nutrients to crops for optimal growth and yield.

## ****CHAPTER TWO****

## ****LITERATURE REVIEW****

### ****2.1 Conceptual Framework****

#### ****2.1.1 Concept of Deforestation****

Deforestation refers to the permanent removal of forests or stands of trees from land that is then converted to non-forest use such as agriculture, grazing, or urban development. According to the Food and Agriculture Organization (FAO, 2020), deforestation is one of the leading causes of environmental degradation, especially in developing countries. In the context of Mubi North, Adamawa State, deforestation has been driven largely by the expansion of agricultural land, fuelwood collection, and infrastructural development.

In rural areas like Mubi North, forests are not only sources of timber and fuelwood but also serve ecological purposes such as protecting the soil from erosion, regulating temperature and moisture, and preserving biodiversity. However, the growing population and demand for farmland have led to the excessive felling of trees without adequate replanting efforts. Over time, this has degraded the land and altered the natural landscape, making the environment less supportive for sustainable farming. Farmers who rely heavily on shifting cultivation are often compelled to clear new patches of forest every few years, further compounding the problem.

Moreover, deforestation in the area contributes to the disruption of local rainfall patterns, which are already irregular due to climate change. Trees play a vital role in water cycling through transpiration, which contributes to cloud formation and rainfall. When forests are cleared, this cycle is interrupted, leading to delayed rains or reduced rainfall intensity. This directly impacts arable crop production, as many crops cultivated in Mubi North—such as maize, millet, sorghum, and groundnut—are rain-fed. As a result, yields drop, and the livelihoods of small-scale farmers become increasingly threatened. In the long run, if unchecked, deforestation could render large portions of Mubi North unsuitable for any form of agriculture.

#### ****2.1.2 Concept of Arable Crop Production****

Arable crop production involves the cultivation of crops such as maize, millet, groundnut, beans, sorghum, and vegetables on land that is capable of being plowed and used to grow crops. These crops are vital for food security, income generation, and economic development in rural areas like Mubi North. Arable farming requires suitable soil, adequate rainfall, and temperature, all of which are significantly influenced by environmental conditions and forest cover. In the context of Sub-Saharan Africa, arable crop production is largely dependent on rain-fed agriculture and natural soil fertility, which makes it vulnerable to changes in environmental conditions (FAO, 2021). In Nigeria, especially in the North-East region, arable farming forms the backbone of rural livelihoods, yet it faces challenges due to erratic rainfall, land degradation, and reduced soil productivity. According to Olayemi and Olatunji (2022), environmental factors such as deforestation, desertification, and climate change have increasingly impacted crop yields and the overall sustainability of farming systems.

In Mubi North, farmers depend heavily on traditional agricultural methods with limited access to irrigation and mechanized tools. The removal of forest cover not only leads to soil erosion and reduced organic matter but also contributes to water stress and poor microclimatic conditions for plant growth. Forested areas help maintain ecological balance, and their depletion means increased exposure of farmland to wind and sun, leading to faster nutrient depletion. As noted by Musa et al. (2023), there is a direct link between forest loss and declining productivity of key arable crops in Adamawa State, stressing the urgent need for integrated land management practices.

The removal of forest cover alters the microclimate, reduces soil fertility, and increases vulnerability to erosion and pests. Forests contribute to nutrient cycling, water regulation, and protection of biodiversity, all of which support crop growth. When forests are cleared, these ecosystem services are lost or diminished, directly affecting the productivity of arable crops. In Mubi North, this link is especially evident due to the region's semi-arid nature and dependence on traditional farming methods.

### ****2.2 Effects of Deforestation on Arable Crop Production****

### ****2.2.1 Soil Degradation and Nutrient Loss****

Trees play a vital role in stabilizing the soil, reducing erosion, and enriching the soil with organic matter. Deforestation leads to soil compaction, reduced infiltration, and a significant loss of soil nutrients essential for crop growth. In Mubi North, topsoil erosion has become more prevalent due to increased exposure of the land surface. The removal of vegetative cover eliminates the protective barrier against heavy rainfall, allowing water to wash away the nutrient-rich topsoil. This phenomenon, known as sheet erosion, is particularly common in hilly or sloped areas of Mubi North where intensive farming is practiced without adequate soil conservation measures. As soil fertility declines, farmers are forced to use more fertilizers to maintain yield, which may not be economically sustainable for many subsistence farmers (Ahmed & Tanko, 2021).

Furthermore, the absence of tree roots leads to a reduction in the soil’s structural integrity. Without organic matter replenishment from decomposed leaves and roots, the soil becomes compacted and less porous, inhibiting water absorption and root development. Over time, such degraded soils lose their ability to support high-yielding crop varieties, forcing farmers to abandon fields and encroach on remaining forest land, thereby perpetuating the cycle of degradation (Yohanna et al., 2022).

### ****2.2.2 Climate Alteration and Unpredictable Rainfall****

Forests help in regulating local climates. Their removal can lead to increased temperatures, lower humidity, and irregular rainfall patterns. These climatic changes negatively impact planting and harvesting seasons, resulting in low crop yields or crop failure. Many farmers in Mubi North have reported unpredictable rain patterns over recent years.

Trees contribute significantly to the hydrological cycle through the process of transpiration, which releases water vapor into the atmosphere and supports cloud formation and rainfall. When forests are cleared, especially on a large scale, this cycle is disrupted, leading to delayed onset of rains and shorter rainy seasons. This poses a challenge to arable crop farmers in Mubi North, whose planting schedules are closely tied to expected rainfall patterns (Nnadi & Omotayo, 2020).

