PEOPLE'S PERCEPTION ON THE IMPACTS OF DEFORESTATION ON LAND DEGRADATION IN MOKWA LOCAL GOVERNMENT AREA, NIGER STATE, NIGERIA

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MTech/SPS/2019/10400

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JUNE, 2023

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A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF TECHNOLOGY DEGREE IN GEOGRAPHY (ENVIRONMENTAL MANAGEMENT)

JUNE, 2023

ABSTRACT

Human development and advancement has welcomed several infrastructural developments and economic activities on the ecosystem. These developments have aggravated the nutrients and the potentials of land which includes the attenuation of forest resources and biodiversity in the environment. This study examined the People's Perception on the impacts of deforestation on land degradation in Mokwa Local Government Area of Niger State. The objectives of this study are; Assess land use land cover changes from 2000-2020 in Mokwa LGA; examine the trend of deforestation in the study area from 2000-2020; analyze the impact of deforestation on land degradation in the study area; and identify mitigation and adaptation strategies to land degradation in the study area. The data utilized for this research were both primary and secondary data, the primary data through questionnaire administration and secondary data was sourced from satellite imageries of Mokwa Local government area from 2000-2020. Descriptive statistics and Geographic Information system (GIS) techniques were used to analyze the data. The result of this study revealed a progressive decline of vegetal cover of the study area from 228,691 hectares (53.3%) in year 2000, to 171,170 hectares (39.8%) and 164,029 hectares (28.4%) in 2010 and 2020 respectively. On the contrary, built-up and bare surfaces increased from 23,351 hectares (5.4%) and 143,947hectares (33.7%) in 2000 to 53,226 hectares (12.3%) and 181,305 hectares (42.3%) respectively in 2010 and a further increase in 2020. In addition, result of the questionnaire revealed that global warming (22.9%) was the major impact of deforestation, followed by soil erosion (20.8%), and the least imperative impact was low rainfall (9.4%) in the study area. More so, the result of the study revealed that the mean decadal trend of deforestation was 61%, which showed that the vegetation declined by about 61% from 2000-2020. The implication of the findings is that further unabated depletion of the forest will aggravate its footprints in the study area, hence the dire need for implementation of workable decisions. The study provides the following recommendations; Adoption of Agroforestry system for a sustainable solution in response to land degradation, afforestation and enrichment planting practice to improve soil fertility, forest conservation management can also bridge gaps between climate change and mitigation strategies, forest education should be mandated in school to keep young generation abreast on the positive effect of forest to the ecosystem.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

One third of the earth's land surface is covered with forest providing numerous benefits including prevention of climate change, soil conservation, a vital role in hydrologic cycle and preservation of biodiversity. Resource in the forest provides long term national economic benefits. At least over 145 countries of the world are currently involved in wood production (Sheram, 1993). There are a lot of evidences available that the world is facing environmental crises on account of heavy deforestation. Over the years, destruction of forest has been going on and we have not been able to understand the dimension until recently. Nobody can give account or estimate of how much of the world's rainforests have already been razed and continue to be destroyed each year.

Agriculture is one of the most vital economic activities in the world because it is the source of food, beverages and raw materials for industries. The significance of agriculture as an economic activity is very expedient in the developing countries where the majority of the populations are farmers. Agricultural activities include the growing of crops, fishing, rearing of live stocks and lumbering (Adetumberu, 2000).

Vegetation is one of the major characteristics easily identified in an environment. Of all the components of the environment, man has greater control on plant's life than any other components. Man has brought a lot of changes to plant communities which have led to various changes in the environment such as influence of climate, soil modification that have affected geomorphic process and changes in the quantity of natural water (Adebayo, 2010).

The forest is enriched with large biomass and it is of significant use to man and mankind at large. It is extremely beneficial and is such an important factor in societal development. The unselective exploitation of forest without replacement otherwise known as deforestation has a negative effect on health, the environment and the economy. The adverse effect of forest exploitation on environment cannot be overemphasized. The over exploitation of available forest resources for meeting the ever growing population demand which has resulted in loss of soil nutrient and environmental degradation is disturbing (Gabriel and Ayuba, 2006).

Deforestation is the removal of forest trees where the land is used for other non-forest activities ranging from conversion of forest reserves to residential or industrial areas to removing of forest as a result of road construction, agricultural activities and cutting down of forest trees for domestic and industrial use. It also entails all other activities that result in temporal removal of vegetal covers such as shifting cultivation, clear cutting, slashing and burning techniques. Most times, critical limits are usually exceeded leading to irreparable damage to the forest. Lack of protecting influence and regenerative functions of trees and their root system on land, heavy downpour on the cleared lands cause erosion to erode the land, resulting in degraded forest, loss of nutrients and they produce devastating flooding and erosion which destroy farmlands, settlements, highways, dams and bridges (Adetumberu, 2000).

Forest in the world and Nigeria in particular is of vital importance to man. Forest is a source of wood for furniture, building industry and fuel wood. The implication in Nigeria has been that the areas of high forest have declined very rapidly through the process of deforestation. Deforestation has also led to both socio-economic and environmental degradation problems. That is why the forest needs to be properly managed for it to function efficiently (Bankole and Gbadamosi, 2010).

The continuous call for the natural resource management has been compelled by the increasing demand for wealth and population pressures resulting in serious environmental and ecological instability. Over the past 300 years, the effect of Land Use Land Cover Change (LULCC) have taken dimension of significant proportions. People are forced to overexploit resources e.g. forests, fishery and water in order to survive due to poverty. The consequences of these environmental problems are serious both in short and long terms. There is need for regular auditing since the environment is useful and the inhabitants are precious that the future need not to be left to chance (Adetumberu, 2000).

Land Use/Land Cover Change is driven by underlying factors central to change, environmental process and management through the influence on biodiversity, heat, livelihoods and a wide range of socio-economic and ecological processes. Studying the land use dynamics is essential for the understanding of various ecological and developmental consequences of Land use land cover change over a space of time. That is why land use mapping and change detection is a relevant input to decision making for implementing appropriate policy responses (Nwobodo, 2018). Land use land cover change detection permit the identification of important processes of change and, by inference, the characterization of land used dynamics. With rapid urbanization and a limited land area, the available land per individual is reducing on a daily basis. There is an urgent need for proper management of land that is dependent upon the availability of comprehensive, accurate and up- to- date data. Land use land cover change is a key to environmental process, environmental change and environmental management because of its influence on biodiversity, water budget, trace gas emissions, carbon cycling, livelihoods and many other ecological and socio-economic processes affect biosphere and global environmental change (Bankole and Gbadamosi, 2010).

Land use land cover change plays a vital role in detecting the direction of land degradation, land fragmentation, decline of agricultural productivity, rural poverty, and depopulation, environmentally-induced migration of people and emerging spatial trends and patterns.

New tools for sophisticated management of biodiversity, Remote Sensing (RS) and the Geographic Information System (GIS) and geospatial tools currently provide cutting-edge environmental management with new gadgets. Satellite data encourage brief analysis of the earth system, structures and changes over time from neighborhood to global scales (Nwobodo, 2018).

Land degradation refers to the process by which the value of the physical environment is affected by one or more combination of anthropogenic induced processes acting upon the land. It is also the compromising of natural quality of soil component of any ecosystem. Land is seen as a decline in land quality caused by human activities which has been recognized as a major environmental issue threatening the planet since the 20^{th} century and it has remained high on the international agenda in the 21^{st} century (Imoke, 2012). Land degradation can be viewed as any undesirable change or disturbance perceived to be harmful (Eswaran *et al.*, 2001).

Half of the forest on planet earth is gone, removed for timber, fuel wood, pastures, and agricultural activities. Important timbers are cut down and the remaining forest is cleared for farming (Mohammed and Butswat, 2005). On many occasions, the inhabitants grow crops for few years before nutrient are washed away since it is no longer fertile for agriculture. When the soil becomes barren, more forest is cleared by the inhabitants to cultivate crops resulting in more erosion. Different species of wildlife in the forests are killed or displaced when these forests are cut down by lumbermen and farmers. Habitat destruction does not only threaten the wildlife species but many species are facing extinction (Mohammed and Butswat, 2005).

The activities of man have had a major impact on forest degradation as a result of the exploitation of forest unselectively. Oroka (2009) shows that between 1990-2000, An estimated five million hectares of forest were lost in Africa. Madagascar has suffered significant destruction and West African countries such as Nigeria, Ghana, Cote D'Ivoire where population growth and agricultural development have been rapid. Policies for economic development have harmed forests in these countries. In the case of Niger delta, forests have been harmed by development and pollution related to petroleum exploitation while in other parts of the country forest has been cleared for large scale plantation.

Forest clearance, agriculture, herding, and hunting for food have put animals under pressure, facing threats that include habitat loss from these mentioned activities. The indiscriminate exploitation of vegetal covers has led to environmental degradation with a drastic decline in biodiversity (Peter, 2002). Forest provides habitat for wild life, foster medical conservation and support biodiversity.

The country once depended on agriculture as the major source of revenue and foreign exchange for its development. Forest exploitation go beyond the search for fuel wood, game and construction materials and medicinal herbs (Oroka, 2009). The deforestation is as a result of consequences of man's activities leading to erosion, desertification, soil infertility, shortage of food and fiber, reduction in the potential of trees for air purification and reduction in wood and non-wood products. The decrease in the quality of Nigeria forests is attributed to population pressure that necessitated the increase in the number of houses, accelerated urbanization and agricultural activities, fuel wood gathering, bush burning, industrialization where lands are cleared for industrial land use and transport system which has warranted cutting roads deep in forests.

These activities have led to deforestation (Oyewale, 2006). Land degradation as a result of unselective exploitation of forest, However, these have injuriously affected the capacity of land to contribute to food security. The impact of deforestation on land degradation in Mokwa Local Government is enhanced due to high demand for agricultural land, urbanization and fuel wood. Forest provides a lot of benefit in the form of food, income, wood and watershed protection which play a vital in enabling people to secure consistent and adequate food supply (Badege, 2009). Therefore, adverse consequences of deforestation in Mokwa Local Government Area need to be understood.

1.2 Statement of the Research Problem

The earth surface, by virtue of the available evidence is changing at an alarming rate (Naissan and Lily, 2016). Towns and cities are experiencing modifications and undergoing expansions on a daily basis. Due to human activities, infrastructural development and others, its land use land cover change plans are changing. Growing population is the main constraint responsible for LULCC.

Despite the fact that Nigeria has abundant natural and human resources for food production, it still suffers from food shortage both in quality and quantity and Nigeria may no longer be a food producer as noted by Akinbode (1994). It can be argued that the persistent food crises in Nigeria result directly from poor management of natural resources and inability to practice sustainable forest management development (Otegbeye, 2003).

The increasing population growth and Urban sprawl being experienced is putting unprecedented pressure on forest resources, once the population reaches a stage where the land can no longer sustain it and there is an irregular cutting of forest trees that provide soil with humus and the flood and erosions are likely to occur in Mokwa Local Government Area.

In Mokwa Local Government Area of Niger State majority of the inhabitants are farmers. Food production depends on the farmer's output and the fertility of the soil depends on the presence of vegetation and this vegetations is indiscriminately exploited thereby leading to land degradation and high carbon concentration in the surrounding environment resulting in increasing temperature (Ndabula *et al.*, 2013). Much of Mokwa local Government Area rich biodiversity is found in its forest, through indiscriminate exploitation many of these biodiversity is threatened as a result of habitat loss. It is painful to report that in Mokwa Local Government Area, forest trees are usually cut down unselectively to provide raw materials to Saw mill industries in and outside Mokwa Local Government Area. Most inhabitants believe that the study area have started experiencing the effect of land degradation such as socio-economic and ecological consequences of deforestation as well as urban heat island.

It is in the light of these shortcomings, hence, poses the need for this research in Mokwa local Government area of Niger State because there is little enlightenment campaign against indiscriminate exploitation of forest and no adequate measures to implement the laws enacted against the exploitation of forest. This research can serve as medium to suggesting recommendations for the people in the study area and Nigeria at large the effective ways of reducing forest depletion in order to maintain and restore the vegetal covers and soil nutrients in the already degraded environment.

1.3 Research Questions

The research questions for this study include:

i. What happened to the land cover of the study area over the past two decades 2000-2020?
ii. What is the trend of deforestation in the study area from 2000-2020?

iii. How does deforestation affect land degradation in the study area?

iv. What are the needed mitigation and adaptation strategies to land degradation in the study area?

1.4 Aim and Objectives of the Study

The aim of this study was to examine the impacts of deforestation on land degradation in Mokwa Local Government Area of Niger State. The objectives of the study were to:

i. Assess land use land cover changes from 2000-2020 in Mokwa LGA;

ii. Examine the trend of deforestation in the study area from 2000-2020;

iii. Analyze the impacts of deforestation on land degradation in the study area; and

iv. Identify mitigation and adaptation strategies to land degradation in the study area.

1.5 Justification for the Study

The increasing population growth and Urban sprawl being experienced is putting unprecedented pressure on forest resources in the study area. The research is worth undertaking considering the frightening spate at which the country is losing is forest cover. It is obvious that the wave of deforestation is alarming looking at the existing forest and exerting greater pressure on regulatory processes of forest. The study will provide some useful reasons why the forests should be preserved beside sustainability reasons.

This research will bring to fore the challenges and prospects that forests in Mokwa Local Government Area face. This will inform policy makers to get the best out of the forests we have in Mokwa Local Government. The findings may possibly assist policy makers in developing

pertinent policies to protect the forest in Nigeria and provide better alternatives for the people to take advantage of the forest for their own development.

1.6 Scope and Limitation of the Study

The study examined the People's perception on the impacts of deforestation on land degradation in Mokwa Local Government Area of Niger State, Nigeria. The scope of the study was restricted to land use land cover changes, the trend of deforestation and impact of deforestation as well as mitigation and adaptation strategies in the study area. The spatial scope covered the areas where forest resources are experiencing exploitation in the study area. The temporal scope of the study was from 2000- 2020.

1.7 The Study Area

1.7.1 Location

Mokwa Local Government Area in Niger state, is located between Longitude 4° 45' 00" to 5° 45' 05" East and Latitude 8° 45' 00" to 9° 40' 00" North. It covers a total land area of 4,338 km² with a projected population of 404,448 by World Health Organization in 2021. It shares boundaries with other local government areas; Mashegu to the North, Lavun to the East, Edati to the South East and Borgu to the West.

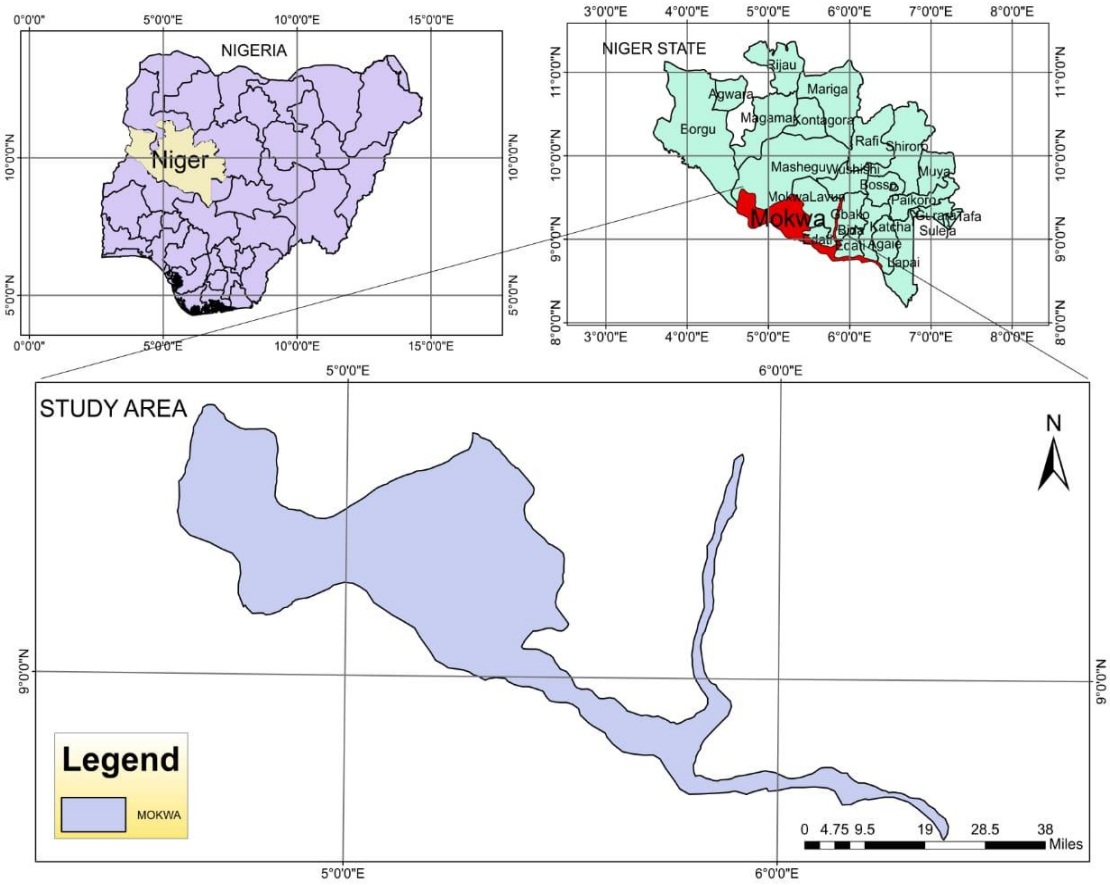

Figure 1.1: Location Map of the Study Area
Source: Authors' work (2021)

1.7.2 Vegetation of the study area

The vegetation of the study area falls within the zone of Guinea Savannah, which is a major vegetation zone across Niger state. It consists of wood land and light forest. The common tree found in this zone are; Shearbutter, Neou oil, African locust bean, axle-wood and thinning's piliostigma tree (Ahmad, 2018).

