ANALYSIS OF ECONOMIC VALUE, UTILIZATION AND CONSERVATION OF SELECTED NON-TIMBER FOREST PRODUCTS IN THE FALGORE GAME RESERVE IN KANO, NIGERIA

By

Muhammad Sabiu Suleiman (BSc., MSc.)

A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements for the Degree of Doctor of Philosophy in Dryland Resource Management in the Department of Land Resource Management and Agricultural Technology, Faculty of Agriculture, University of Nairobi, Kenya

DECLARATION

THIS THESIS IS MY ORIGINAL WORK AND HAS NOT BEEN PRESENTED FOR A DEGREE IN ANY OTHER UNIVERSITY.

_____ _____

Muhammad Sabiu Suleiman Date

Department of Land Resource Management and Agricultural Technology, University of Nairobi.

APPROVAL

THIS THESIS HAS BEEN SUBMITTED FOR EXAMINATION WITH OUR APPROVAL AS UNIVERSITY SUPERVISORS:

_____ _____

Dr. Oliver V. Wasonga Date

Department of Land Resource Management and Agricultural Technology, University of Nairobi.

_____ _____

Dr. Judith Syombua Date

Department of Land Resource Management and Agricultural Technology, University of Nairobi.

_____ 4th May, 2017

Professor Aminu Suleiman Date

Department of Agricultural Economics and Extension, Bayero University Kano

DEDICATION

This work is dedicated to my wife Hafsat Hassan Zakari, my beloved children Jamila Muhammad and Ahmad Muhammad and my family at large for their moral support and sacrifice during my study.

ACKNOWLEDGEMENTS

All praise belongs to Allah, the glorified, the powerful, and the fulfiller. Peace and blessings of Allah be on the most exalted messenger, our leader, Muhammad (S.A.W) his family companions and those who follow his teachings.

The task of writing this dissertation has been very onerous. It will therefore be inappropriate to assume that the entire effort involved in preparing and producing it to its current standard is solely mine. Some eminent personalities have contributed both directly or indirectly in seeing that the dream for this thesis is translated to concrete reality. I must first of all express my immeasurable gratitude to my supervisors Dr. Oliver V. Wasonga, Dr. Judith S. Mbau and Prof. Aminu Suleiman for their tireless constructive criticisms and contributions to the success of this work. I owe a lot to Dr. Oliver for mentoring me through my PhD programme and exposing me to the art of scientific writing. Your friendly and proactive approach throughout the process will forever be appreciated. To Dr. Judith your motherly and scholarly advice that lead to the success of this work is well acknowledge. It was a great privilege working with you all.

I want to place on record my appreciation and thanks to the Managements of Regional Forum for Capacity Building in Africa (RUFORUM) and the Carnegie Foundation of New York for funding my study and this research. Your contribution will forever be remembered. I am grateful to all the staff of the Faculty of Agriculture and specifically staff of the Department of Land Resource Management and Agricultural Technology for your moral and academic support. To my mentors and colleagues in Bayero University, Kano, Professor S. A. Musa, Professor Jibrin M. Jibrin, Drs. Amina Mustapha, Amina Aminu and Aminu Nasir, I thank you for your intellectual, moral and parental advice.

I want to acknowledge the moral and spiritual support from my late father Suleiman Aliyu Muhammad who passed away before the end of this journey. May your gentle soul rest in perfect peace. I am equally grateful to the management of Falgore Game Reserve for their maximum cooperation, support and patience throughout the fieldwork. There have been numerous authors whose research work I made reference to, to you all I am very grateful because your ideas were helpful in guiding me during my study. I share with you all the success of this joyful achievement. Lastly my special gratitude goes to my friends and relatives who may not be mentioned individually, I thank you all for your prayers and well wishes. May Allah reward you abundantly Amin.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

CBD	Convention on Biological Diversity
CV	Compensating Variation
CVM	Contingent Valuation Method
EV	Equivalent Variation
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FGN	Federal Government of Nigeria
FGR	Falgore Game Reserve
FMA	Federal Ministry of Agriculture
FOS	Federal Office of Statistics
GIS	Geographic Information System
GDP	Gross Domestic Product
HHI	Household Income
IIED	International Institute of Environmental Development
IUCN	International Union for Conservation of Nature
KII	Key Informant Interview
KNARDA	Kano Agricultural and Rural Development Authority
KRIP	Kano River Irrigation Project
LGAs	Local Government Areas
LULCC	Land Use and Land Cover Change
MDG	Millennium Development Goals
NGO	Non-Governmental Organization
NPC	National Population Commission
NTFPs	Non-Timber Forest Products
RS	Remote Sensing
SSA	Sub-Saharan Africa
TEV	Total Economic Valuation
UNDP	United Nations Development Programme
USAID	United State Agency for International Development

USD	United States Dollar
USGS	United States Geological Survey
WCS	World Conservation Society
WHO	World Health Organization
WTA	Willingness to Accept
WTP	Willingness to Pay

ABSTRACT

The increasing degradation of non-timber forest resources due to anthropogenic activities and the growing impacts of climate variability and change call for a shift in the approaches of managing natural resources. Experts warn of imminent collapse of the forest ecosystems at current levels of degradation, which is mainly attributed to unsustainable management and utilization of natural resources. However, lack of data and absence of reliable information to guide formulation of appropriate policies for resource utilization and specifically conservation of non-timber forest products (NTFPs) is a major drawback in the efforts to ensure sustainable utilization of forest resources. In order to bridge the knowledge gap, this study analysed trends of forest cover change and the perceived drivers of forest resources degradation in the Falgore game reserve from 1985 – 2015, estimated the economic value of selected NTFPs from the FGR, determined the relative contributions of selected NTFPs to households' income in the study area, and assessed the perceptions and attitudes of forest dependent communities towards protected area conservation approach. Multistage sampling technique was used to select 400 respondents for the study. Household interviews, focused group discussions and key informant interviews were used to elicit the prerequisite primary data in addition to the secondary information. Both inferential and descriptive statistics were used in data analysis.

The results of the spatio-temporal analysis of forest cover change in FGR shows that moderate woodland dominated in 1985 (46%) and 2005 (57%), but was replaced by open woodland in 2015, which now accounts for 58% of the total area of the forest. Dense woodlands occupied the least area of the forest and varied between 17% in 1985 and 1% in 2015. The results further indicate that dense woodland, moderate woodland, and very open woodland declined at an annual average rate of 3%, 1% and 0.4%, respectively. The main drivers of forest resource degradation in the area were found to be excessive fuelwood collection, poor grazing management, expansion of crop cultivation, harvesting of medicinal herbs and forest fires caused by illegal hunters and honey collectors.

The results of economic valuation of NTFPs in FGR show that about 80% of the interviewed households were willing to pay for collection and conservation of NTFPs. The monthly value of the selected NTFPs based on average willingness to pay were $152684 for (fuelwood), $109060 (honey), $87248 (gum arabic), $35000 (fodder), $43624 (medicinal herbs) and $65436 for (fruits). The results further indicate that households' WTP for NTFP conservation was significantly influenced by sex, level of education, household size, interaction with extension agents, membership to a social group, households' income and distance from homestead to market and FGR.