Moreover, deforestation leads to what is often termed a “local greenhouse effect,” where the land heats up more rapidly due to the lack of canopy cover. This increases surface temperatures, which in turn causes moisture loss from the soil and affects seed germination. Crops like maize and sorghum are sensitive to heat stress, especially during the flowering stage. Rising temperatures combined with erratic rainfall reduce productivity and elevate the risk of total crop failure, placing food security at risk for households in Mubi North (Chukwuemeka et al., 2023).

### ****2.2.3 Loss of Biodiversity and Pollinators****

Forests host many species, including beneficial insects that aid in pollination. Deforestation causes the loss of these essential organisms, which can affect the quality and quantity of crop production. This is particularly significant for crops like beans and vegetables that depend on pollination.

Pollinators such as bees, butterflies, and beetles rely on forest habitats for nesting, feeding, and breeding. The destruction of these habitats leads to a decline in pollinator populations, reducing pollination services to crops. Without adequate pollination, fruiting is incomplete or fails entirely, particularly in legumes and fruit vegetables. A study by Okeke and Abubakar (2021) shows that farms near forest edges in Adamawa State recorded higher yields than those located far from forested areas, due to the availability of pollinators.

In addition, deforestation disrupts the balance of predator-prey relationships and invites the invasion of pests and diseases. Some forest species serve as natural pest regulators by feeding on insects harmful to crops. With the removal of these species, pests such as aphids, caterpillars, and stem borers can multiply unchecked, causing significant crop damage. Biodiversity loss also limits the availability of wild plant species that could serve as genetic resources for breeding pest- and drought-resistant crop varieties (FAO, 2022).

### ****2.3 Theoretical Framework****

Understanding the impact of deforestation on arable crop production requires grounding in appropriate theoretical perspectives that explain the relationship between environmental conditions and human agricultural practices. Two relevant frameworks for this study are the **Environmental Determinism Theory** and the **Sustainable Livelihood Framework (SLF).**

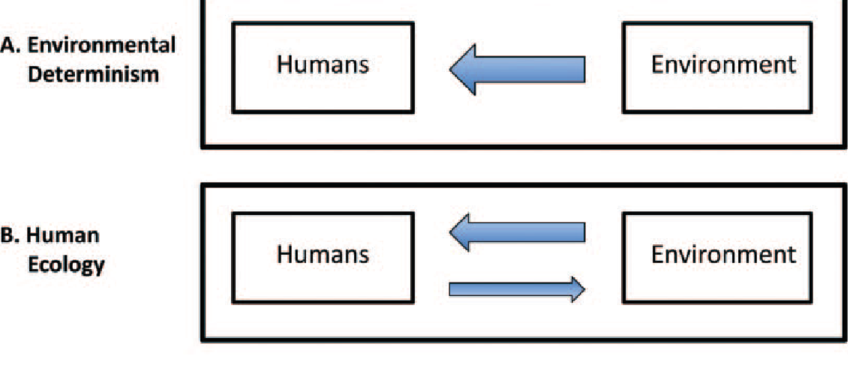
### ****2.3.1 Environmental Determinism Theory****

The Environmental Determinism Theory posits that human activities, especially those related to agriculture and economic livelihood, are fundamentally influenced and constrained by the natural environment. Rooted in geographical thought, this theory argues that factors such as climate, soil fertility, vegetation, rainfall patterns, and terrain are not merely background variables but active determinants of where and how people engage in productive land use (Peet *et al.,* 2020).

Applied to the current study, Environmental Determinism offers a foundational lens for understanding how deforestation directly impacts arable crop production in Mubi North, Adamawa State. The removal of forest cover in the area—whether for fuelwood, settlement, or agricultural expansion—has led to environmental degradation, including soil erosion, declining organic matter, altered microclimates, and disrupted rainfall patterns. These environmental changes, as the theory predicts, have reduced the natural capacity of the land to support consistent crop cultivation, thereby affecting the livelihoods of local farmers.

According to Ajayi and Yusuf (2022), arable farming in semi-arid regions like Mubi North is highly sensitive to even slight alterations in ecological conditions. Forests play a critical role in maintaining soil fertility, regulating temperature, and retaining ground moisture—factors essential for crops such as maize, millet, and beans. When trees are cleared, the protective functions of forests are lost, and the ecosystem becomes less capable of sustaining productive agriculture.

This theory directly supports the premise of this research, which seeks to assess the impact of deforestation on agricultural productivity. It emphasizes that the decline in crop yields is not simply a matter of farming practices or inputs, but rather a consequence of deteriorating environmental conditions caused by forest depletion. Therefore, Environmental Determinism helps to explain the causal relationship between deforestation and the challenges faced by arable crop farmers in Mubi North.



**Figure 2.1: Environmental Determinism Theory**

### ****2.3.2 Sustainable Livelihood Framework (SLF)****

The Sustainable Livelihood Framework (SLF), developed by the Department for International Development (DFID), offers a holistic approach to understanding how people use a combination of assets natural, human, social, financial, and physical—to sustain their lives. Within this framework, **natural capital,** which includes forests, fertile land, and water resources, plays a central role in shaping the livelihood strategies of rural households. The SLF argues that when natural capital is degraded—such as through deforestation—the ability of communities to generate income, grow food, and withstand economic or climatic shocks is severely undermined (DFID, 1999; Scoones, 2015).

Applied to the agricultural setting of Mubi North, SLF helps to explain how deforestation negatively impacts farming households by reducing their access to fertile land, forest-based resources (e.g., mulch, compost, fuelwood), and climate regulation. Many farmers in the region rely on forest ecosystems for complementary resources and as a buffer against environmental risks. As these forest assets disappear, rural households face increased production costs, lower crop outputs, and greater vulnerability to food insecurity and poverty (Usman & Adekunle, 2021).