1.7.3 Climate of the study area

The temperature of the study area rarely falls below 20°C, the wet season average temperature is about 20°C and the peak is 38°C in February to March and 35°C in November to December while the mean relative humidity is 33-83%. However, Meteorological research confirms that Rainfall is highly seasonal and controlled by the irregular movement of the Inter-Tropical Discontinuity (ITD). Onset is usually by April/May and cessation in October with an average record of 200 days of rainy days for year with an average mean rainfall of 1,300mm (Adefolalu, 1986).

1.7.4 Soil of the study area

The plains have the most fertile soils and the best agricultural lands of all plains of the study area while the high sand content of most soils within the study area accounts for the relatively high erosion status. There is, however, one major advantage about the type of rocks and soils found in the study area for availability of construction materials in the form of building stones quartz and pistol tic gravel, building sands and earth for use as foundation materials. Most of the soils of the study area were classified according to Food and Agricultural Organization as Alfisols and Inceptisols.

1.7.5 Geology of the study

Geologically, Mokwa Local Government Area is located within the Bida Basin which is a NW-SE trending intracratonic sedimentary basin extending from Kontagora in Niger State of Nigeria to areas slightly beyond Lokoja in Kogi state. The Bida Sandstone is the basal sediment of the

middle Niger Basin and it consists mainly of fine grained sandstone, conglomerates, siltstone and claystone (Yusuf *et al*., 2018).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Preamble

The tone of the study has been set by the previous chapter, giving an overview of the background to the study, statement of problem, research questions, objectives and significance of the study. This chapter is dedicated to the review of literature on deforestation and its impacts on land degradation. A considerable number of researches have been carried out with regard to environmental consequences of exploitation of forests.

2.2 Conceptual Framework

The concept of Restoration and sustainable forest management was chosen consciously considering it link and application to the topic under study. The study connects the concept of Restoration and sustainable forest management with forest exploitation and its environmental, ecological and socio-economic consequences on land degradation in Mokwa Local Government Area. According to Chazdon and Brancalion (2019) ‘‘Restoring forest is a means to many ends”, Restoration and Sustainable Forest Management of forest throughout the world represent one the most vital goals of the century. Forest is of great significance for multifarious ecosystem services such as the timber production, non-timber forest product, global water and nutrient cycles, and climate change mitigation. However, forest continues to decline worldwide. The reasons for forest

loss are many including land use change towards agriculture, unsustainable forest management, urbanization, mining and wildfires (Vankooten and Bulte, 2000).

The aim of Restoration and sustainable forest management is to ensure that forests continue to supply goods and services to meet both present-day and future needs and contribute to the sustainable development of communities. The United Nations General Assembly in 2007 recognizes Restoration and Sustainable Forest Management as a dynamic and evolving concept that aims to maintain and enhance the economic, social and environmental values of all types of forests for the benefit of present and future generations, considering the following seven thematic elements as a reference framework: (1) extent of forest resources; (2) forest biodiversity; (3) forest health and vitality; (4) productive functions of forest resources; (5) protective functions of forest resources; (6) socio-economic functions of forests; and (7) legal, policy and institutional framework.

International Tropical Timber Organization (ITTO) (2015) defines restoration and sustainable forest management as "the process of managing forest to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment".

In a more simple term it can be viewed as the accomplishment of equilibrium between increasing continuous population demands for forest products and use and conservation of forest and varieties. This equilibrium is very important to the existence and viability of the forest and to the forest fringe communities. Forests across the world contain different varieties of plant and animals that provide essential ecosystem services. Yet, forests are experiencing expeditious indiscriminate

exploitation that is causing land degradation with global negative impacts on biodiversity and services rendered by the ecosystem. Despite the flexibility of the forest ecosystems, there are extents to which it can resist some environmental change that degrade the environment when limits are surpassed and also lose is reviving capacity artificially or naturally. However, knowing these limitations and aftermath authorize us to handle, supervise and utilize the forest judiciously and precisely to increase its productivity, biodiversity and its regenerating ability without any glaring environmental, ecological or socio-economic impact.

Restoration and sustainable forest management refers to understanding the extent of how forest can resist environmental change and regenerate independently and concertedly and in coping with human activities and interference to produce utmost level of derivable benefits within ends.

The following are some of the factors suspected to have influenced deforestation:

(i) Urbanization

(ii) Bush burning

(iii) Climate change and other unmentioned Anthropogenic activities

Here are some key parameters identified from the definition of Restoration and sustainable forest management, which include:

(i) Productive and protective functions

(ii) Renewal and revival functions

(iii) biodiversity

(i) Productive and protective functions: the productive function of a forest includes the number of different species and independent trees growing on a place, climate and soil fertility. By- products from the forest account for a significant nutrient of a given forest land. Consequently,

unselective removal of this forest waste can reduce the fertility of the soil. Hence, there is need to ameliorate our comprehension on the adverse effect of deforestation on soil nutrient

(ii) Renewal and revival functions: the revival function of a forest ecosystem after experiencing different kinds of disturbances lean on the nature, magnitude of the disturbance and method of its reproduction species found in the forest. The susceptibility of forest ecosystem to pressure is ascertained by the kind of forest ecosystem either delicate or flexible and by the type of pressure. Jordan (1989) classified Forest ecosystem renewal pattern into three levels;

(a) Self-renewal: Forest ecosystems are able to renew themselves easily without human interference at an average level of degradation after the withdrawal of the disturbing factor.

(b) Rehabilitation: in this type of revival function, the forest ecosystem may need long period to naturally recover at an intermediate level of degradation but through the intervention of human this period can reduce.

(c) Restoration: at a level of forest degradation, practically deforestation become irreparable within human time frame because it is identified by a combination of near or total loss of forest cover that is deforestation, species and soil degradation. In such a difficult condition, the recovery process may take centuries as a result of natural process or decades with human intervention. It would be impossible to recreate the initial original natural state of the forest, but it may be possible to create a secondary forest of manifold species.

(iii) Biodiversity: forest is very rich repository of earth genetic heritage. Poore and Sayer, (1991) reaffirmed that the forest contains over 50 percent of all the plants and animal species in about six percent of the world's surface area. The biodiversity is vividly decreasing as a result of human activities such as non-selective hunting of animals and exploitation of trees in the forest.

Practicing Restoration and sustainable forest management, through the management of forest ecosystem for their manifold derivable benefits and usefulness is very essential to refrain from excessive future costs. United Nations Conference on Environment and Development (UNCED, 1991), stated that there is need for appropriate international framework to be devised to promote restoration and sustainable forest management. Restoration and sustainable forest management is viewed as important value to make sure that, while trying to satiate the current demand we leave a restorative forest to meet the needs of the future generations.

2.2.1 Deforestation

Deforestation is the conversion of forested areas to non-forest land use such as arable land, urban use, logged area or wasteland. According to Food and Agricultural Organization (FAO, 2010), deforestation is the conversion of forest to another land use or the long-term reduction of tree canopy cover below the 10% threshold. Deforestation can result from deliberate removal of forest cover for agriculture or urban development, or it can be an unintentional consequence of uncontrolled grazing (which can prevent the natural regeneration of young trees). The combined effect of grazing and fires can be a major cause of deforestation in dry areas. Deforestation implies the long-term (>10 years) or permanent loss of forest cover.

Definitions can also be grouped into those which refer to changes in land cover and those which refer to changes in land use. Land cover measurements often use a percent of cover to determine deforestation. Land use definitions measure deforestation by a change in land use. This definition may consider areas to be forest that are not commonly considered as such. An area can be lacking trees but still considered a forest. It may be a land designated for afforestation or an area designated

administratively as forest. Land cover based definitions can be measured using remotely sensed data. Detailed ground survey is needed to monitor land use type deforestation processes.

Deforestation is the process of changing forest to permanent non-forested land Use such as urban development, grazing and Agriculture (Vankooten and Bulte, 2000). Deforestation is mainly a concern for the third world nations in the tropics and Deforestation can be euphemistically called "timber extraction" happening throughout the developed and developing world can and be seen as a by-product of development and industrialization process (Myers, 1988).

Deforestation has been happening continuously since past centuries but its consequences were not known in the medieval or later periods, so it is not a new occurrence. Its consequences have shown great diversity of threats not only to mankind but also to the earth and the scientists and other organizations have been tirelessly working on its limitations. Some parts of the world are richer in forests than the rest of the world and Amazon is one of them. In Amazon, deforestation is taking place at extensive level and there are no precautions being taken in this regard, numerous studies have shown the great magnitude of the issue.

The Earth has lost 40% of its original forest cover. Deforestation and degradation process of the world forests have been accelerating significantly during the last two centuries, precisely since the 1950s.In recent decades, specifically in the Tropics, deforestation and degradation of forests have been going on at a frightening rate. The FAO estimated the total net loss of forests in countries with a negative change of forest cover at 13×106 ha yr^{-1} between 1990 and 2005. Deforestation has led to a great loss in biodiversity, destruction of the hydrological cycle, decrease in water quality, and acceleration of soil erosion. The global climate system is usually altered as a result of decline in forest cover potentially affecting surface energy, water, and greenhouse gas fluxes. It

has been predicted that there would be a substantial increase in deforestation rates during the coming decades due to human activities. Negative consequences of anthropogenic induced deforestation would be accelerated by expected climatic change. The stability of the Earth system is threatened by consistent and continued deforestation and substantial national and international efforts is urgently required to halt this global challenge.

Converting natural vegetation, forest or grassland to agricultural areas decreases biodiversity, reduces the capability of vegetation to capture atmospheric moisture and retain water in the vegetation cover, exposes land to be subject to water and wind erosion and changes the radiation balance of the land surface as land is exposed and barren part of the year. These all have still unknown impacts on regional climate.

2.2.2 Deforestation at the global level

Annually, the global deforestation is estimated around 13 million hectares, most of which occurs in the developing countries (FAO, 2010; CIFOR, 2005). As outlined by Myers (1988) the rate of annual exploitation of forest seems to increase further and could double in another decade. Sub-tropical and Temperate areas experienced most deforestation. However, in the developed temperate countries, deforestation is no longer rampant now and most temperate countries are now recording increase in forest areas. Usually on most occasions developing countries are located in tropical domains and developed countries in temperate domains. However, between 1990-2000, deforestation was significantly less in tropical moist deciduous forest than 1980-1990 (Sheram, 1993).

Meanwhile, large scale tropical deforestation is quite a modern event that gained momentum in the 20th century and especially in the last half of the 20th century. As indicated in 2010 report of

Food and Agricultural Organization, there was a noticeable deforestation in the world between 1990-2010 but this was majorly limited to tropical areas (Sheram, 1993).

The largest net loss of forest during the last decade was experienced by South America with about four million hectares per year, followed by Africa with 3.4 million hectares annually and Oceania is the least with 7 lakh hectares annually. As a result of Australia severe drought and forest fires from 2000AD Oceania experienced increased loss. Brazil and Indonesia had the highest net loss of forest during the decade of 1990 but has significantly reduced their rate of loss after this decade. In the decade of 1990s Brazil and Indonesia dominated accounting for over 35 per cent of net forest loss. Despite the fact that Brazil was the leading deforesting country by area, the forests in Brazil are so large that this just represents a loss of o.4 per cent per year. North America and Central America forest regions remained stable during the past decade. The Europe forest regions continue to undergo expansion at a slower rate of seven hectare per year during the last decade than in the 1990s with nine hectare per year. During the 1990s Asia lost some six hectares annually but gained more than 2.2 million hectares per year during the last decade (Sumit *et al.,* 2012).

The ten countries with the largest net loss per year in the period 1990-2000AD had a combined net loss of forest area of 7.9 million hectares per year. In the period 2000-2010AD, this was reduced to six million hectares per year as a result of decline in deforestation in Indonesia, Sudan, Brazil and Australia. 28 countries and areas which have an estimated net loss of one per cent or more of their forest area per year. Five countries with the largest annual net loss for 2000-2010AD were Comoros (-9.3 per cent), Togo (-5.1 per cent), Nigeria (-3.7 per cent), Mauritania (-2.7 per cent) and Uganda (-2.6 per cent). Globally, the other wooded land area has decreased by about 3.1 million hectares per year during 1990-2000AD and by about 1.9 million hectares per year during

the last decade. Wooded land area in Africa, South America and Asia had also decreased during the past two decades (Sumit *et al.,* 2012).

2.2.3 Deforestation in Africa

Forest loss in Africa is extremely worrisome and is as a result of the fact that; 80% of the continent's population depends on forest resources for income and food supplementation and 90% of Africans use fuel wood and charcoal as sources of energy (FAO, 2010). Hence, the over dependence on forest resources and non-timber forest products (NTFPs) has accounted for the major change in vegetal cover and that deforestation in Africa is estimated at around 3.4 million hectares per year (FAO, 2010; CIFOR, 2005).

Naoto (2006) reported that between 1990 and 2000 Africa had the highest rate of deforestation of about 0.8% followed by Latin America with 0.4% and 0.1% in Asia. Many scholars linked deforestation rate in Africa to their phlegmatic economic growth. However, the importance of deforestation to Africa has resulted in a number of recommendations on how to reduce the high rate of deforestation on the continent. Loss of vegetal cover on the continent of Africa is due to poverty. United Nations Economic Commission for Africa (UNECA, 2005), shows that in the sub-Sahara Africa the proportion of land covered by forests is estimated to have decreased by 2.2% between 1990 and 2000. Due to over dependence on forests to meet the energy demands, with little access to other affordable sources of energy, the rate of loss of forests is increasing at a frightening rate. Forests provide 60% of Africa's energy demands.

2.2.4 Deforestation in Nigeria

Forestry Management Evaluation and Coordinating Unit (FORMECU) (1996) stated that in Nigeria the situation is not different. The zonal breakdown of deforestation from1979 to 1995

shows that the total areas have declined by 48% in the North-Central, 7% in the North East, 60% in the North West, 53% in the South East, 13% in the South-South and 12% in the South West.

Food and Agricultural Organization (2010) documented that in 2000, the forest cover was estimated at 13.5 million hectares compared to 17.5 million hectares in 1990, indicating forest cover loss of close to 400 thousand ha per annum or a decline of about 2.6%. Forest now stands at 13% of the total land area. Nigeria needs a work of this nature to examine the current deforestation rate due to global outcry on the consequences of continuous unsustainable forest destruction. Nigeria's forest resources are under pressure from urbanization, infrastructure development, residential construction, population growth, nomadic farming and expansion of agricultural crop cultivation. Indicators and proof of these pressures is the growth degradation of both community and natural forest.