The study also found that the major NTFPs utilized by households in the study area were fuelwood, honey, gum arabic, fodder, fruits and medicinal herbs. In addition to these tangible products, FGR was reported to contribute to the households' livelihoods through provision of cultural services, and soil erosion and flood control. On average, NTFPs contributed 20% to 60% of the total income of sampled households. These results show that FGR immensely contributes to rural livelihoods through provision of goods and services to households for consumption and sale. About 64% of the respondents held positive attitudes and perceptions towards protected area conservation approach. The communities further perceived that, if implemented, participatory forest resource management could offer a lasting solution to indiscriminate resource exploitation and general resource degradation in the reserve.

It is evident that there has been a significant change in forest resources in FGR between 1985 and 2015, which is mainly attributed to unsustainable exploitation of NTFPs and poor enforcement of conservation policies. The key hotspots (northern tip, central and eastern parts) of forest resource degradation in the FGR coincided with the areas where excessive fuelwood collection, timber logging and poor grazing management were reported in the forest reserve. The respondents' willingness to pay for conservation of NTFPs in FGR is dependent on the known, as well as foreseen benefits that are likely to accrue from their conservation. For instance, communities are willing to pay more money for fuelwood and honey collection from

the reserve because majority of the households rely on fuelwood for most of their domestic energy needs and because these two products have high market value. Extraction of Non-timber forest products represent an important source of income for communities proximate to FGR given that they contribute approximately 40% of the total income of about 68% of the households in the study area. The results show that most of the respondents are aware of the benefits of the conservation of FGR, and also support the need to conserve the forest.

We recommend that intervention efforts should be directed towards restoration of degraded areas, especially around the central, eastern northern of the forest as they are most prone to overexploitation. In addition, promotion of alternative domestic cooking energy, such as biogas to communities proximate to FGR is recommended in order to reduce pressure on the forest wood resources. Further, it is important to promote off-farm and other alternative income generating activities to extraction of NTFPs to reduce overreliance on the forest resources for income generation. This would help shift focus to conservation rather than exploitation of the NTFPs given that the expected income was the main motivation behind the positive attitude and willingness to pay for NTFPs and forest conservation.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

The importance of forests in the provision of a wide range of non-timber forest products (NTFPs) and related services have long been recognised by conservationists, policy makers, researchers and development practitioners. Forests provide products for different uses such as wood for construction, fuelwood, food, medicine, fodder and other related products to both rural and urban populations (Ormsby and Kaplin, 2005; Appiah, 2009). These products are usually grouped into timber and none timber products. However, whereas timber products are highly valued, non-timber products, which play an important role in sustaining livelihoods of the rural communities worldwide has been given little attention. The term NTFPs refers to all the resources or products, other than industrial round wood that may be extracted from forest ecosystem and are utilised domestically by households or marketed for income but also have social, cultural or religious significance (Falconer and Koppell, 1990; Ndoye *et al*., 2016).

The NTFPs constitute an important source of livelihood for millions of people across the world, and research have shown that there are more than 500 million people that are highly dependent on forest resources, particularly the NTFPs, in Latin America, sub-Saharan Africa, and South-eastern Asia (Shackleton *et al*., 2007). The NTFPs provide about 17 million and 30 million full-time jobs in the formal and informal sectors as well as 13-35% of all rural non-farm employment in developing countries (Duong, 2008). In addition to their wide industrial applications in developed countries, non-timber forest products are consumed locally and are used in religious and cultural rituals (Chikamai *et al*., 2008; Wekesa *et al*., 2010).

In the recent past, human population increase in Nigeria has brought about an increase in the demand for food that overwhelms the capacity of the country's agricultural sector (Ashaolu *et al*., 2011). The Nigerian rural economy is highly dependent on natural resources specifically NTFPs for social and economic wellbeing (Okafor *et al*., 1998; Sonwa *et al*., 2002; Babalola, 2009). For instance, in a study conducted in Omo Forest Reserve, Egunjobi (2003) found that NTFPs contribution to the rural community's social and economic wellbeing is higher than that of timber. In addition, Jimoh and Azeez (2002) observed that rural households derived up to 80% of their incomes from the sale of NTFPs. Equally, over 70% of the country's households depend directly on fuelwood as their main source of energy, with daily consumption estimated at 27.5 million kg/day (Ogunsawo and Ajala, 2002; Emodi and Boo, 2015).

The exploitation of NTFPs in many areas in Nigeria has gone beyond subsistence and local sales needs to respond to international cross-boundary trade demands. For example, in the high forest zones of Eastern and Western Nigeria, exploitation of game meat and snails for sale, besides domestic consumption, is a major income generating activity almost all year round (Onuche, 2011). In the savannah zone of the central and northern Nigeria, honey, fuel-wood, locust-bean seeds, gum arabic and charcoal making generate a substantial amount of income to the rural dwellers (Jimoh and Azeez, 2002).

The establishment of protected areas (game reserve, forest reserve and national parks) in the world dates back to the 17th century. These areas are mainly set aside to provide habitat for natural resources and scenic areas of national or international importance for scientific, educational and recreational purposes (Ejidike and Ajayi, 2013). However, protected areas in many Africa countries, have been established and managed with little or no regard for local peoples' dependence on them for natural resources. In many cases, local communities have been evicted and disenfranchised from their traditional areas of settlements, with severe consequences on their social, cultural and economic survival (Balmford *et al*., 2015). This

approach to natural resource management has produced antagonistic relationships between indigenous communities and protected area managers, thereby causing resource-use conflicts. Such conflicts, as shown in different parts of the world may result in immense loss of biodiversity.

In spite of the existence of many protected areas in Nigeria, the rate of deforestation and forest degradation is threatening the country's biodiversity. For example, IUCN red list of globally threatened species contains 141 animal and 168 plant species found in Nigeria that are endangered (IUCN 2010). This has led to renewed efforts towards forest resource conservation in and outside the protected areas across the three tiers of governments in the State under the new ACT of National Environmental Standards and Regulations Enforcement Agency (NESREA) (Meduna *et al*., 2009). This change in environmental policy was specifically aimed to conserve the remaining forest ecosystems and increased tree cover by 20% as envisaged in the country's development plan vision 2020 (Meduna *et al*., 2009).

Falgore Game Reserve (FGR), which is located in Kano State is an example of the protected areas found in the savannah woodland ecosystems of Nigeria. The reserve is a watershed for river Kano and also the main source of water to Lake Tiga that supplies water to the Kano River Irrigation Project (KRIP). Despite its protection, rural households living next to reserve have been encroaching into it mainly because of the poor enforcement of rules, and partly due to the shifts in rural household economy and population pressure. These have rendered the reserve a more or less de facto open access resource. Institutions such as BirdLife International (2007) have reported that if left unchecked the high rate of deforestation in FGR could accelerate the siltation rate in the Lake Tiga, thereby undermining its socio-economic and ecological functions. The main challenge facing the management of FGR is thus reconciling the short term extractive needs of the local people and the long term conservation interests.