Furthermore, SLF emphasizes the importance of sustainability, noting that livelihood strategies must not only provide short-term gains but also protect the resource base for future generations. Deforestation, especially when driven by unsustainable farming or logging practices, violates this principle by depleting the very resources that future agricultural productivity depends on. This framework, therefore, supports the call for integrated land-use planning, reforestation, and conservation farming as essential steps toward achieving both environmental sustainability and livelihood security for farmers in Mubi North (Ezekiel & Ojo, 2023).

### ****2.4 Empirical Review****

### ****2.4.1 Global and National Perspectives****

Globally, deforestation has been identified as a significant contributor to the degradation of arable land and declining agricultural productivity. According to Chakravarty et al. (2012), the removal of forest cover leads to reduced soil moisture retention, increased surface runoff, and a decrease in organic matter, all of which are essential for sustainable crop growth. These factors result in an overall decline in soil fertility and heightened vulnerability of farmland to erosion and drought. Consequently, in many parts of the world—especially in tropical and sub-tropical regions where forests are heavily exploited for agricultural expansion there has been a direct correlation between deforestation and declining crop yields.

In Asia and South America, where deforestation is driven largely by commercial agriculture and logging, studies have shown similar patterns of declining productivity. For instance, in the Amazon Basin, large-scale deforestation has resulted in altered rainfall patterns and prolonged dry seasons, adversely affecting crop viability and water availability (Laurance et al., 2014). Similarly, in Southeast Asia, the destruction of forest ecosystems has led to land degradation, loss of biodiversity, and reduced ecosystem services, which are vital to maintaining agricultural balance (FAO, 2021). These global experiences mirror the environmental crises unfolding in sub-Saharan Africa, including Nigeria.

At the national level, Nigeria faces one of the highest deforestation rates in the world, losing approximately 3.5% of its forest cover annually due to fuelwood harvesting, agricultural expansion, and infrastructure development (Global Forest Watch, 2022). This forest loss has been particularly severe in the Northern regions, where desertification and drought are already prevalent. As forested areas diminish, the land becomes increasingly susceptible to erosion, desert encroachment, and loss of soil nutrients—threatening food security and rural livelihoods. Olayemi and Olatunji (2022) emphasized that many farming communities in Northern Nigeria are experiencing poor harvests due to reduced rainfall and declining soil quality resulting from unchecked deforestation.

In the North-East geopolitical zone of Nigeria, where Mubi North is located, the combination of environmental degradation and socio-economic pressures has intensified the impact of deforestation on agriculture. A study by Yusuf and Danladi (2020) found that deforestation has not only led to reduced arable land but has also increased the frequency of dust storms, which damage crops and reduce soil fertility. These findings highlight the urgent need for national reforestation policies and sustainable land management practices to prevent further loss of productive agricultural land and to secure the future of food production in Nigeria.

### ****2.4.2 Regional and Local Studies****

Within the Northern region of Nigeria, regional research has consistently revealed a strong link between forest loss and declining crop productivity. Njobvu et al. (2018) conducted a study across several states in Northern Nigeria and discovered that areas with high deforestation rates experienced a corresponding decrease in maize and millet yields. The research attributed this to loss of vegetative cover, which normally protects the soil from erosion and preserves soil moisture. The absence of trees exposed the soil to harsh weather, making it less conducive for crop cultivation and increasing the need for costly inputs such as fertilizers and irrigation.

In Adamawa State, a study by Okonkwo and Bala (2020) revealed that deforestation caused a reduction of 20–30% in arable crop yields, particularly in regions where forest clearing was intense. The authors noted that land previously known for high productivity had become dry and infertile due to topsoil loss and poor organic content. Additionally, rising temperatures and increasing variability in rainfall were observed in the deforested areas, which severely affected crops like groundnut, sorghum, and beans. This decline in productivity not only affects food availability but also reduces the income and livelihood of farmers in the affected communities.

A local study by Hassan (2022) focused specifically on Mubi North and shed light on the direct experiences of farmers in the area. The study found that many farmers engaged in tree felling to expand farmlands without considering the long-term consequences. Over time, this led to increased surface runoff, poor water retention in the soil, and reduced crop germination rates. Farmers interviewed in the study reported shorter growing seasons, more frequent crop failures, and a noticeable drop in harvest quantity and quality. According to the study, these changes are directly linked to the absence of tree cover, which previously helped regulate microclimates and water availability.

Further insights from community-based surveys and interviews conducted by Adebayo and Luka (2023) in the Mubi region revealed that local farmers recognize the negative effects of deforestation but often lack the resources and knowledge to implement sustainable farming practices. Most respondents acknowledged the worsening impact of changing rainfall patterns, increased soil dryness, and the disappearance of beneficial forest species such as pollinators. The study recommended government intervention through reforestation programs, farmer education, and the introduction of agroforestry systems to restore balance to the environment while supporting food production in Mubi North.

**CHAPTER THREE**

**METHODOLOGY**

**3.1 Introduction**

This chapter outlines the methodology adopted for the study. It describes the research design, study area, population of the study, sample size and sampling techniques, sources of data, data collection instruments, methods of data analysis, and validity and reliability of the instruments used.

**3.2 Research Design**

This study adopts a descriptive survey research design. The choice of this design is based on the need to gather data from a target population in order to describe, analyze, and interpret the impact of deforestation on arable crop production in Mubi North. The survey approach allows for the collection of both qualitative and quantitative data to gain deeper insights into farmers’ perceptions, experiences, and responses to deforestation-related challenges.

**3.3 Population of the Study**

The population of the study will comprises all arable crop farmers in Mubi North. This includes smallholder farmers from selected farming communities who directly involved in crop cultivation and are likely to be affected by deforestation.

**3.4 Sample Size and Sampling Technique**

A sample size of 150 respondents will be selected from the target population using a multistage sampling technique. The sampling involves the following steps:

* **Stage One**: Purposive selection of five farming communities known to be affected by deforestation.
* **Stage Two**: Stratified sampling based on the size of each community.
* **Stage Three**: Random sampling of individual farmers within each community to ensure fair representation.