Eboh *et al.* (2005) revealed that about 25% of forest cover was lost from 1991 to 2003 with the remaining forest now standing at about 16 to 17%. FAO (2010) reported that the country lost 55.7% of its total primary forest between 2000 and 2005 and the rate of forest change increased by 3% to 3.2% per annum. The spread of deforestation is noticeable near urban Countries. The growths of urban areas bring about significant demand for fuel wood, charcoal and saw wood and this account for much of the observed decline in forest stock (Ogundele, 2012). Cooking with fuel wood or charcoal has remained the only alternative to ever increasing cost of fossil fuel in Nigeria. It is, therefore, predicted that the demand for biomass energy in urban areas would remain strong and continue to account for much of the spread of deforestation. Forest in the country is said to contribute substantially to the national Gross Domestic Product (GDP) and sustenance of the

livelihood of the people. This probably may be the reason why the trend of deforestation across the country is on the increase and the GDP from the forestry sector decline.

Kelvin and Lewis (1997) warned that Enormous reliance on biodiversity resources brings with it a specific vulnerability. In the occurrence of declining productivity or poor yield owing to environmental degradation, few possible development plans are easily available and funds for carrying out environmental restoration are limited. Vital biological resources provided by ecosystem are many at different levels including species richness and genetic variability. Environmental degradation that results to the destruction of these ecosystems must therefore be seen as a serious threat to Africa's future. Africa is and will continue relying on her biological resources for income, shelter and food. Ecosystem, if properly maintained and kept in a healthy state, will allow Africa to meet the subsequent challenges of the decades using sustainable forest development concept.

Peter (2002) explained that in Africa, about 70% of the land that supports habitats for wild plants and animals is now used for other purposes. Despite all the exploitation, African forest still contains huge and vital biodiversity, whereas in some parts of the world it may be too late to bear the loss of much of the biodiversity that formerly existed. Most African countries, particularly Nigeria still have the opportunity to make proactive interventions.

Adetumberu (2000) noted that Forest exploitation is the process of utilizing forest resources such as vegetal covers by lumbermen, farmers, hunters, economic trees and animals. As usual the motive of the people have always been the same, that is, to provide raw materials for saw mill industries, meat for human consumption and medicine to cure different types of illness. In recent time, the magnitude of damages resulting from unselective forest resources exploitation is so

troubling that it has caught the attention of various scholars, Government and individuals. This rising concern has nothing to do with the fact that over 40% of the earth's flora and fauna are lost to deforestation annually (Nye and Greenland, 1960). Decrees and Laws on deforestation have been enacted by local, state and federal Governments; mass media enlightenment campaigns have been embarked upon, forest administrative strategies and policies that were designed to control human activities in the exploitation of forest resources have been put in place over the years. In order to conserve the forests, rules and regulations are vital and meant to be followed so as to achieve the maximum benefit derivable from forests. The motive of these regulations is to reduce or stop the prevalence occurrence of deforestation and general environmental degradation. Despite all the efforts and the global attention, the consequences of deforestation continue to increase uncontrollably in recent times (Adetumberu, 2000).

2.2.5 Causes of deforestation

United Nations Framework Convention on Climate Change (UNFCCC, 2010) uncovered that there are a lot of reasons why deforestation happens: land cleared is used for settlements, plantations for crops and livestock pastures while trees are cut down to be used or sold as fuel or sometimes in the form of charcoal. Inadequate reforestation after cutting down of trees can lead to soil degradation, habitat loss and biodiversity loss.

The direct cause of deforestation is agriculture. Peasant and small scale farming account for 48% of deforestation, while 32% of deforestation is as a result of commercial agriculture; logging is responsible for 14% and gathering of fuel wood make up for 5% of deforestation (UNFCCC, 2010).

Deforestation is induced by a lot of agents. Daniel and Edwards (1998) detected some of the causative factors as summarized below

2.2.5.1 *Expansion of farm lands and bad Agricultural practices*

About 60 per cent of tropical moist forest is cleared for Agricultural settlement (Myers, 1988) and other reasons like roads and fuel wood accounting for the rest (Anon, 2010). Majority of the inhabitants of the tropical forest live with less than a dollar a day, where a third of a billion are estimated to foreign settlers. However, people are compelled to migrate searching new forests boundary increasing deforestation (Wilkie *et al*., 2000) (Amor and Pfaff, 2008). Expansion of Agricultural land is one of the leading causes of deforestation. This is due to the fact that Agricultural land expansion is widely seen as the major source of deforestation accounting for about 60 per cent of overall tropical deforestation (Amor and Pfaff, 2008).

Old farming methods like slash and burn, where a part of forest is cleared and dry vegetation are set ablaze before the Onset of rainy season. This is deliberate in most cases. However, such deliberate controlled burning often extends in to close by forest leading to widespread of deforestation. Reports showed that shifting agriculture is responsible for half of the deforestation in the tropic and some said it is up to two-thirds. In Asia, shifting Agriculture was more intense (about 30%) only 15% over the whole tropical world. It indicates that the percentage of direct conversion of forest to agriculture is increasing and there is reduction in the proportion of slash and burn with time (Sumit, 2012).

2.2.5.2 *Logging and fuel wood*

Putz *et al*. (2001) opined that, logging can seriously degrade forest and not necessarily result in deforestation. In south East Asia logging is more intensive and can be destructive. In addition, log scales help finance the cost of cutting down trees. Logging provides access roads to follows on settlers and preparing land for cultivation of crops or pastures. Thus, logging aids deforestation (Chomitz *et al.*, 2007). Gathering of fuel wood is usually practiced in tropical dry forests and degrade forest areas (Repetto 1990; Rowe *et al*., 1992). Usually fuel wood is not the main cause of deforestation in the humid regions though it can be in some populated regions such as the drier areas of the tropics. Gathering of fuel wood constitute a major cause of deforestation and forest degradation. Taking El Salvador into consideration, fuel wood gathering was considered to be the major cause of forest degradation and deforestation (Repetto, 1990).

2.2.5.3 *Urbanization, industrialization and infrastructure*

Expansion of towns and cities need land to erect necessary infrastructure to meet the needs of the increasing population which is done by clearing the forest (Mather, 1991; Sands, 2005). Kaimowitz and Angelsen (2001) reported that in pristine areas, Tropical forests are usually a major point of infrastructure development for hydropower dam construction, exploitation of oil or logging concession which inescapably conveys the road network extension and road construction. Roads, Railways, Bridges and Airports construction unlock land to development and increase the numbers of people to the forest frontier where assisted/ backed or not by the government programmes. These inhabitants usually dominate and rule the forest by using new road to access the forest for subsistence land (Wilkie *et al.*, 2000; Amor and Pfaff, 2008).

Bawa *et al.*, (2004) were of similar view that the development of these infrastructure projects are of global concern, since clearing of tropical forest accounts for approximately 20 percent of human

carbon emission destroying globally important carbon sinks and about 21 percent of tropical forest have been lost world wide since 1980.

2.2.5.4 *Corruption and political cause*

The FAO (2010) pinpoints forest crime and corruption as the major causes of deforestation in its 2001 report and cautioned that immediate attention has to be given to illegal activities and corruption in the world forests in many countries. Unlawful forest practices include the approved of illegal contracts with private enterprises by forestry officer, under-declaring volumes cut in public forests underpricing of wood in concession, illegal sale of harvesting permits, harvesting of protected trees by commercial corporations, smuggling of forest products across borders and allowing unauthorized logging, processing forest raw materials without a license (Contreras – Hermosilla, 2000).

2.2.5.5 *Tourism*

Shukla (2010) observed that without any doubt Natural parks protect the forest but unrestrained and opening of forest and areas to the public for tourism is bad. People are now erecting residential houses and other infrastructure on forest land all in the name of eco-tourisms which are deleterious in terms of attracting people other than tourists to forest land.

2.2.5.6 *Overgrazing*

Vegetal covers are removed by animals and wind finished the job by blowing away the top most soil, changing grasslands in to Arid land (Hays, 2008). It also exposes the land to erosion and effects of ultra violet radiation from the sun.

2.2.5.7 *Climate change*

Ultimate change is one of the causes of deforestation. Over 300 million years ago, the carboniferous rainforest collapsed and causing the extinction of many plant and animal species. The change was sudden, explicitly; in recent time that climate has become cooler and driver, Condition which is unfavorable for the growth of forest and many biodiversity within them (Hays, 2008).

2.2.5.8 *Mining*

Oil and coal mining requires a significant amount of forest land. Apart from this, roads and highways have to be built to make way for trucks and other equipment. The waste that comes out from mining pollutes the environment and affects the biodiversity (Hays, 2008).

2.2.5.9 *Overpopulation*

Overpopulation needs more land to build houses and settlements. It generates a significant need for food and farmland to grow food and raise livestock. It automatically requires many more roads and highways for transport and communication, All these result in deforestation. Moreover, the growing human population is directly linked to deforestation (Hays, 2008).

2.3 Major Drivers of Deforestation and Degradation

Tropical deforestation is driven by a sophisticated combination of direct and indirect drivers of different nature (social, ecological, economic, environmental, biophysical), which interact with each other, often synergistically; the specific combinations of drivers vary within a region of the globe, by countries, and across localities within countries (Amor and Pfaff, 2008).

2.3.1 Direct drivers of deforestation

Direct drivers are basically human activities at the local level and can be broadly categorized into those related to agricultural expansion, wood extraction, and infrastructure extension. Agriculture expansion is the most important direct driver of deforestation in practically all tropical regions and includes shifting cultivation, permanent agriculture, pasture creation, and resettlement programs, following converting of the forest to other land uses (Wilkie *et al.*, 2000).

Wood extraction includes commercial logging, fuel wood harvesting, and charcoal production. A substantial negative effect is provided by illegal harvest: over 70 countries have problems with illegal logging that leads to dramatic ecological and economic losses. Commercial logging is an important direct driver in Asia and Latin America while fuel wood gathering is one of the most important drivers in Africa (Robert, 2007).

Infrastructure extension includes construction of transport ways; development of new industrial enterprises; settlement expansion; and a variety of other activities (oil exploration and extraction, mining, construction of hydropower stations, pipeline and electric grids). The construction or paving of roads in forested areas is among the principal causes of deforestation. For example, in the Brazilian Amazon, above 80% of deforestation occurs in a 100 km band along major roads. During the recent decades, wildfires have been recognized as a new actor of deforestation and degradation in the Tropics, as a rule following land-use change and fragmentation of forest cover. Exceptional fires took place in east South Asia and the Amazon in 1997–98, provoked by the severe droughts due to the El Niño event. In Indonesia alone, these fires enveloped 2.4 million ha of forest and peat land. Other drivers can be important in different regions of the globe, such as

insect damage, drainage or other forms of alteration of wetlands, permafrost destruction in high latitudes (Hays, 2008).

2.3.2 Indirect drivers of deforestation

Indirect drivers of deforestation are caused by fundamental social processes which are usually revealed as a sophisticated interplay of factors of different nature.

Economic factors such as rapid market growth and incorporation into the global economy, commercialization, urbanization and industrialization, growth of demand for forest-related consumer goods and poverty are crucial across many tropical regions (Robert, 2007).

Institutional factors include taxation, subsidies, corruption and property rights are frequently tied to economic drivers.

Cultural and sociopolitical factors like lack of public support for forest protection and sustainable use, low educational level, and low perception of public responsibilities also play a substantial role. Population growth, density, and spatial distribution are usually not a primary driver of deforestation: these are always combined with other factors. Nevertheless, in a number of studies, population density was discovered to be highly correlated with the determination of certain land-use patterns often connected to deforestation. Impacts of some of the above factors are often difficult to separate (Robert, 2007).

2.4 Effects of Deforestation

The effects of deforestation are far- reaching as they exceed national boundaries. This accentuates the need for a global approach to confronting the problem.

2.4.1 The effects of deforestation on the environment

It is widely known that forest serve as source of raw materials for paper industries, saw mills industries and source of food. However, the destruction done by the haphazard forest resources exploitation in our environment surpassed its assumed benefits (Fuwape, 1989).

Robert (2007) revealed some of the effects of indiscriminate forest exploitation on the environment, which includes;

i. It leads to spread of semi-arid areas and desert encroachment
ii. Non-selective forest exploitation results in the decline in number of biodiversity and extinction of many species. The removal of vegetal covers has resulted in a degraded environment with reduction in biodiversity
iii. Landslides, flooding and soil erosion are as a result of deforestation. Areas where deforestation took place become source of surface water runoff which moves much faster than subsurface flows. Faster movement of surface water can result into flash flooding and more localized floods thereby reducing the amount of nutrient in the soil.
iv. Evapo-transpiration has decreased due to indiscriminate exploitation of forest which reduces atmospheric moisture in some situations that affect precipitation levels.
v. Relocation and destruction through migration of wildlife and consequent reduction in the supply of animal protein.
vi. Haphazard removal of vegetal covers and resultants exposure of the soil to erosion. The expected benefits of exploitation of forest resources can be achieved better by adoption of afforestation, forestation, reforestation and discouragement of illegal hunting and lumbering. Since forest are the most diverse ecosystems on the earth and 80% of the world's known

biodiversity is found in the forests, destruction of significant areas of forest cover has resulted in a degraded environment with decreased biodiversity (Adeyoju, 1965).

vii. Unselective forest exploitation results in changes in the composition and structures of the initial vegetal cover, High peak vegetation are destroyed in the process.

2.4.2 Socio-economic effects of deforestation

Colchester and Lohmann (1995) affirmed that deforestation is an expression of social injustice. There are numerous social consequences of deforestation with long tern negative impacts. The instant social impact of deforestation happens at the local level, the loss of ecological services provided by the forests. Forests afford human valuable services such as erosion prevention, water treatment, flood control, fisheries protection and pollination functions that are specifically significant to the world's poorest people who depend on natural resources for their day to day survival. By destroying the forests, we risk our own quality of life, gamble with the stability of climate and local weather, threaten the existence of other species and undermine the valuable services provided by biological services (Schmink & Wood, 1992).

According to Oyewale (2006) forest resources is a source of wealth to the communities that make use of them, the livelihood of the inhabitants depends on the forest. The rural dwellers trade in forest products to earn a living and meet their other needs. Fruits, herbs, wildlife and fuel wood provided by the forest are sold to earn extra income. Both urban and rural dwellers earn income from these forest activities. But it is a shame today that the level of income usually earned from the forests has been reduced incredibly as a result of deforestation.

Otegbeye (2000) discovered that in some parts of Sudano-Sahelian region, the drying effect of the prevailing wind on the soil is reduced because of the presence of trees on farmlands, which conserve soil moisture needed for better crop growth and development. Trees retard the speed of sand planted crops. Without wind breaks, already planted crops may be lost. Replanting is an economic setback in terms of seeds and labor costs. In extreme cases, delayed planting may lead to low crop yield, food insecurity and low returns on investment.

Hasen (1997) comprehensively documented that, by destroying the forests, all the future expected employment and revenues that could be gotten from the sustainable management for timber and non- timber products vanished. The tropical forests scorched each year amounts to a loss in forest capital value at $45 billion.

2.4.3 Effects of deforestation on agricultural productivity

With increasing deforestation, agricultural lands are destroyed. In a highly deforested environment, agricultural productivity will reduce when the soil nutrients are exposed to erosion, because the vegetal cover that are supposed to serve as protective cover for it has been removed indiscriminately. As vegetation resources decline due to lumbering, bush burning, bad system of farming and urbanization, there will be a decline in agricultural productivity because these factors will result in loss of soil nutrient content. Falconer (1992) lamented that due to the deforestation of natural forests, the pressure on agricultural land will be doubled. Otegbeye (2003) was of Similar notion that, honey production which is another form of agricultural practice has declined in the farming communities in the country because of the disappearance of forest tree species from the environment.

Famuyide *et al*. (2000) noted that, Agricultural production is a source of subsistence and cash income to the rural populace. Produce from agriculture such as cocoa, groundnut, coffee, yam, rice, beans, etc. Are relied upon to provide nutrition to the people and generate income or revenue for the people and government. Agricultural production has significantly reduced as a result of haphazard exploitation of forests.

2.4.4 The ecological costs of deforestation

Sahney *et al.* (2010) expressed that, on a human scale, reduction in biodiversity is as a result of deforestation and a natural scale is believed to cause the extinction of numerous species. The clearing of areas with vegetal covers can result in degraded environment with decline in biodiversity. With motive of meeting the demands of the ever growing population, loggers and fuel wood traders are believed to cut down trees covering thousands of kilometers of standing forests, consisting of wet wood to meet urban demands.