Therefore, understanding of the economic value and utilization trends of the NTFPs by the forest proximate communities, and their perception on forest management by external agencies is essential for designing management policies that would address the dual goal of community interests and conservation for future generations.

1.2 PROBLEM STATEMENT

The challenges facing forest conservation in Nigeria exemplifies that of many developing countries. This can be seen in terms of lapse in management of the protected areas, which are now facing encroachment by neighbouring communities who usually derive significant part of their livelihoods from the gazetted areas. Presently, about 1,000 forest reserves, nature reserves and parks from Nigeria are listed on the world data base on protected areas managed by International Union for Conservation of Nature (IUCN). However, most of these reserves are highly degraded with some barely having any forest left (Oseni, 2007; Meduna *et al*., 2009). Falgore game reserve which is the main focus of this study is facing reported an indiscriminate exploitation of forest resource by the local communities surrounding the reserve (Badamasi *et al*., 2010; Tudunwada, 2012). This has been attributed to growing food demand, little knowledge on economic value of resources, poverty, poor enforcement of protection rules and limited awareness among resource users on sustainable resource extraction as well as lack of involvement of forest dependent communities in forest conservation programmes (Ejidike and Ajayi, 2013). The challenges have weakened the ability of the country to meet the growing demand of both timber and non-timber forest products that support the livelihoods of forest dependent communities.

In spite of increasing awareness on social and economic importance of NTFPs to local economies, very few studies have been conducted on savannah woodland ecosystems of Kano State with exceptions of Badamasi *et al*. (2010) and Tudunwada (2012) who studied the

relationship between land use and land cover change and population growth in Kano, Nigeria. These studies did not provide detailed analysis of the interaction between the local communities and the forest resources, as well as the existing conservation approaches in the study area. This study therefore attempted to bridge this research gap to inform policy and activities of development and conservation organisations to conform with the ecological, socio-cultural and economic realities in the study area.

1.3 JUSTIFICATION OF THE STUDY

Millions of people, especially those living in the rural areas of developing countries, gather non-timber products on daily basis for their livelihoods. About 80% of rural dwellers in developing countries depend on NTFPs for their food and income needs (Cavendish and Campbell, 2002; Shackleton and Shackleton, 2004). For instance, Ojo (2004), FAO (2006), and Ahenkan and Boon (2010) observed that NTFPs contribute significantly to households' food security, income, and medicine in African countries such as Nigeria, Kenya, and Cameroon. However, despite the significant contribution of NTFPs to the local and national economies, the forestry master plan for Nigeria gives little attention to the important role played by NTFPs in rural livelihoods. This can be primarily attributed to the lack of quantitative information to justify the role of non-timber forest products in local and national economies. This knowledge gap partly explains the government's little attention to conservation of forest ecosystems in different parts of the country, in spite of their protection status.

As indicated by Van Kooten and Bulte (2000), most resource users as economic agents rarely decide on how much natural resources to conserve but rather how much to use. Therefore, perceptions of the forest proximate communities on exploitation of natural resources should be of concern to conservationists. Therefore, the prerequisites for sustainable conservation of

natural resources and biodiversity is to change human attitudes toward exploitation and utilization of environmental resources (Margoluis *et al*., 2008).

Falgore Game Reserve is a protected ecosystem designated mainly for floral and faunal protection in Kano State of northern Nigeria. The reserve is not only providing a unique ecosystem that serves as an important freshwater catchment for Kano, Jigawa, Bauchi, Yobe and Borno States and Lake Chad, but also contributes towards Nigeria's desire to meet the Sustainable Development Goals (SDGs) number six (provision of clean drinking water for the country's ever rising population). However, despite commitment of resources by successive governments of the host State to protect the FGR, it is still vulnerable to various kinds of unsustainable exploitations such as felling of trees for fuel, fishing, uncontrolled hunting and livestock grazing by herdsmen (Badamasi *et al*., 2010).

In order to inform sustainable conservation in FGR and other forest ecosystems facing similar challenges, empirical evidence on the status and utilization pattern as well as value attached to the forest resources by the neighbouring communities is imperative. It is against this background that this study was conducted to analyse the economic value, utilization and conservation of NTFPs in FGR. This study is therefore expected to provide a better understanding of the monetary values of selected NTFPs from FGR, perceptions and attitudes of forest dependent communities towards protected area conservation approach, as well as performance of governance of FGR. In addition, the findings of these study are expected to stimulate interest for further research on NTFPs in the study area.

1.4 BROAD OBJECTIVE

The overall objective of this study was to analyse the economic value, utilization and conservation of selected non-timber forest products in Falgore Game Reserve in order to generate information that would contribute to formulation of policies and conservation

strategies for sustainable management and utilization of the non-timber forest products in Nigeria.

1.4.1 Specific Objectives

The specific objectives of this study were to:

1. Determine the trends of forest cover change and the perceived drivers of forest resources degradation in the Falgore game reserve during the last three decades.
2. Estimate the economic value of selected non-timber forest products from the Falgore game reserve.
3. Determine the relative contribution of selected non-timber forest products to households' income in the study area, and the factors influencing their utilization.
4. Establish the perceptions and attitudes of forest dependent communities towards protected area conservation approach.

1.4.2 Research Questions

1. To what extent has forest cover of Falgore game reserve changed in the last three decades, and what are the perceived drivers of the change?
2. What is the economic value of non-timber forest products from Falgore game reserve?
3. How much do NTFPs contribute to households' income and what factors influence their utilization in the study area?
4. What are the perceptions and attitudes of forest-dependent communities towards Falgore game reserve?

CHAPTER TWO

LITERATURE REVIEW

2.1 FOREST COVER CHANGES IN NIGERIA

Forest degradation involves complex interactions between social, economic and biophysical factors that in most cases act in concert to drive the processes of soil and vegetation degradation. The combined effect of these factors has been recognized as the leading driver of forest cover loss and also as a threat to the survival of the wild flora and fauna of global significance (Mengistu and Salami, 2007). Between 1990 and 2015, deforestation caused a loss of about 129 million hectares of forestland globally representing about 0.13% loss per annum (Keenan, 2015).