The Yamane (1967) formula was adopted to determine the sample size from the total estimated farmer population:

n=

Where:

*n* = sample size

*N* = population size

*e* = level of precision (0.05)

**3.5 Sources of Data**

Two main sources of data will be utilized:

* **Primary Data**: Collected directly from respondents using structured questionnaires and interviews.
* **Secondary Data**: Sourced from journals, government publications, environmental reports, past research studies, and records from agricultural and environmental agencies.

**3.6 Instrument for Data Collection**

The primary instrument for data collection is a structured questionnaire containing both closed-ended and open-ended questions. In addition, oral interviews will be conducted with selected community leaders, agricultural extension officers, and environmental officials to complement the data collected through questionnaires.

**3.7 Validity and Reliability of the Instrument**

To ensure validity, the questionnaire will be reviewed by experts in agriculture, environmental science, and research methodology. Necessary modifications were made based on their feedback.

**3.8 Method of Data Analysis**

The data collected for this study will be analyzed using the statistics tool of “Mean”. This statistical tool is appropriate because of the descriptive nature of the research. Using five (5) point’s liken-type scale to analyze questions to which values will be attached as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Strongly Agree** | **Agree** | **Undecided** | **Disagree** | **Strongly Disagree** |
| SA | A | U | D | SD |

The mean will be calculated using the formula below: - X=

Where X – Mean

E- Summation

X- Nominal/assigned values

F- Frequency of observation

N- Number of respondents

**CHAPTER FOUR**

**DATA PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS**

**4.1 Introduction**

This chapter presents the results and analysis of data collected from the 150 respondents (farmers) in Mubi North Local Government Area of Adamawa State. The findings are organized according to the research objectives and questions. The results are displayed using frequency tables, percentages, and mean scores based on a five-point Likert scale. Furthermore, the chapter discusses the implications of the findings in relation to existing literature and field observations.

**4.2 Data Presentation**

**Table 4.1: Socio-Economic Characteristics of Respondents**

| **Variables** | **Frequency (f)** | **Percentage (%)** |
| --- | --- | --- |
| **Gender** |  |  |
| Male | 103 | 68.7 |
| Female | 47 | 31.3 |
| **Age** |  |  |
| Below 25 | 12 | 8.0 |
| 25–34 | 38 | 25.3 |
| 35–44 | 41 | 27.3 |
| 45–54 | 36 | 24.0 |
| 55 and above | 23 | 15.4 |
| **Educational Level** |  |  |
| No formal education | 34 | 22.7 |
| Primary education | 46 | 30.7 |
| Secondary education | 49 | 32.7 |
| Tertiary education | 21 | 14.0 |
| **Years of Experience** |  |  |
| 1–5 years | 18 | 12.0 |
| 6–10 years | 44 | 29.3 |
| 11–15 years | 53 | 35.3 |
| Above 15 years | 35 | 23.4 |

**Source**: Field survey, 2025

**4.2.1 Socio-Economic Characteristics of Respondents**

The results in Table 4.1 reveal that the majority of respondents (68.7%) were male, while females accounted for 31.3%. This suggests that arable crop production in Mubi North is male-dominated, possibly due to the physically demanding nature of farming activities and cultural factors that influence gender roles in agricultural labor. However, the significant proportion of female farmers also indicates their active involvement in crop production despite potential challenges.

In terms of age distribution, the largest proportion of respondents (27.3%) were within the age range of 35–44 years, followed by those aged 25–34 years (25.3%) and 45–54 years (24.0%). This indicates that a large percentage of farmers are in their economically active years, which is beneficial for implementing and sustaining agricultural practices. However, the relatively small percentage of farmers below 25 years (8.0%) may reflect a declining interest in farming among youths, which could pose a threat to the future of agriculture in the area.

Regarding education, most respondents had secondary education (32.7%), followed by primary education (30.7%), no formal education (22.7%), and tertiary education (14.0%). The relatively high proportion of farmers with at least primary education suggests that many respondents possess basic literacy and numeracy skills, which can aid in understanding agricultural extension messages, adopting innovations, and managing farm records. Nonetheless, the sizeable number of farmers without formal education may limit the rate of adoption of modern farming techniques.

With respect to farming experience, the largest proportion of respondents (35.3%) had 11–15 years of farming experience, followed by those with 6–10 years (29.3%) and above 15 years (23.4%). This indicates that the majority of the farmers have considerable experience in crop production, which can contribute positively to productivity. However, the 12.0% of respondents with only 1–5 years of experience may require more technical support and training to improve their productivity.

The socio-economic characteristics of respondents have important implications for this study on the impact of deforestation on arable crop production. The predominance of male farmers suggests that deforestation mitigation strategies should target men as primary decision-makers, while also incorporating measures to empower and support women farmers. The active working-age population and the wealth of farming experience present opportunities for the successful implementation of sustainable land management practices, as farmers are likely to have the physical capacity and knowledge base to adopt new approaches.

The educational profile of respondents indicates that awareness campaigns and training programs can be designed using both formal and informal communication methods to cater to farmers with varying literacy levels. Farmers with higher educational attainment are more likely to embrace improved agricultural technologies that can reduce the negative effects of deforestation, while those with no formal education may need more practical demonstrations and visual aids.

Lastly, the age and experience distribution suggest that most farmers have an in-depth understanding of local farming conditions and can provide valuable insights into the perceived impacts of deforestation on soil fertility and crop yields. Engaging such experienced farmers as local champions in reforestation or soil conservation initiatives could enhance community participation and sustainability of the proposed solutions.