Ibrahim (2005) elaborated that in Nigeria, cutting down trees for fuel wood is largely practiced in rural areas leading to deforestation and resulting in the removal of important species of trees which could be used to improve variety of crops and boost Agricultural productivity which is the backbone of rural livelihood. Nigeria is losing over 600,000 hectares of the total 9.6 million hectares of forest cover to deforestation as a result of the fuel wood exploitation, unselective logging and bush burning. Below are some of the identified ecological costs of forest indiscriminate exploitation

2.4.5 Land degradation

The soil looses it ability and affinity to check surface run off when trees are cut down. Apart from inducing erosion, it reduces the fertility of the top soil and the ability to generate vital nutrients, as it has been discovered from the analysis of data. In Nigeria desertification and soil erosion are now destroying agricultural land development and productivity in agricultural zones (Ibrahim, 2005).

2.4.5.1 *Loss of soil fertility*

A forest recycles its own nutrients from leaves, dead plant stems, dead organisms and agricultural residues like corn cobs, corn stalk, dung, rice stalk etc. scattered on the forest's surface when left untampered with when these residues are removed from the lands, the consequence is that the soil will be deprived of the important nutrients that these residues would have made available for the soil. This phenomenon was attributed to the failure of crops in Nigeria in 1990s (Ibrahim, 2005).

2.4.5.2 *Fauna species loss*

Obueh (2000) echoed that of the 247 classified species of mammals in Nigeria, thirty are already endangered and about half are on brink of extinction. Decreasing the size of the forest for wood usually razed the habitat of some vital species of animals leading to extinction.

2.4.5.3 *Reduced pollination*

Species of trees in the tropics are usually male and female trees. Birds, bats, and pollinating insects carry pollen grains from the male to the female tree flowers. Although, this process can only have happened if the tree grows adequately to be within the flying radius of the insects or birds. If the distance is greater the trees would no longer be able to regenerate (Ibrahim, 2005).

In recent time, the production capacity of the forest has been outpaced due to the non- selective exploitation of forest by the farmers, hunters, and lumbermen. Consequently, exploitation of forest resources for profit – based motives can be destructive to the environment if it is not well planned.

It is believed that the major reason for the increased rate of deforestation in Nigeria is due to the continuous exploitation of forest resources so as to source for raw materials in wood processing industries, fuel and non- profit oriented motive. Deforestation has many negative impacts on the environment such as acid rain, pollution, increase in erosion rate, flooding, desertification and changes in the world climate which have resulted in great environmental problems in our society (Myers, 1988).

Myers (1988) reported that soil under primary forest erodes at an average rate of 12 tons per hectare per year while open vegetation in deforested area occasioned by the timber logging even within upland topography, erode at the rate of about 84 tons per hectare per year. The leading environmental problem in Nigeria is land degradation in form of erosion, loss of soil fertility, severe moisture stress and deforestation resulting from gathering of fuel wood, intensive land use systems combined together with low technological know – how.

2.5 Forest Exploitation and Land Degradation

Agele (2011) stated that land degradation implies loss of biological and economic productivity of soil as a result agricultural, urban development and mining activities. Such degradation shows changes in physical and chemical properties of the soil, loss of biodiversity, forest cover, nutrient cycling and energy balances. Notwithstanding, the vital role of forest to the economic development

and environment, there has been indiscriminate exploitation of forest resources particularly in the tropics.

Mohammed and Butswat (2005) found that the annual rate of deforestation between 1980 to 1990 in Northern Nigeria alone runs to about 92,000 hectares while the Southern rainforest which covers only 2 per cent of the total land in Nigeria is being exhausted at annual rate of 3.5 per cent. Extensive deforestation in Nigeria, especially in the lower land forest areas, has led to number of problems including flooding, sheet and gully erosion. Other activities that add to destruction of vegetation in Nigeria include persistent bush burning, intensive grazing, and absence of fallow periods as well as extension of agricultural activities to less favored, usually environmentally delicate areas. Severe land degradation is usually the end result of deforestation, bush burning, over cultivation and intensive grazing.

Otegbeye (2003) disclosed that generally, removal of vegetal covers aggravates local flooding, increase soil erosion, diminishing land productivity and accelerates surface runoff. Serious land degradation has also caused desertification. Severe ecological and socio-economic problems which include food shortage, wood shortage, erosion, flooding, and destruction of wildlife habitat and increased poverty particularly in the rural communities are aggravated by deforestation. To curb all these environmental problems, there is need to stop indiscriminate forest resources exploitation and start practicing sustainable forest development to create an environment that will meet the needs of the present generation without compromising the ability of the future generations to meet their own needs.

2.5.1 Process of land degradation

Lar *et al.* (1989) grouped the processes of land degradation into five classes as stated below:

i. Stalinization: this process has to do with all the types of land degradation brought about by increased concentration of salt in the soil,
ii. Lowering of the water table: this is caused by pumping of ground water for irrigation which exceeds the natural recharge capacity. This form of land degradation is brought about by pumping of water for urban and industrial uses.
iii. Erosion by water: this includes inter-rill and rill erosion, gully and landslides caused by clearing of vegetation.
iv. Water logging: this is induced by over irrigation and restricted infiltration of water into soil. This lowers land productivity through the rise in ground water close to the soil surface.
v. Soil fertility decline: this simply means the deterioration in biological activity; abasement in soil physical properties caused by reduced organic matter and adverse changes in soil nutrients status including reduction in availability of the major nutrients.
vi. Land degradation is the direct result of unselective forest exploitation. The high intensity of rainfall leads to accelerated soil erosion once deforestation occurs and poor farming practices encourages land degradation.

2.6 Deforestation and Land Use/ Land Cover Change

Patel *et al.* (2019) defined Land cover change as a change in certain continuous characteristics of the land such as vegetation type, soil properties, and so on; whereas land-use change consists of an alteration in the way certain area of land is being used or managed by humans. This involves the transformation in the natural landscape due to urban growth. It is interesting to note that this change is responsible for a number of local and global effects, including biodiversity loss and its

associated effects on human health, and the loss of habitat and ecosystem services. It is mainly driven by urban growth and is particularly important now for developing and underdeveloped countries. However, natural causes may result in land cover change, but land-use change requires human intervention (Joshi *et al.,* 2016).

Land-cover change has numerous ecological, physical and socioeconomic consequences. On the positive side, agricultural expansion may increase food production for a growing population, although it is unclear how productive the last exploited lands will be as they are typically the least favorable. There are numerous negative consequences with both known and unknown links and feedback mechanisms (Otegbeye 2003).

Holder (2004) observed that converting the natural vegetation to agricultural land is likely to change the radiation balance of the given unit of area. In principle, the albedo increases as land is without vegetation at least in some parts of the year causing more solar energy to reflect back to the space. Other environmental impacts include the decrease in soil water-holding capacity. As natural vegetation is replaced by agriculture, soil porosity may be reduced by soil compaction, decreasing infiltration capacity and increasing the risks of soil erosion. In mountainous areas, the conversion of the forests to agricultural lands decreases as does the occult precipitation as croplands capture less atmospheric moisture than multilayered indigenous forest or forest of any kind. Cloud formation over the land unit also decreases as the evapo-transpiration rate is less from fields than from forests causing evidently reduced precipitation.

Performing land use change detection is an important tool to understand the extent of land cover loss and gain over time. Understanding the characteristics, extent and pattern of land use land cover change (LULCC) is an important supporting tool for decision making processes (Armenteras *et*

al., 2019). Detecting land use change over time has become increasingly important consideration for environmental management (Kiswanto *et al.,* 2018). Therefore, studying the rate of LULCC support a decision making processes. Due to world population boom and advancement in science and technology, the natural resources are overexploited for the sake of economic activities with high severity in developing countries. Agricultural expansion into the forest land, timber logging, charcoal production and firewood harvesting are the major drivers of deforestation in Africa (Declee *et al*., 2014; Muhati *et al*., 2018). Small holder farmers collect fuel wood, construction materials, wild foods, and other forest products for subsistence (Nerfa *et al*., 2020).

2.7 Role of Remote Sensing and GIS in LULCC

As indicated by Surabuddin *et al.* (2015), Remote Sensing and Geographic Information System (GIS) have been developed as useful tools to render spatial stocks of daily property and condition. Remote detecting and GIS, and procedure based demonstrating play significant parts in spatial and dynamic evaluation of a zone. GIS and Remote sensing approach have been generally utilized over the world for the investigation of sequential changes in LULC and LST examination. As indicated by Weng *et al*. (2004), vegetation cover, air contamination, LST and other surface characteristics can be distinguished utilizing Remote Sensing. Moreover, the connection between Land Surface Temperature and LULC is essential to deal with the land. Progressions in LULC can be examined over a period using Landsat sensors such as Landsat MSS information and Landsat TM information using methodologies for picture arrangement as expressed by Gumindoga *et al*. (2014).

Landsat satellites have been delivering repetitive, descriptive, global coverage of high-resolution multi-spectral imagery since 1972. According to Haile *et al.* (2010), who analyzed the LULC

dynamics in Southern Ethiopia's Borana rangelands and its implications since the 1960s, the interpretations of remotely sensed data such in analytical applications, aerial photographs and satellite images were found to be useful.

Ronchi, 2018; Bekele *et al.* (2019) acknowledged that Land use and land cover (LULC) dynamics globally are important landscape practices able to modify the fuxes of biotic and abiotic components and how they interact with each other. Anthropogenic changes of the earth's surface are calculated to have reached unrivaled extent, and the conversion of Land Use and Land Cover (LULC) are estimated as widely significant globally (Melese, 2016; Zhang *et al.,* 2015).

Pervez *et al.* (2016) and Srivastava *et al.* (2013) stated that Remote Sensing (RS) and Geographic Information System (GIS) are essential tools in obtaining accurate and timely spatial data of LULC, as well as analyzing the changes in a study area. RS images efficiently record LULC conditions and offer a tremendous source of data, from which updated LULC information and changes can be extracted, analyzed and simulated efficiently in the detection and monitoring of land uses at different scales (Rai *et al*., 2017; Singh *et al*., 2017). GIS on the other hand offers a flexible environment for collecting, storing, displaying and analyzing digital data necessary for change detection (Panwar and Malik, 2017). Although there are several methods for detecting and analyzing LULC changes (Lu *et al.,* 2004; Ayele *et al.,* 2018), RS and GIS approaches make it possible to effectively monitor and forecast the trends in LULC changes via the study of historical remotely sensed imagery. This could offer a foundation for systematic and effective land use planning, management and ecological restoration for socio- economic development (Liping *et al.,* 2018).

2.8 The Role of Forest in Soil Nutrients Availability

Vardan (2012) indicated that, the Role of forest in soil nutrient cycling cannot be underemphasized. Forest exert a significant influence on the soil profile development and contribute substantially to the soil organic pool through their litter such as leaves, roots and stem. The protective role of forest in protecting soil nutrient against erosion cannot be overemphasis. Forest aids the transfer of nutrient from atmosphere to the soil. FAO (1997) recognized that Forest actively contributes to the availability of nutrients in the soil. In addition, they have cultural and recreational value; they perform multiple roles such as preventing soil degradation and erosion. Despite these benefits of forests, reports continue to indicate huge forest losses. The establishment of a forest cover under good management is an effective means of increasing organic matter production and soil nutrient contents; it helps in rehabilitation of degraded soil. The trees are always relied upon all over the world to rebuild the soil already damaged and degraded by erosion as a result of deforestation and to improve the properties of the soil that are too fragile to withstand rain and runoff. The forests through their roots and the interception of precipitation by their crowns, improve and restore soil fertility and prevent soil erosion (Lamb, 1990). Soil nutrient contents however, are reduced because of the indiscriminate exploitation of forest.

2.9 The Effects of Regulation Enforcement on Forest Based Livelihoods

Most regulating bodies such as public agencies in an attempt to halt deforestation by introduce new laws and regulations to stop people from trespassing into forest reserves. These laws sometimes prevent communities that depend on forest resources from accessing non- timber forest products which is very important for their survival.

Sunderlin *et al.,* (2005) give a detailed explanation of forest based livelihood activities that involved important human-forest relationship. There are three types of forest- based livelihood activities, which include; the first activity contains hunting and gathering of food and other non-timber forest products. The second activity is the slash and burn form of farming. The third activity is the sedentary agriculture and marketing of forest products (Sunderlin *et al.,* 2005).

Hunting and gathering was identified as a major livelihood activity for people who live close to the forest. Gathering of a wide variety of forest products such as fuel wood, bush meat, fruit, herbal medicines, weaving material and wood for construction. These products are reaped for both subsistence and commercial use on regular basis (Shackleton and Shackleton, 2004).

Most of the above listed forest-based livelihoods are greatly hampered by policy and regulations in relation to the forest (Sunderlin *et al.,* 2005). Kaimowitz (2003) explained many situations under which the livelihoods of poor rural households and communities will be affected as a result of strict enforcement of forest management laws.

Rural households can be negatively affected or can be strengthened depending on the character of the forest laws. Many existing laws have serious negative impacts for rural livelihoods.

Major negative impacts include government interference with traditional and indigenous forest regulations regarding the use of the forest, threat to physical security, loss of social capital, loss of job opportunities and access to forest resources such as food and fuel wood. Eventually, enforcement of these laws can cause further degradation of forest. However, other legislation can improve the livelihoods of local communities living close to the forest areas. This can be done by ensuring the rural communities have access to non-timber forest products, decreasing the level of

violence by stricter control and punishment of illegal activities, helping to maintain the long term supply of forest products that serve poor households, promoting poor people ‘s participation in decision making and respecting poor households rights, cultures and tradition (Shackleton and Shackleton, 2004).

2.10 Review of Related Literature

Negassa *et al.* (2020) studied forest cover change using Geographic information systems and remote sensing techniques: a spatio-temporal study on komto protected forest priority area. East wollega zone, Ethiopia. Forest plays a vital role in carbon sequestration and regulating the climate. Komto forest is the only remaining active natural forests found in GutoGida district of east wollega zone, Ethiopia that provide and support the local community for energy, construction and household furniture. Presently, affected by Land use Land Cover Change (LULCC), this forest has been decreasing at a worrisome rate. Determining and understanding the driving force has a vital role in decision making processes. This study examined differences in forest cover dynamics over the period 1991-2012 using Landsat TM image of 1991, ETM + of 2002 and OLI-TIRS of 2019. The result of detection revealed that a considerable increase of agricultural land from (24.78%) in 1991 to (33.5%) in 2019 with annual expansion rate (23.68%) per annum, where the forest has decreased by (20.1%) in 1991 and (37.38%) in 2019 with annual decreasing rate of 4.18% per annum. Finding shows the increment of settlements, agricultural land and grassland; whereas the open and dense forest covers indicate a declining trend. The declining of forest cover is presumably to cause unpleasant environment which would affect human wellbeing. Timber exploitation and charcoal production are other problems that accelerate the declining of forest covers.

MacDonald *et al.* (2019) examined Amazon deforestation drives Malaria transmission, and Malaria burden reduces forest clearing. Deforestation and land use change are among the most pressing anthropogenic environmental impacts. In Brazil, a resurgence of malaria in recent decades paralleled rapid deforestation and settlement in the Amazon basin, yet evidence of a deforestation driven increase in malaria remains equivocal. Hypothesized underlying cause of this ambiguity is that deforestation and malaria influence each other in bidirectional causal relationships. Deforestation increases malaria through ecological mechanisms and malaria reduces deforestation through socioeconomic mechanisms and that the strength of these relationships depends on the stage of land use transformation. They tested these hypotheses with a large geospatial dataset encompassing 795 municipalities across 13 years (2003 to 2015) and showed that deforestation has a strong positive effect on malaria incidence. The results suggest a 10% increase in deforestation leads to a 3.3% increase in malaria incidence, (9,980 additional cases associated with 1,567 additional km2 lost in 2008, the study midpoint, Amazon-wide). The effect is larger in the interior and absent in outer Amazonian states where little forest remains. However, this strong effect is only detectable after controlling for a feedback of malaria burden on forest loss, whereby increased malaria burden significantly reduces forest clearing, possibly mediated by human behavior or economic development. They estimate a 1% increase in malaria incidence results in a 1.4% decrease in forest area cleared (219 fewer km2 cleared associated with 3,024 additional cases in 2008). This bidirectional socioecological feedback between deforestation and malaria, which attenuates as land use intensifies, illustrates the intimate ties between environmental change and human health.