In Nigeria, forests account for about 10 million hectares an equivalent of 10% of the total land area (910770 km^2). This comprises 5,495,000 and 326,000 hectares woodland forest and primary forest respectively. The country has a total of 445 nature reserves spread across its four main ecological zones, namely: the mangrove; the lowland rainforest; the southern/northern Guinea Savanna; and the Sudan/Sahel Savanna. Despite having many gazetted reserves in the country, the rate of deforestation has been rising in Nigeria. For instance, from 1956 to 1986 the country lost about 23,000ha of the gazetted forest estates per annum through government de-reservation (Kio and Abu, 1992). The rate of loss of primary forests in Nigeria is among the highest in the world. For instance, the country's undisturbed forest cover decreased by 53.5 % from 25,951 km^2 in 1976 to 12,114 km^2 in 1991 (Akinbami *et al*., 2003). The worst deforestation rate of primary forests in Nigeria occurred between 2000 and 2005 (FAO, 2005). During that period the average rate of deforestation was 5.7%, making the country to be the leading among the five countries with the highest deforestation rate in the world that include Viet Nam 5.5 %, Cambodia 2.9 %, Sri Lanka 1.6 % and Malawi 1.5 % (FAO, 2005).

According to Famuyide *et al*. (2013), the main driving force of forest loss include expansion of crop cultivation, population growth, urbanization, logging, mining and excessive collection of fuel wood for domestic energy requirements. In addition, the rising prices of petroleum products, especially cooking gas and kerosene, have been reported to push both rural and urban households to rely on fuel wood and charcoal as their main sources of energy.

2.2 DRIVERS OF FOREST COVER CHANGE IN THE WORLD

Forest ecosystems cover about 31% (4 billion ha) of the total global land area. However, between 2000 and 2010, about 13 million hectares of forest were cleared and converted to other land uses, mostly to arable land for commercial crop cultivation (32%) or subsistence agriculture (42%), while 26% was degraded due to non-tangible uses (UNFCCC, 2007). There are a number of competing schools of thought on the causes of land-use and land-cover change, particularly in relation to forests. These views continue to provoke debate within the academia, governments and civil society (Chan and Sasaki, 2014). Katila *et al*. (2010) indicated that forest cover change are mainly driven by factors such as expansion of crop cultivation, animal ranching, mineral exploration such as gas and oil extraction, and infrastructural development such as construction of roads and dams.

2.2.1 Illegal logging and fuelwood collection

Forest products extraction inform of illegal logging, fuelwood gathering and charcoal making are among the major cause of deforestation and forest degradation in many parts of the world (Youn *et al*., 2017). Illegal logging has been identified as the most important driver of forest cover decline globally, and has consistently drawn the attention of the state forestry authorities and researchers worldwide. As indicated by World Bank (2006), illegal logging causes a total loss of about USD 5 billion per annum globally. In addition to illegal logging fuelwood gathering and extraction of other non-timber forest products for subsistence or supplementary

livelihood purposes have been reported to immensely contribute to forest resource degradation in many developing countries (van Kooten and Bulte, 2000; Islam *et al*., 2015). For instance, May-Tobin (2011) reported that fuelwood collection and charcoal making greatly contributes to forest degradation because the collectors often engaged in cutting down of fresh trees rather than utilizing the dead and dry ones as required in government protected areas. Furthermore, fuelwood and charcoal are the primary energy sources for rural households as well as some industrial users in developing countries, and are more affordable and readily available compared to alternatives source such as liquefied petroleum gas (LPG), kerosene and electricity (Youn *et al*., 2017).

2.2.2 Overgrazing

Forests can also be degraded when they are grazed beyond their carrying capacity. Overgrazing would occur when forests are not given adequate time to recover from previous grazing. Such a situation is would arise in the absence of traditional or statutory regulations, and is characterized by the tendency of individuals to maximize their own gains at the expense of others and the environment, a situation also known as tragedy of the commons (Garrett Hardin, 1968). This concept is underpinned by the theory of the prisoner's dilemma that states that given the two options of either to conserve or deplete a public resource, a competing user would opt to exhaust the resource for immediate gain, in the belief that if one conserves, he has no guarantee that the other will also conserve; instead the other may exploit his restraint in order to maximize short – term gains (Selten and Stoecker, 1986).

2.2.3 Forest fires

Fire is often used for land clearing for crop cultivation, range land management and for forest improvement in the tropics. However, abuse of fire can be destructive to forest ecosystems or agricultural land thereby causing significant resource degradation. Information available from

one hundred and eighteen countries having 65 percent of the total world forest estates indicates that about 19.8 million hectares of forest are affected significantly by fire each year (Nepstad *et al*., 2001).

2.2.4 Mining

Exploration of mineral resources such as gold, copper, nickel, tin, coal, oil and gas is a major cause of forest cover loss globally (Sands and Peel, 2012). There is evidence of high rate of deforestation and forest degradation due to mining in Nigeria, Philippines and India (Griffiths and Hirvelä, 2008; Docena, 2010). For instance, Griffiths and Hirvelä (2008) reported destruction of 750 ha of forest reserve in Nyamagari hills in Orissa India due to bauxite mining by Vedanta Aluminum Corporation's plant. In addition, development of infrastructure such as of roads, railways and airports to support mining activities often attract more people to the forest frontier that put pressure on the surrounding environment, and if fuelwood is used as the main energy source for mining operations, it can cause serious deforestation in the affected areas (Nepstad *et al*., 2014).

2.2.5 Urbanization

Urban centers around the world are growing rapidly. For example, in 2008 United Nations reported that 50% of the global population live in urban or peri-urban areas, and that by 2050 this is expected to reach 70% (Montgomery, 2008), and therefore if necessary measures are not put in place, to the trend will negatively affect environmental management planning in many parts of the world. Expansion of cities and towns require provision of the necessary infrastructures to support the growing populations. This is would imply clearing the natural forests where they exist to pave way for buildings and other infrastructure (Amor and Pfaff, 2008). Urbanization therefore causes a significant loss of vegetation cover through direct forest clearance for housing construction or indirectly through generation of building materials such

round wood, land, among others. Similarly, migration of rural residents to urban centers reduce direct pressures on forests frontier in rural areas, although in many cases the forestland after rural urban migration are often converted to larger, more intensive agricultural use.

2.2.6 Agricultural expansion

Historically, agriculture has expanded and developed at the expense of forest land (Katila *et al*., 2010). Forest and agriculture have been in competition since time immemorial and presently the increasing demand for food and forage to feed the ever growing human and livestock populations has worsened the situation (Katila *et al*., 2010). FAO (2009), reported that the world population is expected to exceed 9 billion people by 2050, thus, there would be an equivalent increase in the demand for food and energy (fuelwood) especially in the developing world. Therefore, in the absence of sustainable agricultural growth and energy through technological advancement to match the population growth, expansion of agricultural land will cause further loss of forest cover to cultivation and fuelwood collection.

2.3 CONSTRAINTS TO CONSERVATION OF NATURAL RESOURCES IN NIGERIA

Various factors hamper the formulation and effective implementation of natural resource conservation policies in Nigeria. The main barrier has been identified as inadequate data for both current biodiversity status and the extent of resource degradation (USAID, 2008). This situation has made it difficult to design effective conservation programmes, as well as efficient natural resource management strategies in the country. This results in inconsistent policy and institutional framework. The consequence is the destruction of primary forests in favour of other land uses such as agriculture, grazing and settlements across the country (FAO, 2000). In addition, the rapid turnover of the country's leadership has resulted in varying degrees of commitment to the implementation of conservation policies and its sustainability (Usman and Adefalu, 2010).