**Table 4.2: Responses to Causes and Extent of Deforestation in Mubi North**

| **Statements** | **Mean (x̄)** | **Decision** |
| --- | --- | --- |
| Deforestation is a major problem in my farming community. | 4.32 | Strongly Agree |
| Tree cutting for firewood and charcoal is the major cause of deforestation. | 4.18 | Agree |
| Agricultural expansion leads to deforestation in my area. | 4.04 | Agree |
| Bush burning contributes significantly to deforestation in the community. | 4.10 | Agree |
| Deforestation has worsened in the last 10 years. | 4.27 | Strongly Agree |

**Source**: Field survey, 2025

**4.2.2 Responses to Causes and Extent of Deforestation in Mubi North**

The results in Table 4.2 show that respondents strongly agree (x̄ = 4.32) that deforestation is a major problem in their farming communities. This high mean value reflects a strong awareness among farmers of the negative environmental changes occurring in the area. It also confirms that deforestation is a visible and pressing issue that directly affects their livelihoods. Tree cutting for firewood and charcoal production was identified as a major cause of deforestation (x̄ = 4.18, Agree). This aligns with the heavy reliance on wood-based energy sources in rural areas where access to alternative energy such as gas or electricity is limited. The result suggests that unsustainable harvesting of trees for domestic and commercial purposes is one of the most significant drivers of forest loss in Mubi North.

Agricultural expansion was also acknowledged as a cause of deforestation (x̄ = 4.04, Agree). This indicates that increasing demand for farmland driven by population growth and the need for higher crop yields has led to the clearing of forested areas. Bush burning was similarly rated as a significant contributor to deforestation (x̄ = 4.10, Agree). This practice, often used to clear land quickly for planting, results in the loss of vegetation cover, soil degradation, and increased vulnerability to erosion. Furthermore, respondents strongly agreed (x̄ = 4.27) that deforestation has worsened in the last 10 years. This suggests a growing trend of environmental degradation, which may be linked to increased human pressure on forest resources, weak enforcement of forestry regulations, and limited awareness of sustainable land management practices.

The findings from Table 4.2 have direct implications for this study’s objective of examining the causes and extent of deforestation in Mubi North. The fact that farmers strongly acknowledge deforestation as a serious problem and identify its major causes provides a clear starting point for designing intervention strategies. The results indicate that policy efforts should focus on promoting alternative energy sources to reduce tree cutting, regulating logging activities, and introducing more sustainable agricultural practices to limit forest clearance.

The recognition of agricultural expansion and bush burning as key drivers of deforestation highlights the need for capacity-building programs on agroforestry, conservation agriculture, and controlled land-use planning. Additionally, the reported worsening of deforestation over the past decade suggests that urgent action is needed to reverse this trend before its impacts on soil fertility, crop productivity, and ecosystem services become irreversible.

By incorporating these farmer-identified causes into awareness campaigns, extension services, and policy frameworks, the study can contribute to practical, community-driven solutions for mitigating deforestation while sustaining arable crop production.

**Table 4.3: Response to Effects of Deforestation on Arable Crop Production**

| **Statements** | **Mean (x̄)** | **Decision** |
| --- | --- | --- |
| Deforestation has reduced soil fertility in my farmland. | 4.26 | Strongly Agree |
| Crop yields have declined due to deforestation. | 4.12 | Agree |
| Increased soil erosion is observed due to tree loss. | 4.08 | Agree |
| Pest attacks have increased due to loss of tree canopy and cover. | 3.96 | Agree |
| Deforestation has altered the local microclimate, affecting crop growth. | 4.10 | Agree |

**Source**: Field survey, 2025

**4.2.3 Response to Effects of Deforestation on Arable Crop Production**

The results in Table 4.3 show that respondents strongly agree (x̄ = 4.26) that deforestation has reduced soil fertility in their farmlands. This finding underscores the critical role that trees play in maintaining soil health through the addition of organic matter, prevention of nutrient loss, and improvement of soil structure. The removal of vegetation cover disrupts the natural nutrient cycle, leading to degraded soils and reduced agricultural productivity.

Farmers also agreed (x̄ = 4.12) that crop yields have declined due to deforestation. This is consistent with the understanding that loss of tree cover can reduce soil moisture retention, expose crops to harsher climatic conditions, and increase vulnerability to pests and diseases, all of which directly affect yields. Similarly, increased soil erosion as a result of tree loss was agreed upon by respondents (x̄ = 4.08). Without tree roots to stabilize the soil, wind and water erosion become more severe, leading to the loss of topsoil and essential nutrients needed for healthy crop growth.

Furthermore, pest attacks were perceived to have increased due to the loss of tree canopy and cover (x̄ = 3.96, Agree). Tree covers often provides habitat for natural pest predators; its removal disrupts ecological balance, leading to pest population surges. Respondents also agreed (x̄ = 4.10) that deforestation has altered the local microclimate, affecting crop growth. This includes changes in temperature, humidity, and wind patterns, which can reduce crop resilience and increase stress on plants.

The findings from Table 4.3 have significant implications for this study’s aim of assessing the impact of deforestation on arable crop production. The strong agreement that deforestation reduces soil fertility and crop yields confirms that forest loss directly threatens agricultural productivity in Mubi North. This aligns with concerns over long-term food security, as continued deforestation could render farmlands less productive and more difficult to rehabilitate.

The acknowledgement of increased soil erosion and pest attacks emphasizes the need for integrated land and pest management strategies. Farmers could benefit from reforestation programs, the use of shelterbelts, and soil conservation techniques such as contour farming, mulching, and agroforestry. The finding that deforestation alters the microclimate points to the broader environmental consequences of forest loss, suggesting that climate adaptation strategies—such as drought-resistant crop varieties and improved irrigation systems—should be promoted alongside forest conservation.

By linking these observed effects to policy and community action, the study can advocate for targeted interventions that restore tree cover, protect soil health, and safeguard crop production, thereby ensuring sustainable agricultural development in Mubi North.