Prevedello *et al.* (2019) investigated impacts of forestation and deforestation on a local temperature across the globe. Changing forest cover is a key driver of local climate change

worldwide, as it affects both albedo and evapotranspiration (ET). Deforestation and forestation are predicted to have opposing influences on surface albedo and ET rates, and thus impact local surface temperatures differently. Relationships between forest change, albedo, ET, and local temperatures may further vary regionally, as the strengths of warming by albedo effects and cooling by ET effects vary with latitude. Despite these important relationships, the magnitude of forest cover effects on local surface temperature across the globe remains unclear. Using recently-released global forest change data shows that forestation and deforestation have pervasive and opposite effects on LST, ET and albedo worldwide.

Deforestation from 2000 to 2010 caused consistent warming of 0.38 ± 0.02 (mean ± SE) and 0.16 ± 0.01°C in tropical and temperate regions respectively, while forestation caused cooling in those regions of -0.18 ± 0.02 and -0.19 ± 0.02°C. Tropical forests were particularly sensitive to the climate effects of forest change, with forest cover losses of ~50% associated with increased LST of 1.08 ± 0.25°C, whereas similar forest cover gains decreased LST by -1.11 ± 0.26°C. Secondly, based on a new structural equation model, they show that these changes on LST were largely mediated by changes in albedo and ET. Finally, based on this model, which indicated that predicted forest changes in Brazil associated with a business-as-usual land use scenario through 2050 may increase LST up to 1.45°C. Their results contribute to a better understanding of the mechanistic inter-relationships between forest change and changes in albedo, ET and LST, and provide additional evidence that forestation has the potential to reverse deforestation impacts on local climate, especially in tropical and temperate regions.

Vasco and Bohdan (2018) appraised the value chain of charcoal production and implications for forest degradation: case study of Bié Province, Angola. Forest degradation and forest loss

endangered the continuity of many species and reduce the ability of forests to provide necessary ecosystem services. In Angola, clearing for agriculture is an important driver that accelerates deforestation. Charcoal production for urban consumption as a driver of forest degradation has had frightening effects on natural forests, social and economic livelihood of the rural dwellers. The charcoal impact on forest cover change is in the same order of magnitude as deforestation caused by agricultural expansion. However, there is a need to monitor the linkage between charcoal production, forest and land degradation. The aim of this study was to explore the sequence of the charcoal value chain as a systematic key to identify policies to reduce forest degradation in the province of Bié. It is a comprehensive study of the charcoal value chain that does not stop on the production and the consumption side.

The primary data of this study came from 330 respondents obtained using different methods (semi-structured questionnaire survey and market observation conducted in June to September 2013–2014). A logistic regression (logic) model in IBM SPSS Statistics 24 (IBM Corp, Armonk, NY, USA) was used to analyze the factors influencing the decision of the households to use charcoal for domestic purposes. The finding indicates that 21 to 27 thousand hectares were degraded due to charcoal production. By describing the chain of charcoal, it was possible to assess the driving factors for charcoal production and to obtain the first-time overview flow of charcoal from producers to consumers in Biéprovince. The demand for charcoal in this province is more likely to remain strong if government policies do not aim to employ alternative sources of domestic energy.

Singh *et al*. (2017) studied the deforestation and forest degradation drivers in developing countries. Countries are encouraged to identify drivers of deforestation and forest degradation in the

development of national strategies and action plans for REDD+. They provided an assessment of proximate drivers of deforestation and forest degradation by synthesizing empirical data reported by countries as part of their REDD+ readiness activities, CIFOR country profiles, UNFCCC national communications and scientific literature. Based on deforestation rate and remaining forest cover 100 (sub) tropical non-Annex I countries were grouped into four forest transition phases. Driver data of 46 countries were summarized for each phase and by continent, and were used as a proxy to estimate drivers for the countries with missing data. The deforestation drivers are similar in Africa and Asia, while degradation drivers are more similar in Latin America and Asia. Commercial agriculture is the most important driver of deforestation, followed by subsistence agriculture. Timber extraction and logging drives most of the degradation, followed by fuel wood collection and charcoal production, uncontrolled fire and livestock grazing. The findings reflect the most up to date and comprehensive overview of current national-level data availability on drivers, which is expected to improve over time within the frame of the UNFCCC REDD+ process.

Solomon *et al.* (2018) researched on the effect of land cover change on carbon stock in dynamics in dry Afromontane forest in Northern Ethiopia. Forests play an important role in mitigating global climate change by capturing and sequestering atmospheric carbon. Quantitative estimation of the temporal and spatial pattern of carbon storage in forest ecosystems is critical for formulating forest management policies to combat climate change. This study explored the effects of land cover change on carbon stock dynamics in the Wujig Mahgo Waren forest, a dry Afromontane forest that covers an area of 17,000 ha in northern Ethiopia. Results shows the total carbon stocks of the Wujig Mahgo Waren forest ecosystems estimated using a multi-disciplinary approach that combined remote sensing with a ground survey for 1951, 1999, and 1955 GgC in 1985, 2000 and 2016 years respectively. The mean carbon stocks in the dense forests, open forests, grasslands,

cultivated lands and bare lands were estimated at 181.78 ± 27.06, 104.83 ± 12.35, 108.77 ± 6.77, 76.54 ± 7.84 and 83.11 ± 8.53 MgC ha−1 respectively. The aboveground vegetation parameters (tree density, DBH and height) explain 59% of the variance in soil organic carbon. The findings revealed estimates of mean carbon stocks in ecosystems representing the major land cover types are of importance in the development of forest management plan aimed at enhancing mitigation potential of dry Afromontane forests in northern Ethiopia.

Vijay *et al.* (2016) investigated the impacts of oil palm on recent deforestation and biodiversity loss. Globally, Palm oil is the most widely traded vegetable oil, with the current demand projected to increase considerably in the future. Virtually all oil palm grows in areas that were once tropical moist forests, some of them quite recently. The conversion to date, and future expansion, threatens biodiversity and increases greenhouse gas emissions. Today, consumer pressure is pushing companies toward deforestation-free sources of palm oil. To guide interventions aimed at reducing tropical deforestation due to oil palm, they analyzed recent expansions and modelled likely future ones. They assessed sample areas to find where oil palm plantations have recently replaced forests in 20 countries, using a combination of high-resolution imagery from Google Earth and Landsat. They then compared these trends to countrywide trends in FAO data for oil palm planted area. Finally, they assessed which forests have high agricultural suitability for future oil palm development, which we refer to as vulnerable forests, and identified critical areas for biodiversity that oil palm expansion threatens. Their analysis reveals regional trends in deforestation associated with oil palm agriculture. In Southeast Asia, 45% of sampled oil palm plantations came from areas that were forests in 1989. For South America, the percentage was 31%. By contrast, in Mesoamerica and Africa, they observed only 2% and 7% of oil palm plantations coming from areas that were forest in 1989. The largest areas of vulnerable forest are in Africa and South

America. Vulnerable forests in all four regions of production contain globally high concentrations of mammal and bird species at risk of extinction. However, priority areas for biodiversity conservation differ based on taxa and criteria used. Government regulation and voluntary market interventions can help incentivize the expansion of oil palm plantations in ways that protect biodiversity-rich ecosystems.

Salau (2020) stated that the loss of tropical forest in many countries means the collapse of major carbon sinks and generation of more carbon dioxide which is serious threat to global climate and atmospheric temperature distribution. The process of deforestation may result in many negative effects with mix implications, but long-term environmental consequences such as global warming, biodiversity loss and soil degradation are often identified. There is an established relationship between deforestation and global warming because forests, notably tropical forests are major carbon sinks. In view of the foregoing, on-field assessment was undertaken to determine differential rate of deforestation in forest reserve and adjacent parkland in Mokwa LGA of Niger State. Satellite imagery was used to show the extent of forest reserves and adjacent parkland. Descriptive survey design and Geo- information techniques were adopted for the study and it covers changes between 1985 and 2017 of which 1985, 2000 and 2017 serve as specific date for imagery acquisition. Imageries were the main instrument used, and data were analyzed using descriptive statistics. The findings revealed that between 1985 and 2017, various changes in forest cover loss occurred in forest reserve (88.2% to 44.8%) and adjacent parkland vegetation (43.4% to 32.3%), although net loss across years tends to be more in forest reserve area. However, during the same period, there was an increase in non-forested land in forest reserve (11.8% to 55.2%) and in adjacent park land (56.6% to 67.7%) respectively. The results also revealed that rate of deforestation in forest reserve area between 1985 and 2017 increased by 60.70ha/year at the rate

of 11.6% as against 16.1ha/year at the rate of 0.6% for the same period in adjacent Parkland. It was recommended that there is a need for rural advocacy to educate farmers and create awareness on the negative consequences of deforestation. Also, local people should be encouraged to practice agroforestry, and be actively involved in institutional participation in forestry management and conservation.

Jeminiwa *et al.* (2020) stated that forest degradation has become a major concern in many countries around the world as it has become one of the most debilitating land use crisis in tropical ecosystems. Hence, this study assessed the forest degradation indices in Mokwa forest reserve. Data were collected using structured questionnaires and field reconnaissance survey. Five settlements were selected in and around the forest reserve namely Mokwa, Jangi, Epa, Kpataki and Tswanle. Data were analyzed using descriptive and inferential statistics. Results showed that farming (41.7%) was the main occupation of the people, artisan works (18.8%) and studentship had the least (4.2%). Briquetting of charcoal (20.8%) was the highest causes of forest degradation; commercial farming (18.8%), overgrazing (16.7%) and population increase was the least (4.2%).Global warming (22.9%) was the major effect of degradation in the study area, soil erosion (20.8%) and the least was low rainfall (9.4%). Agro-forestry practices (27.1%) were recorded as the main mitigation measure for reducing degradation in the area. This was followed by Afforestation and enrichment planting (22.9%), tree planting campaign (18.8%) and the least was forest conservation and management (6.3%). The stepwise multiple regression analysis of the causes with other variables showed that briquetting of charcoal had the highest R^2 (0.88), followed by commercial farming R^2 (0.84), while population increase had the least R^2 (0.57). Nevertheless, sustainable empowerment programs are recommended to boost the livelihood of the rural populace and to reduce the overdependence of the people on the forest reserve.

Bako *et al*. (2015) assessed vegetal covers transition in the Zugurma Sector of Kainji Lake National Park, Nigeria. National parks play a vital role in modern way of conserving biodiversity. In the future it is expected to be a significant strategy for National biodiversity conservation. The study used satellite derived data such as satellite imageries of 1986, 2000 and 2010 were obtained from GLCF and classified using ArcGIS. Agricultural resources found in the study area were evaluated using Normalized Difference Vegetation Index (NDVI); to understand the human and socioeconomic impacts on the flora dynamics. Interviews and Questionnaire were used; mathematical modeling was used to project the study area to the year 2020. Different softwares (ArcGIS 10.1, SPSS 10.O, Microsoft Office Excel, 2007 and Microsoft Office Word, 2007) were used. Findings revealed that there is drastic decline in forest cover between 1986-2010, while farmlands around forest increases in year 2000 yet reduced again in 2010. Settlements increased as a result of immigration, while the virgin lands around the forest increased or reduced based on variation in climate, human activities and soil erosion. From the classified satellite imageries, NDVI maps were used to show the changes in vegetation indices for Zugurma in 1986, 2000 and 2010. These changes ranged from 0.473684 to 0.503106 then to 0.491525 respectively; this high NDVI values suggests that the forest had degraded undoubtedly as a result of deforestation or climatic factors. The low NDVI shown by the maps are -0.0616327, -0.386773 and -0.118644 for 1986, 2000 and 2010 respectively. It was projected that by 2020, forest will have a percentage of 32.878% (from 70.52%), while farmlands are expected to increase to 25.815% (from 11.34%), Settlements to 29.259% (from 12.85%), bare lands will be the lowest with about 12.048% (from 5.29%). There is a need for continuous dialogue and cooperation between the park authority and the communities around the study area to reduce human pressure on the KLNP.

Fasona *et al.* (2018) studied the drivers of deforestation and land-use change in Southwest Nigeria. Land-based mitigation presents viable mechanism for offsetting carbon deficits from land-use change-driven emissions especially in areas with relatively large lowland forests. The study reviewed key issues about the drivers of land-use change, deforestation, and forest degradation. It also presented a case assessment of perception on drivers of land-use change and deforestation using rapid appraisal data collected from 108 households and 57 forest resource users in 17 purposively selected peri-urban and rural communities in the forest zone of Southwest Nigeria. From the appraisal, lumbering and polewood extraction, fuelwood and charcoal production, crop cultivation, urban growth, animal grazing, and transportation remain important proximate land-use change, deforestation, and forest degradation drivers. Population increase and poverty are considered the most important underlying drivers. Response to economic opportunities with regard to cash (tree) and commercial arable crops and high local and export demands for wood substantially drive land-use change and deforestation. National climate change actions, natural resource policies, land tenure, international multilateral commitments, and carbon credit frameworks have very little impacts with regard to land-use change in Southwest Nigeria. Lack of alternative livelihoods undermines people's resilience and further drives deforestation and forest degradation.

Momoh *et al.* (2021) did evaluation of Socio-Economic impact of deforestation in Edo State. Deforestation creates imbalances in weather patterns, making the weather drier and hotter, consequently leading to increased drought and desertification, coastal flooding, crop failures, and dislodging major vegetation regimes. The study evaluated the socio-economic impacts of deforestation in Edo State. The study utilized ArcGis digitizing tool to determine the tree population and downscale the spatial datasets using defined boundary conditions. Signal 2.0 was

used to establish the relationship of linearity between the forest and economic loss over the region using R-square. Results revealed that as the rate of deforestation in Edo state rose from 4100ha in the year 1990 to 14100ha in 2016, there was also a gradual increase in economic loss from 0.7 to 10.9 billion naira in 2016. It was also observed that the relationship of linearity between deforestation and economic loss in Edo State shows a strong relationship at an R-square of 0.97. Therefore, there is an urgent need to take action towards ameliorating new Climate Change problems by exploring and protecting the local values of forests in order to improve livelihood sustainability. Lowering CO2 emissions is a central global focus through the International Climate Change Policy. About a 5th of emissions globally are caused primarily by deforestation. Reducing CO2 emissions is highly dependent on the reduction of forest loss which can also contribute significantly to the low-cost mitigation portfolio.

Zanuwa *et al.* (2018) studied the effects of deforestation on Human Health in Yelwa forest of Doma local Government area of Nasarawa State, Nigeria. The increase in demand for timber, fuel wood, charcoal, agricultural land and urbanization has placed pressure on forest resources in Nasarawa State. The study examined effects of deforestation on human health in Nasarawa State of Nigeria. The study adopted purposive sampling technique to choose the study area (Yalwa forest) in Doma LGA of Nasarawa State, and systematic sample was used to administer the questionnaires. The study revealed that majority (46.5%) of the respondents pointed out that logging activity is the main factor responsible for deforestation in the study area. More so, 69% of the respondents reported that malaria is the frequent disease in the study area. Also 59.6% of the respondents asserted that malaria is the most common disease their family members have been experiencing. In line with the findings the study recommends that there should be proper management and intensification of existing agriculture rather than expanding it on virgin lands.

Buba and Ayuba (2017) studied the casualty of deforestation in North-Central Nigeria: Case study of Shedam Urban Area, Plateau State. Deforestation in Africa is a major contributor to global warming, erosion, annual flooding and food shortage in Africa. In Africa, 90 percent of the population uses wood for fuel. Forests provide many products/benefits to the people but these forest resources are depleted continuously without replacement. Shendam District is geographically located between latitude 8º53′43.88″N and longitude 9º27′13.41″S in Shendam Local Government Area of Plateau State, Nigeria. The research was a case study undertaken to assess the causalities of deforestation and questionnaires were administered in ward A, ward B and Pangwasa ward of Shendam District. Anthropogenic activities is the cause of forest loss in the study area and the major effects outlined in the study area are biodiversity loss, high temperature, soil erosion, migration and flooding. The activities causing damage to roads, culverts and bridges in Shendam District and its environs. Reducing the rates of deforestation and forest regeneration is among the solution to deforestation in Shendam district and its environs. Better management practices require the need for Public Sensitization on the effects of deforestation, Public Private Partnership (PPP) in tree planting, Rural-Urban Afforestation Programme and the policy of cut-one-tree and plant-five trees instead, should be enforced in Shendam District. Subsidy Reinvestment Programme (SURE-P) should be strengthened for capacity development and human empowerment. The measures will provide alternative means of livelihood and reduce soil erosion, land degradation, flood impact, not only in Shendam L.G.A., but the entire Plateau State.