The lack of qualified staff capable of managing the Nigeria's forest and wildlife resources remains a concern among policy makers and other stakeholders (WCS, 2010). Meduna *et al*. (2009) reported insufficient staffing, inadequate equipment and lack of attractive emolument as some of the major setbacks limiting successful management of National Parks in Nigeria.

Socio-cultural factors have continued to negatively affect effective implementation of conservation policies in the country. In most of the communities in northern and southern parts of Nigeria, land is treated as a sacred property often preserved and passed from one generation to another. This has led to resistance of most government attempts to use what is regarded as individual or communal property for conservation (Usman and Adefalu, 2010). Currently, there are still settlements within many national parks. For example, there are about 600 villages inside the Cross River and Gashaka Gumti National parks (USAID, 2008). The high prevalence of poverty in rural areas and particularly forest dependent communities has led to overreliance and overexploitation of forest resources thereby leading to deforestation and forest degradation (Usman and Adefalu, 2010).

2.4 APLLICATION OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM IN LAND-USE AND LAND COVER CHANGE ANALYSIS

Historically, interactions humans with their surrounding environments have either led to land conversion or modification in order to meet the basic social, economic and cultural needs. However, the current rate of land-use and land cover change (LULCC) is a threats to biodiversity, as well as the very survival of mankind. Clearance of global forest stock in the last few decades has led to unprecedented changes in environmental processes at local, regional and global scales (Chan and Sasaki, 2014). Today, LULCC is believed to be the key driver of the increasing climate variability, water, air and soil pollutions as well as biodiversity loss (Mayes *et al*., 2015). In Kenya for example, increase in human population coupled with

shortage of arable land has led to the expansion of cropland at the expense of forestlands, rangelands and wetlands of national and international importance (Wasonga, 2009). These actions have far reaching implications on the integrity of natural resources and ecosystems in the country. Thus periodic assessment of physical and bio-physical changes of the earth planet has become a major priority among researchers and policy makers around the world (Erle and Pontius, 2007; Chan and Sasaki, 2014). As indicated by Wasonga (2009) and Mbau (2013) determining the trend of land cover changes in space and time is necessary for proper land-use management and decision making processes.

The advent of remote sensing (RS) and geographic information system (GIS) has made it possible to study the changes in land-use and land cover changes within a short time, at low cost and with high degree of accuracy compared to other methods such as aerial photography. The two techniques have provided policy makers and researchers with a powerful tool for ecosystem validation and assessment necessary for planning and decision making over the last few decades (Wasonga, 2009). Remote sensing also called observation method is a technique used to extract data about an object or area at the earth's surface without necessarily being in direct contact with the object or area. Remotely sensed imageries are usually acquired using air borne space satellites. On the other hand, GIS is an organized collection of computer hardware, software, geo-positioning system and personnel designed to efficiently capture, store, update and analyze all forms of geographically referenced information (Mbau, 2013).

The launch of the first Landsat satellite (ERTS-1) in 1972 marked an era of monitoring earth's surface by space-borne satellite. Over the following decades, the medium spatial resolution, global coverage, and potential for time-serial analysis of the Landsat data record have enabled assessments of forest change from local to national scales (Tong *et al*., 2017).

2.5 TOTAL ECONOMIC VALUE (TEV) OF FOREST ECOSYSTEMS

The concept of total economic value (TEV) was coined and developed a few decades ago (Pearce and Turner, 1990; Shanley *et al*., 2015), and has now become one of the most widely used frameworks for assessing and classifying the economic benefits of a given ecosystem. The TEV of a forest ecosystem comprises of use value and non-use value or passive-use value, which people derive from it (Wattage and Mardle, 2008). A "use value" is value arising from actual use made of a given resource. Use value of an ecosystem is divided into direct use values (DUV), which refer to actual resource derived from ecosystem such as fish, game meat, water extraction and plant materials, while the indirect use value (IUV) refers to the ecological functions that the forest resources provide such as erosion and flood control. Option value (OV) is associated with the benefits received by retaining the option of using a resource in the future by protecting or preserving it today.

Non-use values (NUV) are divided into bequest value (BV) and an existence or 'passive use value (XV). Bequest value measures the benefits accruing to any individual from the knowledge that others may benefit from a resource in the future. Existence value is the benefit, often reflected as a sense of wellbeing, of simply knowing resources exists, even if it is never utilized or experienced; it is the benefit simply derived from the knowledge of a resource's existence (Polasky *et al*., 2008; Radeloff *et al*., 2012). An individual's concern to protect, say, the rare species although he or she has never seen one and is never likely to, could be an example of existence value. Therefore, total economic value (TEV) of a given forest ecosystem is the sum of use value and non-use value. TEV is mathematically expressed as follows:

$$TEV = UV + NUV = (DUV + OV) + (XV + BV) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

The current trends show that forest ecosystems are being degraded and lost because of rapid population change and economic incentives that make forest conversion appear more profitable

than forest conservation (Pearce, 2001). Therefore, determining economic values of the tangible and non-tangible forest products has the potential of changing the way we look at forests ecosystems and can make the pendulum swing back in favour of forest conservation and sustainable use (Pearce, 2001). As indicated by Adger *et al*. (1995), most of the environmental and economic benefits associated with forest ecosystems accrue as externalities, usually at a little or no cost to beneficiaries. The authors indicate that in most of the times only the national governments bear the costs necessary for sustainable forest management. Additionally, in many developing countries, Forest Departments usually capture only a small proportion of the values that accrue from forest ecosystems as cash benefits, which are often insufficient to cover the costs of sustainable forest management (Emerton, 1997; Huxham *et al*., 2015).

Improved capacity to value environmental benefits has the potential to change the way in which people make trade-offs between different alternative land-uses to forest conservation (Lette and de Boo, 2002). Whereas most resource users still find it more profitable to exhaust forest resources than to manage them sustainably despite the wider economic or global costs of doing so (Nasi and Frost, 2009). This is often as a result individual attempt to maximize their own gain at the expense of others thereby leading to a scenario known as tragedy of the common. Recent evidence indicates that the returns from sustainable forest resource utilization and management is higher than the profits that can accrued from forest clearance for agriculture or construction purposes. For instance, Peters *et al*. (1989) and Ciccarese *et al*. (2012) indicate that the value for sustainable extraction of NTFPs in Peruvian Amazon is by far higher than the returns from either clear-cutting down of trees for timber, economic tree plantations or cattle ranching. Similar conclusions were made by Loaiza *et al*. (2015) while assessing the value of NTFPs in the Upper Napo area of Ecuador's Amazon region, that sustainable extraction of NTFPs can yield an average of $2850 compared to crop cultivation ($500), timber

($200) and cattle ranching ($172). In spite of these promising evidence that sustainable utilization of NFTP is more beneficial than other forms of forest utilization, there is no clear evidence that the available information is used in influencing decision-making among policy makers, particularly in the developing countries.