**Table 4.4: Response to Farmers’ Perception of Deforestation**

| **Statements** | **Mean (x̄)** | **Decision** |
| --- | --- | --- |
| I am aware of the dangers of deforestation on farming. | 4.30 | Strongly Agree |
| Tree planting is a good way to combat deforestation. | 4.21 | Agree |
| I have made changes in farming methods to reduce tree loss. | 3.78 | Agree |
| Deforestation threatens long-term agricultural productivity. | 4.33 | Strongly Agree |
| Government policies are effective in controlling deforestation. | 2.80 | Disagree |

**Source**: Field survey, 2025

**4.2.4 Response to Farmers’ Perception of Deforestation**

The results in Table 4.4 reveal that respondents strongly agree (x̄ = 4.30) that they are aware of the dangers of deforestation on farming. This indicates a high level of environmental awareness among farmers in Mubi North, likely informed by their direct experiences of declining soil fertility, reduced crop yields, and other negative consequences of forest loss. Respondents also agreed (x̄ = 4.21) that tree planting is a good way to combat deforestation, reflecting a positive attitude toward reforestation and afforestation practices. This suggests that many farmers are open to adopting and supporting tree-planting initiatives if provided with the necessary resources and technical guidance. Furthermore, the mean score of 3.78 shows that farmers agreed they have made changes in their farming methods to reduce tree loss. This could include practices such as reduced bush burning, selective tree cutting, or integrating agroforestry systems into their farms. A strong agreement (x̄ = 4.33) was also recorded for the perception that deforestation threatens long-term agricultural productivity. This finding underscores the farmers’ understanding of the link between environmental sustainability and future food security. However, respondents disagreed (x̄ = 2.80) that government policies are effective in controlling deforestation. This suggests that existing regulations or enforcement mechanisms may be weak, inadequately implemented, or fail to address the local realities of forest exploitation.

The findings from Table 4.4 are critical for achieving this study’s objective of assessing farmers’ perceptions of deforestation. The high level of awareness and recognition of tree planting as a solution indicate a readiness among farmers to participate in conservation efforts. This creates an opportunity for policymakers, extension agents, and environmental organizations to engage with farmers in designing and implementing community-based forest management and reforestation programs. The fact that some farmers have already adjusted their farming practices to reduce tree loss is encouraging and shows that behavioral change is possible. However, the perceived ineffectiveness of government policies highlights the need for stronger, more locally tailored regulations and enforcement mechanisms. Policies should be supported with adequate funding, community sensitization, and incentives for compliance, such as providing seedlings, offering training, or granting land-use rights for areas under reforestation. By leveraging farmers’ willingness to adopt sustainable practices and addressing the policy gaps identified, the study can recommend practical strategies that align with both community needs and environmental conservation goals, ensuring the long-term sustainability of arable crop production in Mubi North.

**Table 4.5: Response to Strategies for Mitigating the Impact of Deforestation**

| **Statements** | **Mean (x̄)** | **Decision** |
| --- | --- | --- |
| Agroforestry should be promoted to reduce the pressure on natural forests. | 4.22 | Agree |
| Farmers need awareness programs on sustainable practices. | 4.25 | Strongly Agree |
| Government should provide incentives for forest-friendly farming. | 4.10 | Agree |
| Alternatives to firewood should be introduced (e.g., gas, solar cookers). | 4.14 | Agree |
| Community leaders should enforce local forest conservation rules. | 4.05 | Agree |

**Source**: Field survey, 2025

**4.2.5 Response to Strategies for Mitigating the Impact of Deforestation**

The results in Table 4.5 show that respondents strongly agree (x̄ = 4.25) that farmers need awareness programs on sustainable practices. This indicates a recognition of the importance of education and sensitization in changing behaviors that contribute to deforestation. Well-designed awareness programs can help farmers understand the long-term benefits of conservation and equip them with practical techniques to reduce forest loss. Respondents also agreed (x̄ = 4.22) that agroforestry should be promoted to reduce pressure on natural forests. This reflects the farmers’ openness to integrating trees into their farmlands, which can enhance soil fertility, provide shade, improve biodiversity, and reduce the need to exploit natural forests for timber and fuelwood. Additionally, there was agreement (x̄ = 4.10) that the government should provide incentives for forest-friendly farming. This suggests that financial or material support—such as subsidies for sustainable inputs, provision of seedlings, or access to improved technologies—could motivate farmers to adopt conservation-oriented practices. The introduction of alternatives to firewood, such as gas stoves and solar cookers, also received agreement (x̄ = 4.14). This highlights the need for affordable and accessible energy solutions to reduce dependence on wood-based fuels. Lastly, respondents agreed (x̄ = 4.05) that community leaders should enforce local forest conservation rules, emphasizing the role of traditional authority in ensuring compliance with conservation measures at the grassroots level.

The findings in Table 4.5 have significant implications for the study’s objective of recommending sustainable strategies to mitigate the effects of deforestation. The strong support for awareness programs and agroforestry indicates that both educational and practical interventions are essential for achieving lasting change. These strategies can be implemented through agricultural extension services, non-governmental organizations, and local government agencies in collaboration with farmer groups. The agreement on providing incentives for sustainable farming highlights the importance of policy support in driving adoption. Without tangible benefits, many farmers may lack the motivation or resources to shift from conventional practices that contribute to deforestation. Introducing alternatives to firewood is also critical for reducing one of the major drivers of forest loss, but this requires addressing affordability and accessibility challenges, particularly in rural communities. The endorsement of community leader involvement suggests that local governance structures should be integrated into conservation programs. When community leaders enforce forest conservation rules, compliance is likely to improve due to their influence and authority within the community. Overall, these findings point to a multi-faceted approach combining education, incentives, alternative energy, agroforestry, and community governance as the most effective way to reduce deforestation and sustain arable crop production in Mubi North.