Odekunle *et al.* (2020) carried out comparative analysis of the top soil properties under forested and deforested zones: implications for the environment. An investigation was carried out to examine the properties of top soils between 0 and 15cm under both deforested and forested zones in Bowen University, Iwo, Nigeria. Top soil samples in the deforested zone was taken from the

Main Gate area of the institution while that of the forested zone was taken from the forested area opposite staff quarters of the University. The soil samples were subjected to standard laboratory tests in the University central laboratory. The results showed that deforested soil has sandy, clay and silt contents of 72.4%, 9.2% and 18.4% respectively while forested soil has 65.2%, 10.8% and 24% in the same order. Also it was discovered that soil under deforestation has organic carbon, organic matter, pH, field capacity, moisture and electrical conductivity of 0.32%, 0.55%, 6.8, 0.72 g, 126.9 g and 230 μʃ/cm respectively while soil under forest has 0.45%, 0.77%, 7.1, 0.90 g, 0.72 g, 129.2 g and 275 μʃ/cm in the same order. The implications of this result is that removal of vegetation contributes to the release of carbon into the atmosphere which increases atmospheric heat, alkalinity of soil, loss of soil nutrients and also could pose limits to the survival of plant growth and also susceptibility of soil to surface wash. Thus, it was recommended that effort should be made to checkmate the removal of vegetation and if unavoidable, relevant policies should be put in place for edge development and its maintenance and also, reforestation steps as remedies to ensure sustainable environment.

Anyanwu *et al.* (2015) research was carried out to determine the impact of deforestation on soil conditions in Anambra State. Ten soil samples were collected at random at a depth of 0-35cm below the litter layer from forests and farmlands. The soil samples were collected and analyzed for pH, field capacity, soil moisture, organic carbon, bulk density, soil micro-organism and particle size distribution. The result revealed that soil texture was mostly sandy except in some areas such as Atani, Nzam, Mmiata and Oroma-etiti, where it was generally heavy (clay loam). The result also revealed that the soil samples from the forests have better physical, chemical and biological properties compared to samples from farmlands. The results showed considerable variation for the soil physical, chemical and biological properties across the study area. Soil data were analyzed

using Least Significant Difference (LSD). The analysis revealed that the main effect of land use was significant ($p<0.05$) for soil moisture, bulk density, organic carbon, organic matter, pH, viable bacteria number and viable fungal propagule. It was not significant for sand, silt, clay and field capacity. The interaction effect of location and land use on soil properties were significant ($p<0.05$) only for soil moisture, it was not significant for other soil variables. The study recommended, among others, the protection of forests from deforestation so as to maintain good soil conditions in the study area.

Yahaya and Adebayo (2015) studied assessment of Land Use /Land Cover Changes in the Savannah Sugar project area, Adamawa State, Nigeria. Landsat satellite images obtained from the Thematic Mapper (TM) and Enhanced Thematic Mapper plus (ETM+), acquired from the United States Geological Survey (USGS) archives, and Topographic maps from the Nigeria survey departments for different dates were used. Algebraic and Markov (in IDRISI) was used for data analysis. To determine image differential from an earlier year and the latter Map algebraic was used, while Markov Method provided a change matrix with change trajectories. This was done using IDRISI software. Findings indicate that cropland has the highest increased gained from vegetation, followed by bare land, built up, marshes and water in that order. This is followed by the bare land which gained from vegetation, crop land, water built-up and marshy land. The highest decline was vegetation which gave out to crop land, bare land, marshes, built up and water. It was deduced that, land cover changes are tending towards bare soils and marshes as causes of environmental degradation, basically due to increased human activities, specifically agriculture, animal grazing, and increased construction of roads and settlements.

Bai *et al.* (2008) worked on proxy global assessment of land degradation. Causes, extent and severity of land degradation are always contested. Land degradation is long term deterioration in ecosystem service and productivity, which can be assessed using remotely sensed normalized difference vegetation index (NDVI) data. Deviation from the norm may serve as proxy assessment of land degradation and improvement if other factors that may be responsible are taken into consideration. These other factors include rainfall impacts which may be assessed by rain-use efficiency, calculated from NDVI and rainfall. Results from the analysis of 23-year Global inventory modeling and mapping studies (GIMMS) NDVI data shows decreasing efficiency adjusted NDVI on ca. 24% of the global land area with degrading areas mainly in Africa south of the equator, south east Asia and south China, north central Australia, the pampas and swaths of the Siberian and north America taiga; 1.5 billion people live in this areas. The findings are very different from the previous assessments which exacerbate current happenings with historical land degradation. Economic evaluation can be carried out when land degradation is expressed in terms of net primary productivity and the consequent data allow statistical comparison with other variables to reveal possible drivers.

Musa *et al.* (2015) investigated environmental challenges and the impact of desertification on the vegetal cover in parts of Jigawa State, Nigeria. Desertification explained the situation of land degradation in desert region as a result of variation in climate and human activities. The current impact of desertification in sahel region of Nigeria has reached a dangerous stage where crop cultivation and animal rearing and grazing are no more productive. The objective of the research paper was to analyze the land cover changes at scale of 1:100000 from the satellite images and 2009; to establish and appraise the relationship between rainfall and temperature on desertification and to assess the role of human activities to desertification of the study area. The materials and

method used for this study were Landsat images TM and ETM of different years, rainfall and temperature data of forty-five years and oral and written Questionnaires that were administered. SPSS was used to analyze the data obtained from the research questionnaire. The study employed both descriptive and inferential statistical analyses to get frequency distribution tables, percentages to determine the proportion of the variables, and the variables were tested using correlation and chi-square contingency. The result of the study has revealed the extent and rate of desertification in the study area. Findings showed human factor remained the major cause of desertification. Large proportion of arable land has been overcultivated and also the land kept aside for grazing have been taken over by farmers leaving no part of the land for grazing. Most of the trees were removed for crop cultivation or for fuel wood. Climatic and human activities are the causes of desertification in Jigawa State. Desertification has led to accelerated development of sand dunes and sand encroachment. The area has experienced vegetation cover transformation. The degradation is still reversible if there is proper land use.

Kuta *et al.* (2013) studied the analysis of forest management practice in Nigeria (Mamu Forest Reserve Orji River) and to establish the role of forest managers in effective forest Resource management. Different methods such as Questionnaires and statistical tools like tables, percentage and charts were used to arrive at considerable findings. From the findings it was recommended that human resource investment in the reserves should be increased, so that effective management of forestry resources can be achieved through strategic forest management planning. It was also discovered from the findings that since establishment of Mamu forest in 1927, it has 11.97ha of trees in 75 years which indicate and average loss of 0.2ha per annum. The lost trees are basically attributed to farming activities and annual bush burning by hunters which is more disastrous in Mamu forest compared to AkwariAni forest. Taking a cognizance of the forest management status

due to some of the problems identified, appropriate recommendations were made which include; provision of comprehensive forest resource plan showing its economic importance. Administration of Mamu forest should be improved with professionals and enactment of forest law to deal with intruders and Land use Act should be reviewed for cultivable land provision to farmers. The reserve should be funded and expanded to attract tourists.

John (2020) assessed the impacts of deforestation on socio-economic development in Nigeria. Deforestation enables the earth soil to run off into sources of water supply due to the absence of tree roots to absorb water thereby causing water pollution. Absence of tree roots further deprives the soil of important nutrients necessary for the growth of new vegetation. Through deforestation, more carbon is released into the atmosphere, climatic changes take place and soil is exposed to rainfalls thus promoting erosions. These are not without serious health implications. The trade of wood products is an obvious source of substantial income for national and local governments as well as traditional rulers and individuals. This often comes in the form of export earnings, taxes, royalties and personal income for those engaged either directly or indirectly in the exploitation of these forest products. Qualitative secondary sources of data collection were used for this study. Amongst other recommendations, is that corrupt government officials in charge of forestry laws and policies should be prosecuted together with illegal loggers. Environmental education should be accorded to the general public on the dire consequences of deforestation on people and the society at large. Skills acquisition program should be organized for rural women dwellers and the uneducated youths in order to curtail the rate of deforestation.

Gaston *et al*. (2002) examined the state and change in carbon pools in the forest of tropical Africa. To improve estimates of the state and change in C pools due to changes in land use in tropical

forests of Africa, they combined spatially explicit estimates of biomass C density, obtained by modeling in a geographical information system (GIS), with new data on the area of forests (woody formations with a minimum of 10% crown cover) reported at subnational units for 1980 and 1990 by the Food and Agriculture Organization (FAO). Estimates of the biomass C densities for grass/shrub savannas were also included using a simple model based on precipitation. The total C pool in above- and below-ground forests and grass/shrub savannas of Africa for 1980 was 50.8 Pg (10 15 g), with aboveground forest biomass accounting for 75% of the total, below-ground forest biomass for 21%, and grass/shrub savannas for 4%. Area weighted mean biomass C densities were about 180 Mg ha -1 for lowland moist forests, 82 Mg ha -1 for all forests, and 6 Mg ha -1 for grass savannas. The total change in the aboveground forest C pool for the decade 1980- 90 due to changes in land cover and use was estimated to be a decrease of 6.6 Pg C. Of this total, 43% was due to deforestation and 57% due to biomass reduction by other human activities. Six countries, mostly in central Africa, accounted for more than 73% of the total change in the C pool. The difference between state and change of C pool estimates made at the sub national scale and those made at the national scale proved to be insignificant across the region as a whole (2% for pools and - 1% for change in pool) but potentially important to individual countries (from 1 36% to - 39% for pools and from 1 43% to - 57% for change in pool). The differences between the two approaches may reflect a better match of the areas being deforested with the biomass C density of forests being cleared.

2.11 Summary

Of all the works reviewed, there is no one that attempted to investigate the causes of and impact of deforestation on land degradation in the study area. However, few researchers worked on

assessment of forest degradation, deforestation and vegetal cover transition but only covers smaller areas in the local Government. For instance, Jeminiwa *et al.* (2020) identified briquetting of charcoal and commercial farming as the major causes of forest degradation but narrowed their work to Mokwa forest reserve. Descriptive and inferential statistic used for analysis only give the summary while the other, you cannot be completely sure of the result in spite of the alpha level (confidence level). Salau (2020) also assessed the differential rate of deforestation in forest reserve and adjacent parkland in Mokwa LGA but failed to specify the causes of deforestation in the forest reserve despite using Geo-information technique. Bako *et al.* (2015) studied the assessment of vegetal cover transition in the Zugurma sector of Kainji Lake National Park using geo-information technique result and suggested that deforestation and climatic factors were responsible for vegetal loss but did not examine the trend of deforestation. Yet, there are several other works on impact of deforestation on land degradation carried out in Niger State and other parts of the world. Some of such are the works of Momoh *et al.* (2021) who worked on evaluation of socio-economic impact of deforestation; Zanuwa *et al.* (2018) on effects of deforestation on health; Buba and Ayuba (2017) studied the casualty of deforestation in the North-Central and Anyanwu *et al*. (2015) worked on impact of deforestation on soil condition. The listed work was also on the impacts of deforestation but not on people's perception on the impacts of deforestation on land degradation in Mokwa LGA.

It is understandable that deforestation has far-reaching implications in terms of environmental, social, and economic aspects of development. The literature reviewed has shown that, human activities such as logging and fuel wood use, mining, cultivation of forest areas, mining, and urbanization form major drivers of the deforestation process. This destruction of forest cover result into land degradation and climate change, such as changes in rainfall pattern, since most farmers

depend solely on rain-fed agricultural production most especially in this study area. When crop failure continues to occur persistently some farmers get worried and disturbed compelling them to quit farming for a particular time losing their means of livelihood.

Another impact of deforestation on land degradation is that the forest rural dwellers that relied on hunting as the means of their livelihoods would be hit hard by the loss of forest where gathering and hunting activities take place. In addition, deforestation makes adequate availability of water resources such as rivers, streams and springs that serve as both domestic and industrial water sources become a problem, as evidently seen in Mokwa town the headquarters of Mokwa Local Government Area where all the streams and Rivers such as Sangi, Dunmi and Gbagungi had dried up and disappeared as a result of loss of forest cover.

More so, rural or local dwellers close to the forests usually derive products mostly Non-timber forest products including leafy vegetables, mushrooms, snails and Raffia. They are of immense importance among the rural dwellers that have access to few forest resources. Due to continuous exploitation without any effort to regenerate forest resources, men, children, youth and women who engage in gathering depend on these resources tend to suffer.

Hence, this review examined what the literature has revealed regarding deforestation and its impacts on land degradation in the study area. This was extended by exploring empirically the impacts of deforestation on land degradation in Mokwa Local Government Area of Niger State, Nigeria.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Preamble

This chapter details the processes and methods used in conducting this research as well as method of presenting the result of the study.

3.2 Sources of Data

The sources of data that were used for this study are:

i. Primary Data

ii. Secondary Data

3.2.1 Primary data

The sources of primary data for this study included questionnaire and oral interview. Questionnaire were administered to the target population of the study. The questionnaire contained two sections; Section "A" contains demographic information of respondents' details such as age, gender, educational level and occupation. Section "B" contains important questions that were in line with the stated aim and objectives of this study.

3.2.1 Secondary data

The sources of secondary data that were used for this study included Landsat images (Landsat ETM 2000, Landsat ETM 2010, Landsat & OLI 2020) of the study area; journals, textbooks, newspapers, unpublished and published theses, and the internet relating to the study.

Table 3.1: Software Components

S/N	Software	Purpose
	ArcGIS 10.3	GIS analysis
	Microsoft Word	Thesis writing
	SPSS (version 20.0)	Statistical analysis

Source: Author's analysis (2021)

3.3 Method of Data Collection

The methods of data collection include questionnaire, semi-structured interview, Landsat images, and field survey.

3.3.1 Questionnaire

Questionnaire and semi-structured interview were used for the collection of vital information. Semi-structured was used for the study which entailed both closed and open ended questions. The questionnaire was tagged "People's perception on the Impacts of Deforestation on Land Degradation in Mokwa Local Government Area, Niger State, Nigeria''. Four hundred (400) questionnaires were administered in selected wards of Mokwa Local Government Area. Questionnaires were equally distributed to each ward according to their population. Simple random technique was adopted for administering questionnaires to the selected respondents from the target

population. The target respondents are the farmers, women in the community, wood dealers and authorities involved in forest management in various ward. The questionnaire was divided into four parts. The first part targeted collection of personal Data of the respondents which serves background information. The second part focused on the causes of deforestation in the study area, the third part focused on the impact of deforestation in the study area and the final part focused on needed mitigation and adaptation strategies to land degradation in the study area.

3.3.2 Landsat image

Landsat images used include Landsat TM 2000, Landsat ETM+ 2010, and Landsat OLI 2020. Landsat image provides different options for LULC Change and farmland monitoring, and the spatial resolution is good for detecting changes between Major Land use change and categories of farmland. This provides us with information to assess Land Use Land Cover Change and to examine the trend of the degradation as a result of deforestation in the study area.

Table 3.2: Details of Satellite Data Used

S/N	Sensor	Path/Row	Source	Year of Acquisition	Scale/resolution
1	TM		USGS	2000	30
2	ETM+		USGS	2010	30
3	OLI		USGS	2020	30

Source: Author's analysis (2021)

3.4 Study Population and Sampling

The coordinate of the locations in the study area were obtained from the field survey using graduated and error free Garmin GPS, location which are known to be one of the best GPS. Stratified sampling technique was adopted for the study based on the number of wards present in

Mokwa Local Government and also their involvement in farming activities. There are eleven wards in Mokwa with a population of 404,448 (WHO projection 2021). Six wards were selected randomly. These are Kpaki/Takuma, Kudu, Mokwa Central, Ja'agi, Muwo/Gbajibo and Gbara. From all the selected wards, a sample size of 400 consisting of farmers, women, head of households and forest management authorities from a list obtained from six wards which were randomly selected from the study area. A sample of 400 respondents was determined using Krejcie and Morgan (1970) model for sample size determination for finite people.

Table 3.3: Distribution of Respondents by Wards

S/N	Wards	N(Population size)
1	Kpaki/Takuma	25,162
2	Kudu	39,005
3	Mokwa	45,282
4	Ja'agi	53,670
5	Muwo/Gbajibo	84,703
6	Gbara	30,185
	Total	**278,007**

Source: (WHO Population projection, 2021)

3.5 Methodology for the Objectives

3.5.1 Assess the land use land cover changes in the study area

To achieve objective I, which is to assess the Land Use Land Cover Changes in the Study Area, four main methods of data analysis were adopted in this study and they include:

i. Calculation of the area in hectares of the resulting land use/land cover types for each study year and subsequently comparing the result.

ii. Overlay operations. – i.e. mathematical and logical operation between two raster layers on a pixel to pixel basis.

iii. Cross tab. – to determine all unique combinations of value in three qualitative images and calculate similarity statistics and

iv. Normalized difference vegetation index.