Forest conservation policies continue to be formulated with little regard to environmental, social, economic and cultural values surrounding forest-human interactions. Such underlying problems and policy gaps are pervasive and complex (Shackleton *et al*., 2011). In the Amazonian forest for example, official development strategy and economic policies are directed exclusively at the expansion of corporate forestry, livestock production, crop cultivation and mineral resource exploration which account for 35% of the total altered forestlands (Barbier, 2007).

2.6 NON-TIMBER FOREST PRODUCTS AND THEIR CONTRIBUTION TO RURAL LIVELIHOODS IN NIGERIA

Extraction of Non-timber forest products (NTFPs) has been an integral part of the livelihoods of rural communities living in and around the tropical forest and Savannah woodlands of Nigeria from time immemorial (Boffa, 2000). They are key to sustaining household subsistence needs in terms of food provision, household healthcare, domestic energy needs, and building materials, in addition to a myriad of social and cultural uses (Lykke *et al*., 2004; Schumann *et al*., 2011).

Employment and income generation from non-farm activities through NTFPs enterprises are found nearly in all developing countries including. They are often one of the few income opportunities, contributing about 6% to 95% of the total households' annual income among the forest dependent communities in Central and West Africa (Shackleton *et al*., 2007). These activities provide safety net when other sources of livelihoods fail to provide cash and food

security for rural communities (Sunderlin *et al*., 2005; Shackleton *et al*., 2007). The NTFPs business enterprises provide an equivalent of 17 million job opportunities in the formal sector, as well as provision of 13-35% of all rural non-farm employment (Duong, 2008). They also contribute to poverty eradication and household food security through direct consumption and sales in the local markets (Chikamai and Kagombe, 2002). The economic contribution of NTFPs to individual households may appear insignificant but collectively they contribute significantly to the rural economies, and national economies through provision of foreign exchange.

Non-timber forest products make substantial contributions to household food security through provision of variety of foodstuff such as leafy vegetables, wild root tubers, fruit nuts, and game meat, which supplies essential nutrients especially during the dry seasons and hard times when other food sources are unavailable. According to Hoskins (1990) and Ejidike and Ajayi (2013), 80% of animal protein consumed by rural dwellers living adjacent to forests in Nigeria come from bush meat. In the northern Nigeria for instance, insects such as grasshoppers and crickets from forest are consumed in various forms and contribute immensely to food security.

Over 80% of the rural inhabitants of Nigeria rely on medicinal plants for household health (Ransome-Kuti, 1991; Borokini and Lawal, 2014). Evidence from available data indicate that the number of people depending on medicinal plants is increasing by day. This has been attributed to deplorable situation of the public healthcare centres and high costs of treatment in private health centres in the country, which makes conventional healthcare treatment inaccessible to poor people (Jimoh and Haruna, 2007; Amusa *et al*., 2017).

2.7 DEFINITION AND CLASSIFICATION OF NON-TIMBER FOREST PRODUCTS

The term non-timber forest products has been difficult to explain amongst forest scientists, policy makers and other stakeholders because of the imprecise bounds between timber and

non-timber products (Ahenkan and Boon, 2011). This difficulty in defining NTFPs has created a lot of debate among scholars and policy makers concerning its actual meaning (Shiva and Verma 2002; Belcher and Vantomme, 2003). Currently, there are many terminologies such as ‘‘non-wood forest products, minor forest products”, “forest biological resources”, special forest products”, “non-wood forest benefits” “non-wood goods and services”, “forest garden products”, among others, which have been used interchangeably to refer to non-timber forest products (FAO, 2006).

Attempts by FAO (1995) to harmonize definitions of NTFPs by bringing various stakeholders to agree on a universal term met little success (Bih, 2008). One of the difficulty encountered in having a universal definition of NTFPs was how to differentiate between NTFP extracted from natural ecosystems and those from man-made systems. In addition, the varied views from many scholars from different disciplines such as forestry, ecology and biology dealing with these products has complicated the situation (Bih 2008; Ahenkan and Boon 2010).

The absence of a universal definition for NTFP has limited duplication of research and investments associated with NTFPs (Belcher and Vantomme, 2003). This has rendered comparisons of costs and benefits accruing from NTFPs in different parts of the world almost impossible because of either exclusion or inclusion of a variety of products. It has further restricted a full and acceptable taxonomic system of NTFPs, which is only possible upon agreed terminology arising from a consensus (Kusters *et al*., 2006). As indicated by Ahenkan and Boon (2010), discussions on NTFPs has been undermined by inconsistent definitions, thus discouraging formulation and implementation of appropriate policies aimed at enhancing sustainable utilization of NTFPs in different parts of the world.

Some of the definitions of NTFs given by various scholars include:

i. The term "Non Timber Forest Products" (NTFPs) comprises all biological resources other than timber, which are extracted from forest for human use (De Beer and McDermott, 1989).
ii. Non wood forest products (NWFP) refer to as 'goods of biological origin apart from round wood harvested from forests, or wooded lands and trees outside forests' (FAO, 1999).
iii. All resources found on forest land with exception of timber, fuelwood, or medicinal plants harvested as whole plants' (Wong, 2000).

It is important to note that despite these efforts by scholars, there is no universally accepted classification scheme for NTFPs at global level (Shiva and Verma 2002). However, several authors (FAO 1995; Shiva and Verma 2002; Ahenkan and Boon 2011) have put forward two broad groups of NTFPs based on their origin namely: NTFPs of animal origin (game and other fauna products), and those of plant origin (leaf, fruit, stem, roots, resins). This classification serves as the background upon which many other classifications have been built. In the current study, a definition that covers a wide range of NTFPs of both animal and plant origin based on the classification by FAO (1995) and Shiva and Verma (2002) was adopted (Table 2.1).

Table 2. 1: Classification of non-timber forest products

Category	Plants and plant products	Category	Animals and animal products
Food	Vegetables and beverages from fruits, nuts, seeds, roots.	Living animals	Mainly vertebrates such as mammals, birds, reptiles, among others.
Fodder	Animal and bee fodder provided by leaves fruits, among others	Honey and beeswax	Products provided by bees.
Utensils, handcraft	Heterogeneous group of products including rattan, wrapping leaves, fibres such as silk, cotton floss, Screw pine, among others.	Bushmeat	Meat provided by vertebrates, mainly mammals.
Perfumes and cosmetics	Aromatic plants providing essential (volatile) oils and other products used for cosmetic purposes.	Other edible animal products	Mainly edible in vertebrates such as insects such as caterpillars, grasshoppers, crickets), crabs and other "secondary" products of animals such as eggs, nests etc
Dyes and tannin	Plant material, mainly bark and leaves that provide tannins and other plant parts (especially leaves and fruits) used as colorants.	Hides and skins	Hide and skin of animals used for various purposes.
Medicine	Medicinal plants from parts such as leaves, bark, roots used in traditional medicines and (or) by pharmaceutical industries	Medicine	Entire animals or parts of animals such as various organs such as caterpillars, crab legs, snake oil, among others used for medicinal purposes.
Construction materials	Thatch, bamboo, fibres.		
Ornamentals	Entire plants such orchids, ferns, philodendron, and parts of the plants such pots made from roots) used for ornamental purposes.	Colorants	Entire animals or parts of animals such as various organs used as colorants
Exudates	Substances such as gums (water soluble), resins (water insoluble) and latex (milky or clear juice), released from plants through exudation.	Other non-edible animal products	Bones, horns, hooves, for carving tools and beadwork.