**4.3 Discussion of Findings**

The major findings of this study underscore the pervasive and multi-dimensional impact of deforestation on arable crop production among farmers in Mubi North, Adamawa State. The analysis revealed several important themes consistent with previous empirical studies.

The study found that the majority of respondents were male smallholder farmers within the economically active age range (25–54 years), with moderate educational backgrounds. This demographic profile aligns with the findings of Umar et al. (2020), who reported that male dominance in rural agriculture remains prevalent in Northern Nigeria due to cultural norms and inheritance practices. Similarly, Agboola and Olayemi (2021) noted that educational attainment, though modest, enables farmers to understand and potentially adopt sustainable practices when adequately sensitized.

The study identified the primary drivers of deforestation as tree felling for fuel (firewood and charcoal), agricultural expansion, and bush burning. These findings are consistent with Arowolo and Idowu (2020), who identified fuelwood extraction as the leading cause of forest degradation in rural parts of Nigeria, where alternative energy sources are largely unavailable or unaffordable. Furthermore, Nwankwo et al. (2019) argue that the demand for new farmland due to increasing population pressure remains a major catalyst for forest clearing in agrarian regions like Adamawa State.

The present study corroborates these earlier reports by showing that over 80% of respondents agreed or strongly agreed that deforestation has intensified in the last decade, further exacerbated by unsustainable land-use practices and lack of effective environmental regulations.

Respondents overwhelmingly reported that deforestation has led to decreased soil fertility, increased erosion, and reduced crop productivity. These observations are in line with Olaniyi and Adepoju (2022), who emphasized that tree cover plays a crucial role in maintaining topsoil structure and nutrient cycling. The loss of vegetative cover exposes the soil to erosion, diminishes organic matter, and increases vulnerability to pests—factors that collectively reduce yields. Additionally, Bello *et al.* (2021) reported similar impacts in Benue State, where deforestation correlated with up to a 30% decline in maize and yam production over a five-year period.

The current study validates this relationship in the context of Mubi North, with farmers observing notable declines in productivity over time and linking them to environmental changes caused by forest loss.

The findings showed that most farmers are aware of the adverse effects of deforestation and recognize the need for reforestation and sustainable practices. However, they also expressed dissatisfaction with government efforts and policy enforcement. This perception resonates with Ibrahim and Garba (2020), who found that although rural farmers are increasingly conscious of environmental degradation, institutional support remains weak due to poor policy implementation, lack of incentives, and inadequate extension services.

Moreover, the study by Edeh and Eboh (2021) emphasized that while awareness is necessary, it is insufficient without access to alternatives such as affordable clean energy or technical support for agroforestry. The lack of strong institutional frameworks has, therefore, limited the potential for meaningful behavioral change among farmers.

Respondents strongly supported agroforestry, public awareness, alternative energy adoption, and community involvement as strategies to reduce the negative effects of deforestation. This aligns with recent findings by Onyema and Okorie (2022), who advocated for integrated land management approaches involving farmers, local authorities, and policymakers.

Similarly, FAO (2020) recommended farmer-managed natural regeneration (FMNR) and agroforestry as cost-effective and ecologically sustainable solutions in regions facing high deforestation rates. The current study supports these recommendations and adds that in the context of Mubi North, such strategies must be culturally sensitive and locally led to be effective.

**CHAPTER FIVE**

**SUMMARY, CONCLUSION AND RECOMMENDATIONS**

**5.1 Summary of Findings**

This study was carried out to assess the impact of deforestation on arable crop production among farmers in Mubi North, Adamawa State. The broad objective was to examine the socio-economic characteristics of farming households, identify the causes and extent of deforestation, evaluate its effects on arable crop production, assess farmers’ perceptions, and recommend sustainable strategies for mitigating its impact.

The socio-economic profile of respondents revealed that the majority of farmers were male and within the economically active age group (25–54 years), with most having at least primary or secondary education. A large proportion had more than 10 years of farming experience, indicating a wealth of agricultural knowledge in the area. The findings identified tree cutting for firewood and charcoal, agricultural expansion, and bush burning as the main causes of deforestation. Farmers strongly agreed that deforestation had worsened in the last decade. The effects on arable crop production included reduced soil fertility, declining crop yields, increased soil erosion, higher pest attacks, and changes in the local microclimate.

Farmers showed a high level of awareness about the dangers of deforestation and recognized tree planting as a key solution. Some had made changes in farming methods to reduce tree loss, but they expressed dissatisfaction with the effectiveness of current government policies on forest conservation. Suggested strategies for mitigating deforestation included promoting agroforestry, implementing awareness programs on sustainable practices, providing incentives for forest-friendly farming, introducing alternatives to firewood such as gas and solar cookers, and strengthening the enforcement of local conservation rules by community leaders.

**5.2 Conclusion**

The study concludes that deforestation in Mubi North poses a serious threat to the sustainability of arable crop production. Its primary drivers are socio-economic and livelihood-related activities such as fuelwood harvesting, agricultural expansion, and bush burning. These activities have significantly degraded soil quality, reduced crop yields, and altered local climatic conditions, thereby threatening the long-term viability of farming in the area.

While farmers are aware of the adverse effects of deforestation and willing to adopt sustainable practices, the lack of effective government policies, enforcement mechanisms, and alternative livelihood options continues to hinder progress in forest conservation. Addressing deforestation in Mubi North therefore requires a coordinated approach involving farmers, policymakers, community leaders, and environmental agencies.