The first two methods were used to identify changes in the land use types. The comparison of the land use/land cover statistics assisted in identifying the percentage change, trend and rate of change between 2000 and 2020. In achieving this, the first task was to develop a table showing the area in kilometer and the percentage change for each year 2000, 2010 and 2020 measured against each land use/land cover type.

3.5.2 Examine the trend of deforestation in the study area

For objective 2 which is to examine the trend of Deforestation in the study Area, Percentage change was used to determine the trend of deforestation which was calculated by dividing observed change by sum of changes multiplied by 100.

$$\text{(Trend) percentage change} = \frac{\text{observed change X 100}}{\text{Sum of change}} \quad (3.1)$$

In addition, the use of spectra vegetation index, namely the Normalized Difference Vegetation Index (NDVI) was applied to detect areas of vegetation cover decrease, and Normalized Difference Built-up Index (NDBI) using equations 3.2 and 3.3:

$$NDVI = \frac{NIR - RED}{NIR + RED} \quad (3.2)$$

$$NDBI = \frac{SWIR - NIR}{}$$

SWIR+NIR (3.3)

3.5.3 Analyze the impact of deforestation on land degradation in the study area

For objective 4 which is to analyze the impact of deforestation on land degradation in the study area. The information and results gathered from questionnaire were subjected to statistical treatment using 3-point Likert type scale and were presented in tables with analyzing comments so as to demonstrate the effectiveness of the technique.

This objective was achieved using a 3-point Likert type scale with response options as very high impact (VHIM) = 3, high impact (HIM) = 2 and low impact (LIM) =1. The mean value of the responses was calculated thus:

$$\text{Mean value } (x) = \frac{3+2+1}{3} = \frac{6}{3} = 2 \quad (3.4)$$

Therefore, any variable with mean score ≥2 was considered impacted variable while those with mean scores less than 2 were regarded as less impacted variables.

3.5.4 Identify the needed mitigation and adaptation strategies to land degradation in the study area

This objective 5 was achieved through four-point Likert rating scale analysis with numerical response options in descending order of Very High Mitigation Strategy (VHMS)-4 points, High Mitigation Strategy (HMS)-3 points, Low Mitigation Strategy (LMS)-2 points and Very Low Mitigation Strategy (VLMS)-1 point. This was applied to adaptation variables too. Likert scale is a very popular rating scale used to determine respondents' agreement level. Likert scales are odd numbered scales. Most commonly used is the 5 point scale, some researchers also use the 7 point scale. Now, at times there are situations when a respondent chooses the 'Neutral' option in a 5 point

Likert scale. Researchers have started using a 4 point scale in which there is no neutral option. This is done in order to extract a specific response from the respondents which why this study choose 4 point scale.

Questionnaire and field survey was used. Descriptive statistic was used for the analysis.

3.6 Presentation of Result

The analyzed data were presented in form of charts, tables and figures to create virtual representation of the result in the next chapter (4)

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Preamble

This section detailed the results and discussion on this research. This chapter is further divided into subsections; Assessment of land use land cover changes from 2000-2020 in Mokwa Local Government Area; examination of the trend of deforestation; Analysis of the impact of deforestation on land degradation, Identification of the mitigation and adaptation strategies to land degradation in the study area and Summary of findings.

4.2 Assessment of Land use and Land Cover Changes

The land use and land cover changes of the study area was assessed from 2000-2020 as shown in Table 4.1 of the study. Each of the decadal map of the study area showed the extent and changes in vegetation, bare lands, water bodies and built-up area (Figure 4.1, 4.2 and 4.3)

Table 4.1: Extent of Land use and land cover changes in Mokwa LGA from 2000-2020

LULC2000 Gridcode	Class name	Area (Ha)	Percentage (%)
1	Water	32701.9	7.6
2	Vegetation	228691.9	53.3

4	built up areas	23351.8	5.4
3	bare land	143947.2	33.7
LULC2010			
Gridcode	**Class name**	**Area (Ha)**	**Percentage (%)**
1	Water	24307.7	5.6
2	Vegetation	171170.3	39.8
3	biult up areas	53226.0	12.3
4	bare land	181305.1	42.3
LULC2020			
Gridcode	**Class name**	**Area(Ha)**	**Percentage (%)**
1	Water	20534.6	4.7
2	Vegetation	164029.7	28
3	built up areas	36443.4	18.5
4	bare land	207463.9	48.4

Source: Author's Data Analysis (2022)

Table 4.1 showed the extent of land use and land cover changes from 2000-2020. It was discovered that in year 2000; the land area of built-up was 23351 hectares which was equivalent to about 5.4% of the total land mass and vegetation was observed to be the most dominant which covered about 228691 hectares and it was approximately 53.3% of the entire land mass.

Furthermore, in 2010, it was observed that the extent of built-up area advanced at the expense of the vegetal land. The built-up area increased to 53226 hectares which was about 12.3% than it was in the previous decade while the vegetation receded to 171170 hectares (39.8%) and the bare surface increased to 181305 hectares (42.3%). And lastly, in year 2020, the built-up area continues to increase to 36443 hectares (18.5%) from what it was in 2010, the vegetation decreased to 164029 hectares which was about 28.4% from what it was in the previous decade.

Figures 4.1, 4.2 and 4.3 display the extent of land use and land cover changes in Mokwa LGA in years 2000, 2010 and 2020 respectively.

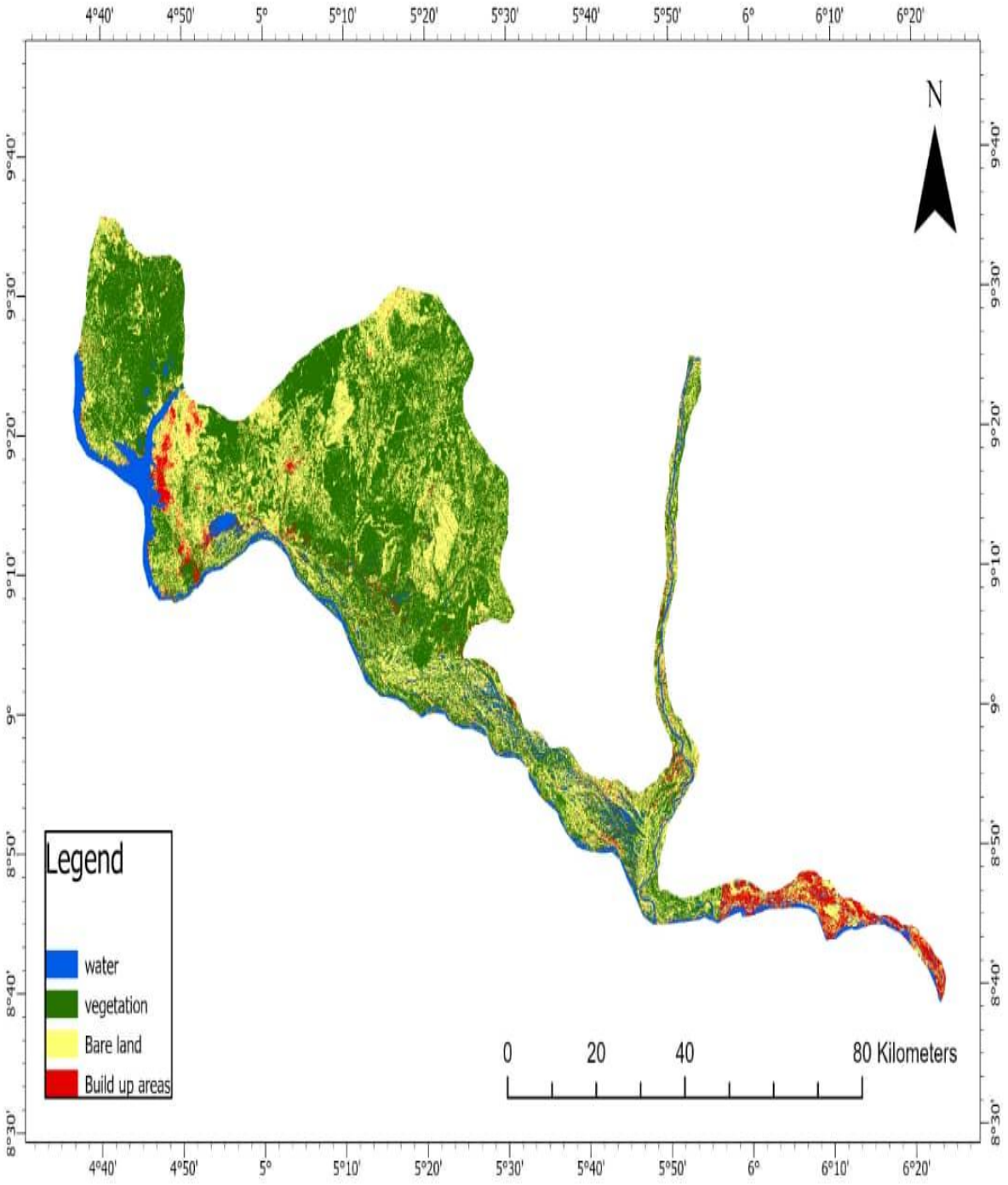

Figure 4.1: Extent of Land use and Land Cover Changes in 2000

Source: Author's data analysis (2022)

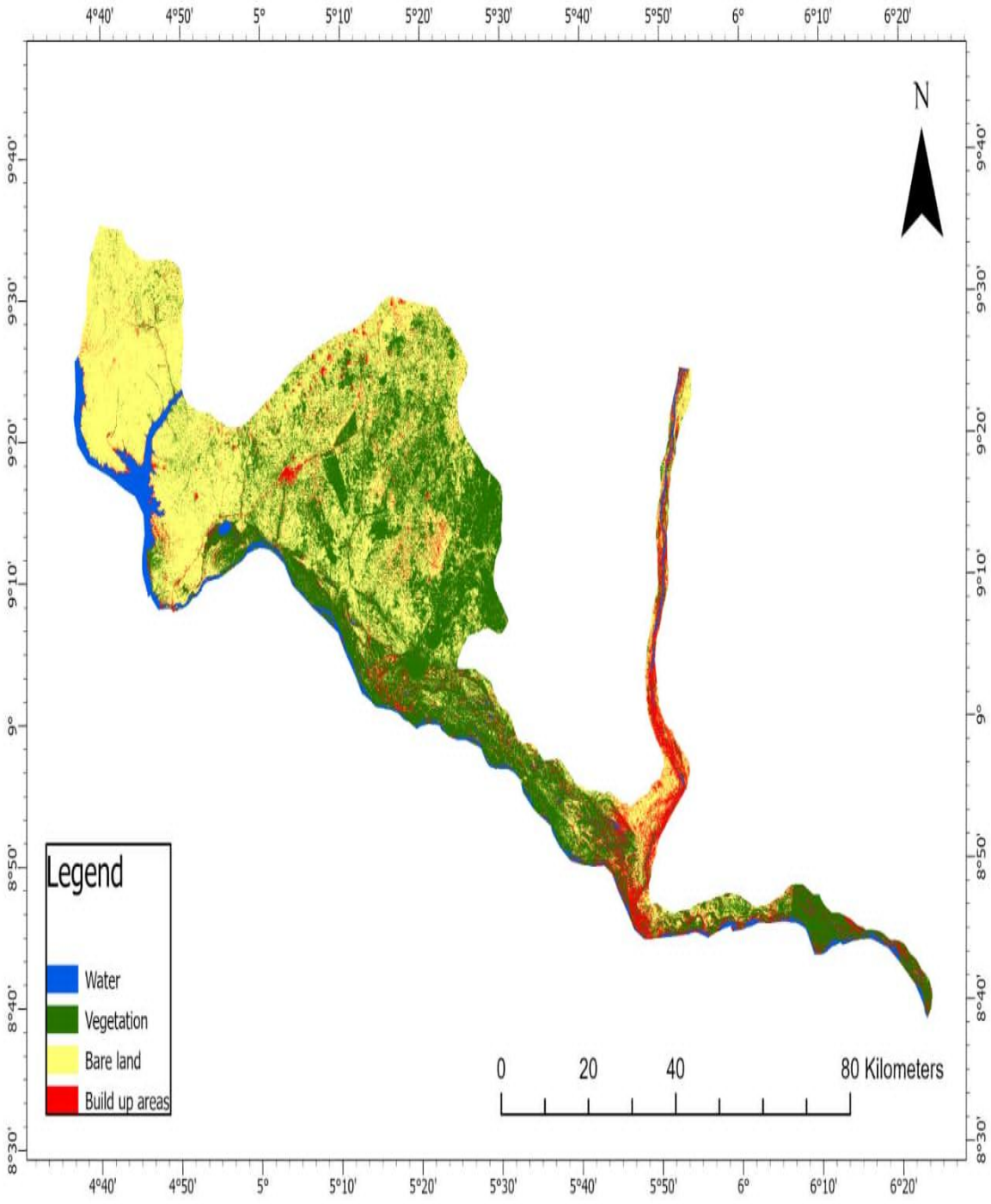

Figure 4.2: Extent of Land use and Land Cover changes in 2010
Source: Author's data analysis (2022)

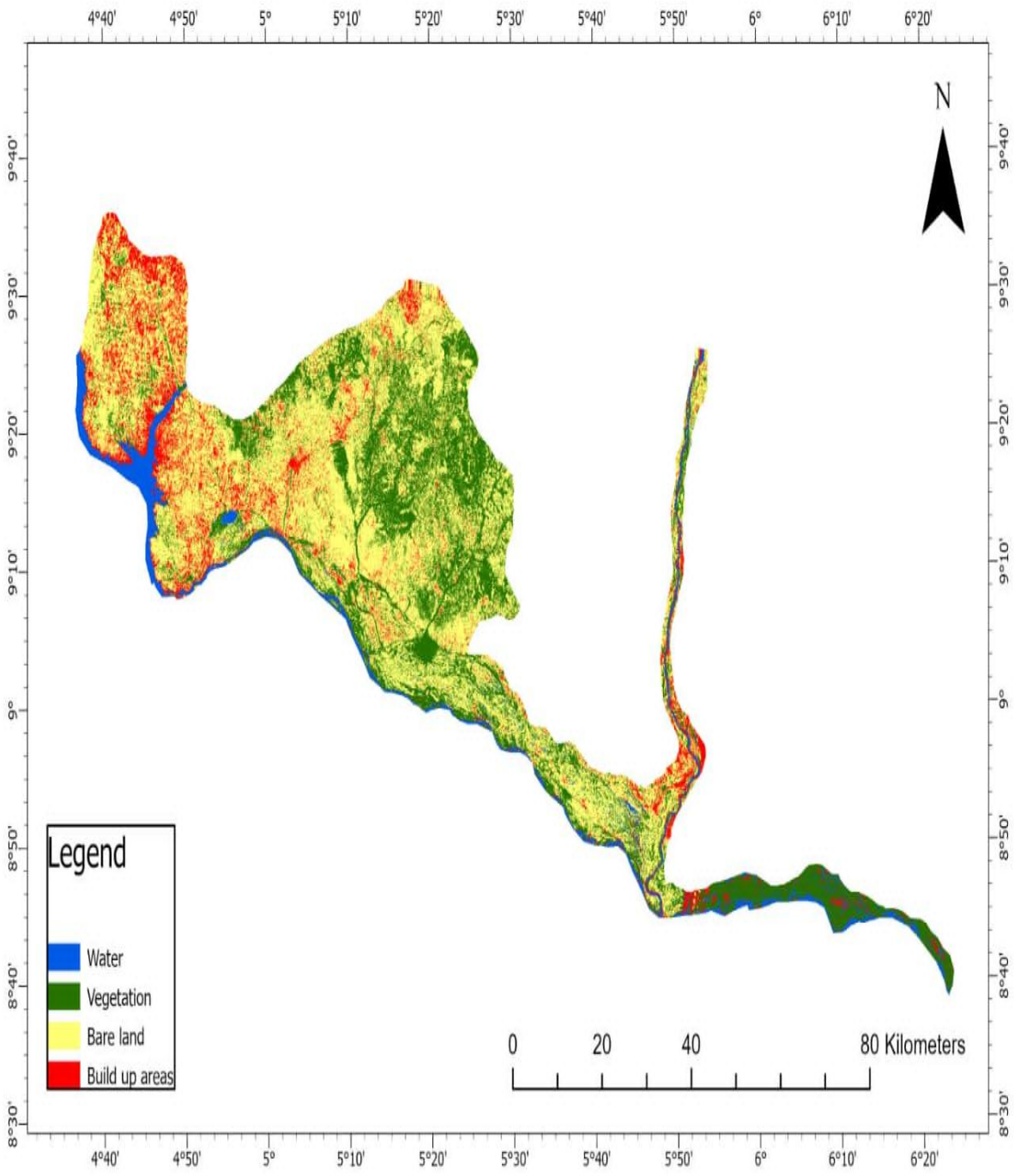

Figure 4.3: Extent of Land use and land cover changes in 2020
Source: Author's data analysis (2022)

4.3 Examination of the Trend of Deforestation

Table 4.2 presents the trend in deforestation in Mokwa LGA from 2000-2020. The decadal trend was given in percentages and hectares.