Source: Adapted from FAO, 1995; Shiva and Verma, 2002 and Ahenkan and Boon, 2011

2.8 FOREST POLICY AND INSTITUTIONAL FRAMEWORK IN NIGERIA

The institutions responsible for forest and biodiversity management at both the federal and state levels in Nigeria are coordinated via the National Council on Environment, which is made up of the Federal Ministry of Environment and State Commissions of Environment. There is however no single government agency, assigned to coordinate biodiversity conservation in the country, making indiscriminate resources exploitation to occur virtually in all parts of the country.

Currently, forest conservation and management policies are taking a new dimension world over with most of the countries adopting complete or partial devolution systems of management. However, despite this spring of change in the world forest subsector, forest policy (Land use Act 1978) and its administrative machinery in Nigeria tend to focus on the government as the sole management agent and therefore main stakeholder. This is because the framework does not encourage communities' participation in forest management, even though it states the need for the private sector participation as part of the strategies to achieve the objective of government policy on utilization of forest product. For example, the compulsion of individuals, groups, organizations and communities to obtain permission from government forestry offices before harvesting any tree, including those raised by individuals on their own land, suggests that all forest resources belong exclusively to the government. This policy negatively affects the level of investment among individuals and private organizations and therefore need to be reviewed if the twin goal of sustainable natural resource management and livelihoods security is to be achieved (Ojo and Akande, 2003). Moreover, the devotion of the protected areas to more or less strict nature reserve is counterproductive and is denying local communities and indigenous people access to non-timber forest products, which are key to their livelihoods.

The success of forest resources conservation in Nigeria requires the full integration of social and economic goals into conservation planning process in order to ensure that forest stakeholders' expectations are met. Sustainable forest resources conservation under the existing states' natural resource laws and regulations are not in tandem with current realities, as well as, the property rights that are not well defined and properly enforced.

2.9 GOVERNANCE OF FOREST SECTOR AND UNDERLINING CHALLENGES

Forest sector governance refers to the ways in which public or private institutions (both formal and informal) exercise authority in the management of the forest ecosystem in order to sustain and improve the welfare and quality of life for those whose livelihoods depend on the sector without compromising its ecological integrity (World Bank, 2007). Effective and efficient forest governance is exemplified by predictable, open, and sound policy decisions based on transparent processes and strong participation of civil society organizations in decisions making process (World Bank, 2006).

The rationale for the good forest sector governance is to address the inherent problems of illegal logging, corruption, and other forest sector crimes, such as arson, poaching, land encroachment, trade in endangered flora and fauna, and evasion of legal taxes and royalties. For example, according to World Bank (2004) illegal logging in public lands in developing countries causes an estimated loss of revenue of about USD10 billion annually, almost six times the total amount allocated for sustainable forests management by local and international donors. In addition, about USD5 billion worth of revenue due for national governments is lost annually because of the tax waiver and uncollected royalties from public forest, as a result of corruption. Good forest sector governance is necessary for biodiversity conservation in the reserve and beyond, and also for improved livelihoods by regulating the behaviour of individuals within a given community (Ostrom, 1990). The overall aim of an effective forest

sector governance is to regulate the interaction between humans and forest ecosystems (Campese *et al*., 2009).

The main challenges in governance of forest as indicated by World Bank (2009) include among others, broad nature of the resources governance system, comprising multiple actors and factors, with complex interrelations; poor utilization of the available information in forest sector decision making process by policy makers; poor institutional and administrative framework; inability to merge the academic efforts with the field experiences, to accelerate learning and development of practical approaches; and finally the fact that governance reforms normally create losers and gainers. The losers will be inclined to block reform efforts, whereas the gainers would be supportive of the introduced reform. These challenges persist due to lack of in-depth understanding of the complex nature of social, economic, cultural and ecological interrelations between communities' livelihoods and natural resources.

2.10 RESEARCH GAPS

The focus on non-timber forest products in natural resource conservation among scholars and conservationists gained momentum around early 1980s. Although many studies (Babalola, 2007; Jimoh and Haruna 2007; Amadi et al., 2016; Amusa, 2017) have been conducted on NTFPs in Nigeria with plethora of empirical evidence on resource degradation and conservation strategies, none has been done in Falgore game reserve. This therefore leaves gaps both in knowledge and practice that need to be bridged. These include among others, lack of information on performance of governance (act of governing, power, relationship, accountability and decision making and how local people are involved in natural resource conservation) on FGR; lack of empirical studies on the economic contribution of NTFPs to households living adjacent to FGR and; mechanisms to ensure benefits from forest resource

conservation accrue to all relevant stakeholders equitably, as well as understanding the factors influencing local people willingness to pay for NTFPs conservation is lacking.