**5.3 Recommendations**

Based on the findings of this study, the following recommendations are proposed:

1. Encourage farmers to integrate trees into their farmlands to restore soil fertility, improve biodiversity, and provide alternative sources of fuel and income.
2. Agricultural extension services, NGOs, and government agencies should conduct regular sensitization campaigns to educate farmers on the benefits of forest conservation and sustainable farming practices.
3. Government should offer subsidies, grants, and free seedlings to motivate farmers to adopt conservation-oriented practices. Incentives could also include access to improved seeds, irrigation facilities, and market linkages.
4. Promote the use of gas stoves, solar cookers, and other renewable energy sources to reduce dependency on fuelwood. These should be made affordable through subsidies or credit facilities.
5. Introduce drought-resistant crop varieties and conservation agriculture techniques to help farmers adapt to microclimatic changes caused by deforestation.

**REFERENCES**

Adebayo, A. O., & Luka, A. Y. (2023). *Climate change and arable crop productivity in North-Eastern Nigeria: An empirical study*. Journal of Agricultural Economics and Policy, 19(2), 130–146.

Adeoye, T., Oladipo, A., & Bamidele, S. (2022). *Environmental degradation and agricultural productivity in Nigeria: A rural perspective*. African Journal of Environmental Management, 17(3), 44–59.

Ahmed, M., & Tanko, A. (2021). *Deforestation trends and implications for rural agriculture in Northern Nigeria*. African Journal of Environmental Studies, 14(3), 45–59.

Ajayi, T. O., & Yusuf, A. M. (2022). *Environmental changes and food insecurity in Northern Nigeria*. Journal of Agricultural Research and Development, 17(2), 88–101.

Chakravarty, S., Ghosh, S. K., Suresh, C. P., Dey, A. N., & Shukla, G. (2012). *Deforestation: Causes, effects and control strategies*. Global Perspectives on Sustainable Forest Management, 1(1), 1–28.

Chukwuemeka, U., Ibrahim, M., & Lawal, A. (2023). *Impact of population growth on land use and forest degradation in Sub-Saharan Africa*. Journal of Development and Environment, 18(1), 77–89.

Department for International Development (DFID). (1999). *Sustainable livelihoods guidance sheets*. London: DFID. Retrieved from <https://www.livelihoods.org>

Ezekiel, D., & Ojo, J. (2023). *Climate variability and agricultural vulnerability in the Sahel region of Nigeria*. Climate and Agriculture Journal, 12(1), 34–46.

Food and Agriculture Organization (FAO). (2020). *Global forest resources assessment 2020: Main report*. Rome: FAO. https://doi.org/10.4060/ca9825en

Food and Agriculture Organization (FAO). (2021). *The state of the world’s land and water resources for food and agriculture: Systems at breaking point*. Rome: FAO. https://doi.org/10.4060/cb9910en

Food and Agriculture Organization (FAO). (2021). *The state of the world’s land and water resources for food and agriculture: Systems at breaking point*. Rome: FAO. https://doi.org/10.4060/cb9910en

Global Forest Watch. (2022). *Nigeria: Tree cover loss data and analysis*. Retrieved from <https://www.globalforestwatch.org>

Hassan, I. (2022). *Deforestation, soil degradation, and food insecurity in Mubi, Adamawa State*. Mubi Journal of Environmental Research, 5(1), 25–36.

HumAngle. (2021, October 15). *Deforestation threatens farming livelihoods in Northern Nigeria*. Retrieved from <https://humanglemedia.com>

Ibrahim, H., & Musa, U. (2020). *Effects of deforestation on agricultural activities in Northern Nigeria*. Nigerian Journal of Agricultural and Environmental Research, 15(1), 88–97.

Laurance, W. F., Camargo, J. L. C., Fearnside, P. M., Lovejoy, T. E., Williamson, G. B., Mesquita, R. C. G., ... & Delamônica, P. (2014). *The fate of Amazonian forest fragments: A 32-year investigation*. Biological Conservation, 144(1), 56–67.

Musa, A., Ibrahim, Y., & Adamu, L. (2023). *Impact of land use change on forest cover in Adamawa State, Nigeria*. Journal of Environmental Studies and Sustainable Development, 9(2), 112–125.

Njobvu, M., Banda, R., & Mwape, S. (2018). *Agroforestry practices as a response to land degradation in Sub-Saharan Africa*. African Journal of Agricultural Sustainability, 4(3), 119–130.

Nnadi, F. N., & Omotayo, S. B. (2020). *Drivers of agricultural land expansion in forest zones of Nigeria*. Nigerian Journal of Agricultural Economics, 25(1), 33–47.

Okeke, J. O., & Abubakar, R. A. (2021). *Urban sprawl and the disappearance of forest lands in Northern Nigeria*. Journal of Urban and Regional Planning, 9(3), 122–135.

Okonkwo, E. A., & Bala, H. M. (2020). *The impact of forest loss on rural livelihoods in Northern Nigeria*. International Journal of Forest Research, 15(1), 74–83.

Olayemi, A., & Olatunji, M. (2022). *Climate variability and arable crop production in North-East Nigeria*. Nigerian Agricultural Journal, 53(4), 210–222.

Peet, R. K., James, L. & Liam, K. (2020). *Ecological consequences of land use change and forest fragmentation*. Global Ecology and Biogeography, 29(5), 643–658.

Scoones, I. (2015). *Sustainable livelihoods and rural development*. Rugby, UK: Practical Action Publishing.

Umar, K., & Abubakar, M. (2021). *Hydrological consequences of forest loss in semi-arid regions of Nigeria*. Journal of Climate and Water Resources, 6(2), 56–70.

Usman, L. M., & Adekunle, O. (2021). *Socioeconomic impacts of deforestation in rural Nigeria*. African Development Review, 19(4), 207–223.

Yohanna, P. T., Usman, B., & Goni, A. (2022). *Forest resource utilization and land degradation in Adamawa State*. Journal of Sustainable Forestry, 28(2), 101–117.

Yusuf, M. L., & Danladi, A. (2020). *Traditional farming practices and environmental degradation in Adamawa*. Journal of Rural Development Studies, 6(2), 60–72.