Table 4.2: Decadal Trend of Deforestation

S/NO	Year	Decadal Trend (Hectares)	Trend (Percentage)
1.	2000	-	-
2.	2010	-277	-49%
3.	2020	-415	-73%

Source: Author's Analysis (2022)

Table 4.2 revealed the decadal trends in vegetal cover depletion. It was observed that from 2000-2010, there was 277hectares of vegetal land lost to deforestation which was approximately 49% decline in green area. Also, from 2010-2020, there was 415hectares loss of vegetation land mass. This account for 73% decline. The decadal mean trend was estimated as -61%.

4.4 Analysis of the Impacts of Deforestation

For this objective, Questionnaire was administered to respondents. The following shows the demographic and socioeconomic characteristics of the respondents.

4.4.1 Demographic and socioeconomic characteristics of respondents

Table 4.3: Demographic and Socioeconomic Characteristics of Respondents

S/No.	Variables	Frequency	Average
1	**Gender**		
	Male	295	295
	Female	85	85
2	**Educational Qualification**		
	Primary education	195	220
	Secondary education	143	143
	Tertiary education	42	42
3.	**Occupation**		
	Farming	189	218
	Lumbering	107	107
	Charcoal Briquetting	84	84
4.	**Age Classification**		
	19-30	56	
	31-40	133	
	41-50	117	42
	51-60	58	
	61 & above	16	

Source: Field Survey (2022)

Table 4.3 revealed the socioeconomic characteristics of respondents. 400 questionnaires were administered but 380 were returned. 295 of the respondents were male while 85 were females. Majority of the respondents were primary school certificate, 37% had secondary education and approximately 12% had tertiary education. Most notable occupation was farming which was about

49.7%, lumbering was 28% and charcoal briquetting was 84%. The mean age of the respondents was 42years.

Table 4.4: Impact of Deforestation on Land Degradation

Impacts	Frequency	Percentage (%)
Soil erosion	79	20.8
Global warming	89	22.9
Aridity	63	16.3
Loss of wild life habitat	48	12.5
Biodiversity	67	17.7
Low Rainfall	36	9.4

Source: Field Survey (2022)

From table 4.4, respondents revealed that global warming was the most common impact of deforestation in Mokwa LGA, Global warming accounted that 22.9% of the responses. It was reported that the study area has been experiencing high diurnal temperature changes in the past decades. After the global warming, soil erosion was the next dominant impact of deforestation in Mokwa LGA with about 20.8% of the total observation. It was also reported by Otegbeye (2003) that deforestation is a prominent cause of soil degradation in the Mokwa LGA. Deforestation also affects the biodiversity in the study area. It was observed to be approximately 17.7%

Desert like condition was also an impact of deforestation in the study area. Aridity accounted for 16.3%. The aridity is also a factor of global warming through increase in daytime temperature and high carbon concentration. Deforestation also impacted the wildlife habitat; cutting down of trees and shrubs has destroyed the habitats of wildlife in the forest. The loss of habitat accounted for 12.5% of the observation and lastly, low rainfall had the least effect of deforestation with 9.4%.

4.5 Identification of the Mitigation and Adaptation Strategies to Land Degradation

Respondents identified some mitigation and adaptation strategies to land deforestation. The percentage and the number of observation for each of the adaptation and mitigation strategies are presented in Table 4.5 of the study.

Table 4.5: Mitigation and Adaptation Strategies

S/No.	Mitigation and Adaptation Strategies	Frequency	Percentage (%)
1.	Tree planting campaign	72	19.0
2.	Forest education	40	10.4
3.	Agroforestry practices	103	27.0
4.	Forest Conservation and management	24	6.3
5.	Enforcement of forest land and policy	55	14.6
6.	Afforestation and enrichment planting	86	22.7

Source: Field Survey, (2022).

Agroforestry practice was observed to be the most notable mitigation and adaptation strategy for land degradation in Mokwa LGA. Agroforestry practices had 27% of the total observation. Likewise, afforestation and enrichment planting were also an important adaptation and mitigation strategies with about 22.7%. Tree planting accounted for 19%, Enforcement of forest land and policy accounted for 14.6%, forest education was 10.4% and the least observation was forest

Conservation and management which was just 6.3%. This implies that agroforestry practice was the major mitigation and adaptation strategy to reduce deforestation across the study area.

4.6 Summary of Findings

The result of this study showed that there were decadal changes in the land use and land cover in the study area from 2000-2020. In 2000, the most dominant land cover was the vegetation which covered 53.3%. By the next decade, the vegetation receded to give more space for more built-up area and bare surfaces which accounted for 12.3 and 42.3% respectively and by 2020, the built-up area had extended greatly to approximately 18.5% of the total land area of Mokwa LGA. It was observed that the mean decadal trend of deforestation was 61%, which showed that the vegetation declined by about 61% from 2000-2020.

From the responses gathered in this research the most imperative impacts were the global warming, soil erosion, biodiversity degradation, aridity, loss of wildlife habitat and low rainfall. Similarly, the adaptation and mitigation strategies shows that the most significant were; agroforestry practices, afforestation and enrichment planting, tree planting campaign, enforcement of forest land and policy and forest education.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Based on the finding of this study, it can be concluded that land use and land cover of Mokwa Local Government Area has been attenuated from 2000-2020. The green area of the study area has been encroached upon significantly by built-up area and bare surface as a result of urbanization and demand for food and energy by the people. The major consequence of this encroachment has led to increase in temperature due to the declining of the carbon sink.

Lastly, Geographic Information System (GIS) and remote sensing is a sophisticated and effective tool for land use/land cover changes monitoring and evaluation due to its capability of large extent coverage that cover be otherwise not possible by other convention means. The satellite imageries provide aerial view of the large extent of the study area and the GIS environment was able to classified every feature in the image.

5.2 Recommendations

The following recommendations are made from the results of the findings obtained

1. Agro forestry practice is recommended to provide benefits such as improvement in soil fertility, reduction in soil erosion, enhanced biodiversity, favorable microclimate and increased water quality.

2. Adoption of agro forestry system is better for a sustainable solution in response to land degradation, soil conservation and can also bridge gaps between climate change and mitigation strategies.
3. Enrichment planting is suggested as a technique for the restoration of overexploited forests as it can increase the total volume and the economic values of forests.
4. Tree planting is highly recommended to help reduced the impact of carbon emissions, restore natural ecosystems, improve soil and prevent erosion and flooding.
5. Enforcement of forest law to ensure the conditions for sustainable management of forests and forest lands as a goods of public interest, in a manner to an extent which conserves and enhances its productivity, biological diversity, ability to regenerate and increase their potentials for the mitigation of climate change.
6. Forest education should be thought in schools to ensure next generation understands the positive role of forests can play in helping humanity combat some of its most profound challenges.

5.3 Contribution to Knowledge

The result of this study revealed a progressive decline of vegetal cover of the study area from 228,691 hectares (53.3%) in year 2000, to 171,170 hectares (39.8%) and 164,029 hectares (28.4%) in 2010 and 2020 respectively. On the contrary, built-up and bare surfaces increased from 23,351 hectares (5.4%) and 143,947hectares (33.7%) in 2000 to 53,226 hectares (12.3%) and 181,305 hectares (42.3%) respectively in 2010 and a further increase in 2020. In addition, result of the questionnaire revealed that global warming (22.9%) was the major impact of deforestation, followed by soil erosion (20.8%), and the least imperative impact was low rainfall (9.4%) in the

study area. More so, the result of the study revealed that the mean decadal trend of deforestation was 61%, which showed that the vegetation declined by about 61% from 2000-2020. The implication of the findings is that further unabated depletion of the forest will aggravate its footprints in the study area, hence the dire need for implementation of workable decisions. The study provides the following recommendations; Adoption of Agroforestry system for a sustainable solution in response to land degradation, afforestation and enrichment planting practice to improve soil fertility, forest conservation management can also bridge gaps between climate change and mitigation strategies, forest education should be mandated in school to keep young generation abreast on the positive effect of forest to the ecosystem.

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APPENDIX A

QUESTIONNAIRE

PEOPLE'S PERCEPTION ON THE OF IMPACTS OF DEFORESTATION ON LAND DEGRADATION IN MOKWA LGA

Department of Geography,

School of Physical Science,

Federal University of Technology Minna,

Niger State.

September 2nd, 2021.

Dear Respondent,

ADMINISTRATION OF QUESTIONNAIRE

I am a Postgraduate student of the Federal University of Technology Minna in the above named department. I am currently undertaking the research title " Impact of Deforestation on Land Degradation in Mokwa Local Government Area, Niger State, Nigeria" as part of the requirement for the award of M.TECH in Geography (Environmental Management Option).

All information supplied shall be treated strictly as confidential, and will only be used for the purpose of this Research.

Thank you for your anticipated co-operation.

Yours faithfully,

ISAH, Abubakar Mohammed

Section A: Socio Demographic Characteristics of the Respondent

(1) Name …….. Community ……..
(2) Age of the respondent Age: <18 years ☐ 18-25 years ☐ 26-40 years ☐ 41-50 years ☐ 50 years and above ☐
(3) Gender.....
(4) Marital Status.....
(5) Size of Household (a) 1 (b) 2 (c) 3 (d) 4 (e) 5+
(6) Educational level attained by the Respondent (a) Qur'anic (b) Primary (c) Secondary (e) Tertiary
(7) What is your main occupation?

Section B: Impact of Deforestation on Land Degradation

(8) How will you classify the forest type present in your community?

i) Closed forest (ii) Open forest

a) I only

b) II only

c) I and II

(9). Do you agree deforestation has been witnessed in this community?

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

(10). How will you describe the rate and extent of deforestation in this community?

a) Rapid

b) Slow

c) Moderate

(11). How will you categorize the major causes accounting for the loss of forest resources in your community? i) Human factors ii) Natural factors

a) I only

b) II only

c) I and II

(12).Which of the following broad elements are known to be the source of Human factor that causes deforestation?

a) Economic

b) Conflict and governance

c) Demographic

d) Social

e) Science and technology

(13). Do you agree with the assessment that causes of deforestation results from activities which serve as livelihoods for people directly and indirectly?

a) Strongly agree

b) Agree

c) Disagree

d) Strongly disagree

(14).Which of the following livelihood activities may be described as the major driver of deforestation in this community?

(a) Agriculture (b) Wood fuel production (c) Chainsaw operation (d) Hunting

(15).Which human factors are noted to account for deforestation in this community?

(i) Agriculture (ii) charcoal production

a) I only

b) II only

c) I and II

(16).The negative impacts of deforestation evidenced in this community can broadly be categorized into? (i) Global warming (ii) Soil erosion (iii) Loss of biodiversity (iv) Loss of Wildlife habitat (v) Aridity (vi) Low rainfall

a) I only

b) II only

c) III only

d) IV only

e) I and II only

f) I and III only

g) I and IV only

h) II and III only

i) II and IV only

j) V and VI only

k) I, II, III, IV, V and VI

(17).What is the manifestations of the impact of global warming as a negative impact of deforestation? (i) Warmer temperatures (ii) Increased drought and dryness of land (iii) Changes in rainfall patterns

a) I only

b) II only

c) III only

d) I and II only

e) I and III only

f) II and III only

g) I, II, and III

(18).Which of the following forest livelihood activities will suffer most from the impact of deforestation?

a) Agriculture

b) Wood fuel production

c) Hunting

d) Chainsaw operation

e) Craft processing

(19).What is the main manifestation of the land degradation as an effect of deforestation?

(i) Reduced soil fertility (ii) Increased soil erosion

a) I only

b) II only

c) I and II only

(20). In which way land degradation most importantly affected agriculture, the predominant livelihood in this community?

a) Increased expenditure on chemical fertilizers

b) Reduced crop yields

c) Loss of farmland or arable land

d) Other, please …….

Section C: Mitigation and Adaptation Strategies to Land Degradation

(21). How do you perceived sustainable forest management?

(a) As a sustainable development (b) as an environmental and economic factor (c) as a legal factor (d) as cultural factor

(22).Which of the following is the most predominant factor used in defining sustainable forest management?

a) Productive functions of forest resources ( )

b) Protective functions of forest resources ( )

c) Legal, policy and institutional framework ( )

(23).What is the main legal and institutional policies to ensure the productive and protective functions of forests in this community?

(a) Forest reserve (b) Penalty on indiscriminate cutting down of trees (c) Embargo on charcoal production.

(24).What is/are the operational land degradation mitigation strategies in your community?

a) Agroforestry practices ( )
b) Forest conservation and management ( )
c) Enforcement of forest law and policy ( )
d) Tree planting campaign ( )
e) Forest education ( )
f) Afforestation and and enrichment planting ( )

(25). How effective is/are the strategies put in place?

(a) Very effective (b) effective (c) indifferent (d) less effective

(26).Which is of the following is/are the most effectual adaptation strategies in your community?

a) Use of efficient wood stove ( )
b) Use of corn straw for cooking ( )
c) Domestication of medicinal plants ( )
d) Conservation agriculture ( )
e) Planting tree as shelterbelt ( )
f) Use of alternative energy ( )
g) Planting of long duration varieties of trees ( )
h) Protection of economic trees ( )

(27).What personal efforts have you made to promote sustainable management of forest resources and how effective are these?

(a) Replacement of cut down trees (b) Protecting vegetative cover (c) Protecting biodiversity (d) Encouraging of forest regeneration

Appendix B




ABSTRACT

Human development and advancement has welcomed several infrastructural developments and economic activities on the ecosystem. These developments have aggravated the nutrients and the potentials of land which includes the attenuation of forest resources and biodiversity in the environment. This study examined the People's Perception on the impacts of deforestation on land degradation in Mokwa Local Government Area of Niger State. The objectives of this study are; Assess land use land cover changes from 2000-2020 in Mokwa LGA; examine the trend of deforestation in the study area from 2000-2020; analyze the impact of deforestation on land degradation in the study area; and identify mitigation and adaptation strategies to land degradation in the study area. The data utilized for this research were both primary and secondary data, the primary data through questionnaire administration and secondary data was sourced from satellite imageries of Mokwa Local government area from 2000-2020. Descriptive statistics and Geographic Information system (GIS) techniques were used to analyze the data. The result of this study revealed a progressive decline of vegetal cover of the study area from 228,691 hectares (53.3%) in year 2000, to 171,170 hectares (39.8%) and 164,029 hectares (28.4%) in 2010 and 2020 respectively. On the contrary, built-up and bare surfaces increased from 23,351 hectares (5.4%) and 143,947hectares (33.7%) in 2000 to 53,226 hectares (12.3%) and 181,305 hectares (42.3%) respectively in 2010 and a further increase in 2020. In addition, result of the questionnaire revealed that global warming (22.9%) was the major impact of deforestation, followed by soil erosion (20.8%), and the least imperative impact was low rainfall (9.4%) in the study area. More so, the result of the study revealed that the mean decadal trend of deforestation was 61%, which showed that the vegetation declined by about 61% from 2000-2020. The implication of the findings is that further unabated depletion of the forest will aggravate its footprints in the study area, hence the dire need for implementation of workable decisions. The study provides the following recommendations; Adoption of Agroforestry system for a sustainable solution in response to land degradation, afforestation and enrichment planting practice to improve soil fertility, forest conservation management can also bridge gaps between climate change and mitigation strategies, forest education should be mandated in school to keep young generation abreast on the positive effect of forest to the ecosystem.