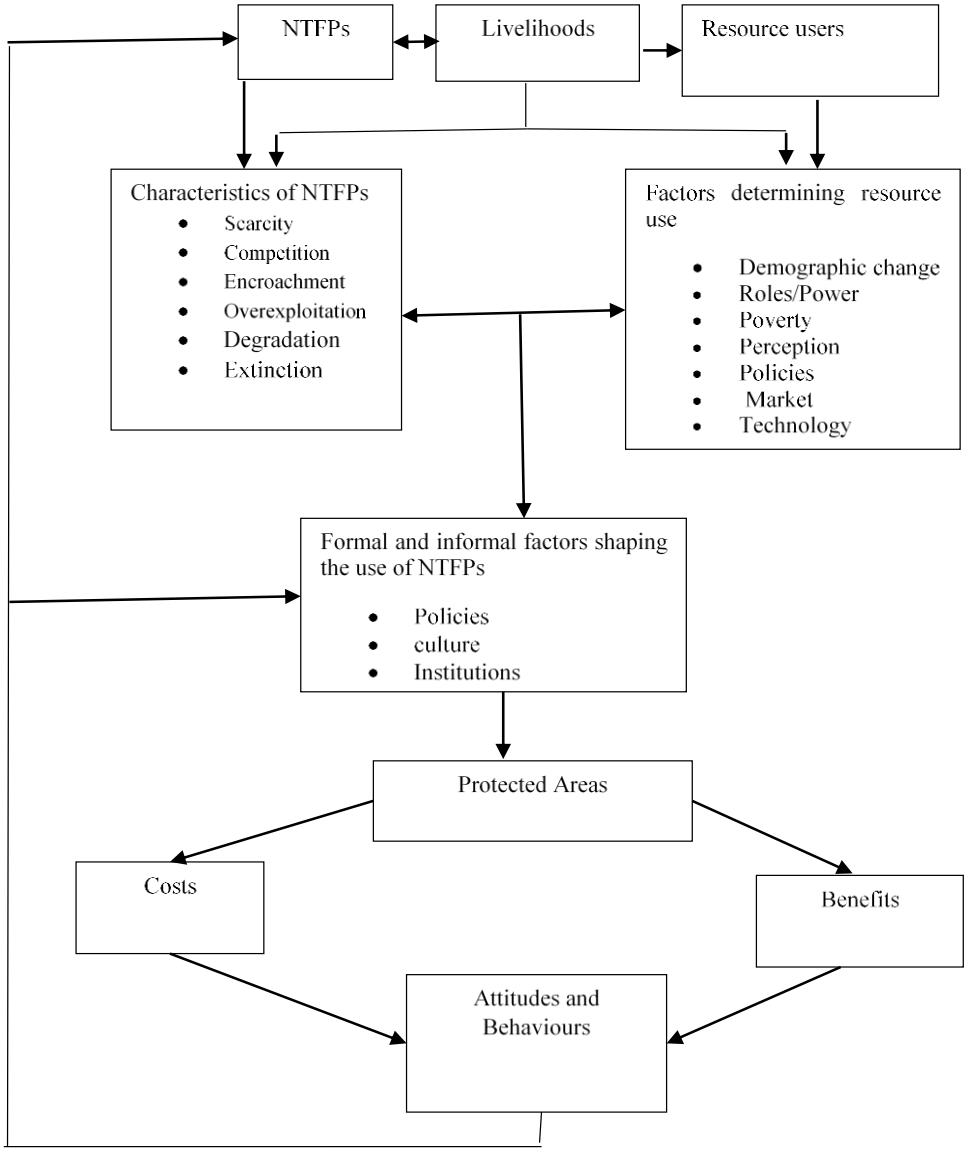
2.11 CONCEPTUAL FRAMEWORK FOR THE STUDY

The conceptual framework as depicted in Figure 2.1 presents the nexus between NTFPs, biodiversity protection and livelihoods improvement as a function of households' characteristics; attributes of the natural resources; rules-in-use; and actors involved, which together determine sustainable management and utilization of NTFPs.

The framework reflects the main hypothesis that the efficiency and effectiveness of forest management approach depend on the costs involved and perceived benefits accruing to stakeholders. It is believed that local people are likely to support a particular forest management approach if they expect to maximize their utility as indicated by Hooker *et al*. (2011), the costs of protection of a given natural resource in terms of access and use are mainly incurred by rural populations. These costs and benefits are however unequally distributed between and among stakeholders at local, national and international levels.

Figure 2.1 show that resource users' attitudes, behaviour and actions towards NTFPs are determined by a number of social, economic and cultural factors. For example, increase in human population may negatively impact on the quantity and quality of NTFPs. This is because exponential growth of human population can lead to high demand for NTFPs thereby leading to overexploitation and forest degradation. This may further interrupt the provisioning of ecosystem services from forestlands (Díaz *et al*., 2015). The growing level of poverty in rural communities is significantly contributing to local people overreliance on natural resources around them (Shackleton *et al*., 2007). Hence, this study hypothesized that poverty may lead individual households to make economic choices that are ecologically destructive. For example, illegal fuelwood collection and charcoal burning may have far reaching negative

consequences on NTFPs conservation, while providing short term economic benefit to resource users.



Source: Adapted from Kideghesho *et al*. (2006)

Figure 2. 1: A conceptual framework showing the relationship between actors and conservation of non-timber forest products.

Infrastructural development such as construction of roads around the protected areas may expose the forest resources to illegal exploitation, as this opens up market opportunities for

local resource exploiters (Meduna *et al*., 2009). Community's perceptions on resources governance, power sharing and responsibility also influence their behaviours' towards other stakeholders and natural resources use. People perceive and interpret issues differently, and these differences stem out from inherent differences in societal norms and values, which may lead to decisions and actions that may undermine the interests and needs of other actors over resources.

The way and manner people interact with their immediate environment is usually determined by internal or external influence. The use of forest resource, for example, in most rural Africa is often regulated by external power outside the local settings, this usually result in conflicts between external actors (Forest Department) and local resource users. For example, use of fine and fence, force, legal or economic power to deny local people access to forest and other resources can lead to resource conflicts among stakeholders. Power imbalance leads to unequal distribution of benefits and costs of conservation and, therefore, resulting in conflicts (Kideghesho *et al*., 2006). Resource-use conflicts can also emerge when action by some actors force others to change nature and pattern of resource exploitation or when an actor decides to resort to strategic behaviour aimed at gaining unfair advantage over others. Peoples' behaviour and level of resource exploitation may change as a result of access to better technology, market outlets and resource use policies. For instance, access to technology and market outlet may encourage overexploitation of forest resources thereby leading to resource degradation (Kideghesho *et al*., 2006). However, poor formulation and implementation of forest policies may encourage overexploitation and resource degradation (Leisher *et al*., 2010; Stainback *et al*., 2012). For example, some policies may favour the economically profitable resources such as timber and neglect other minor resource such as NTFPs whose expectation may be ecologically destructive and, therefore undermining long term conservation goals.

CHAPTER THREE

METHODOLOGY

3.1 STUDY AREA

3.1.1 Location and geo-physical characteristics

The study was conducted in Falgore Game Reserve (FGR) Kano, Nigeria. The FGR formerly known as Kogin Kano Game Reserve is located between longitudes 8^0 30' and 8^0 50' East and latitudes 10^0 46' and 11^0 20' North, and 150 km south of Kano city (Figure 3.1). The reserve has an estimated area of 92,000 ha, and borders Tiga artificial Lake to the north, and Lame Burra Game Reserve in Bauchi State to the southeast (BirdLife International, 2007). Specifically, this study covered three Local Government Areas (Doguwa, Sumaila and Tudun Wada), which border FGR. The FGR and the surrounding communities falls within northern guinea savannah agro-ecological zone of Kano State, which is best suited for arable crops and livestock production.

3.1.2 Climate

The area receives mono-modal rainfall which falls from May to mid-October with the peak in August, while the dry season starts from October to May. The annual mean rainfall is between 800 mm and 900 mm with up to ± 30% mean annual variations (KNARDA, 2006). The area is characterized by three relief types namely, the south and south-eastern highlands, middle and western high plains and north-eastern low Chad plains. The highlands which form a small portion of the area are situated around the southern and south-eastern parts of the reserve joining the foot slopes of Jos Plateau, which rise up to 1100m above sea level. The elevation of their bases ranges between 700m and 800m (Badamasi *et al*., 2010). With the highest peak being about 1230 m above sea level.

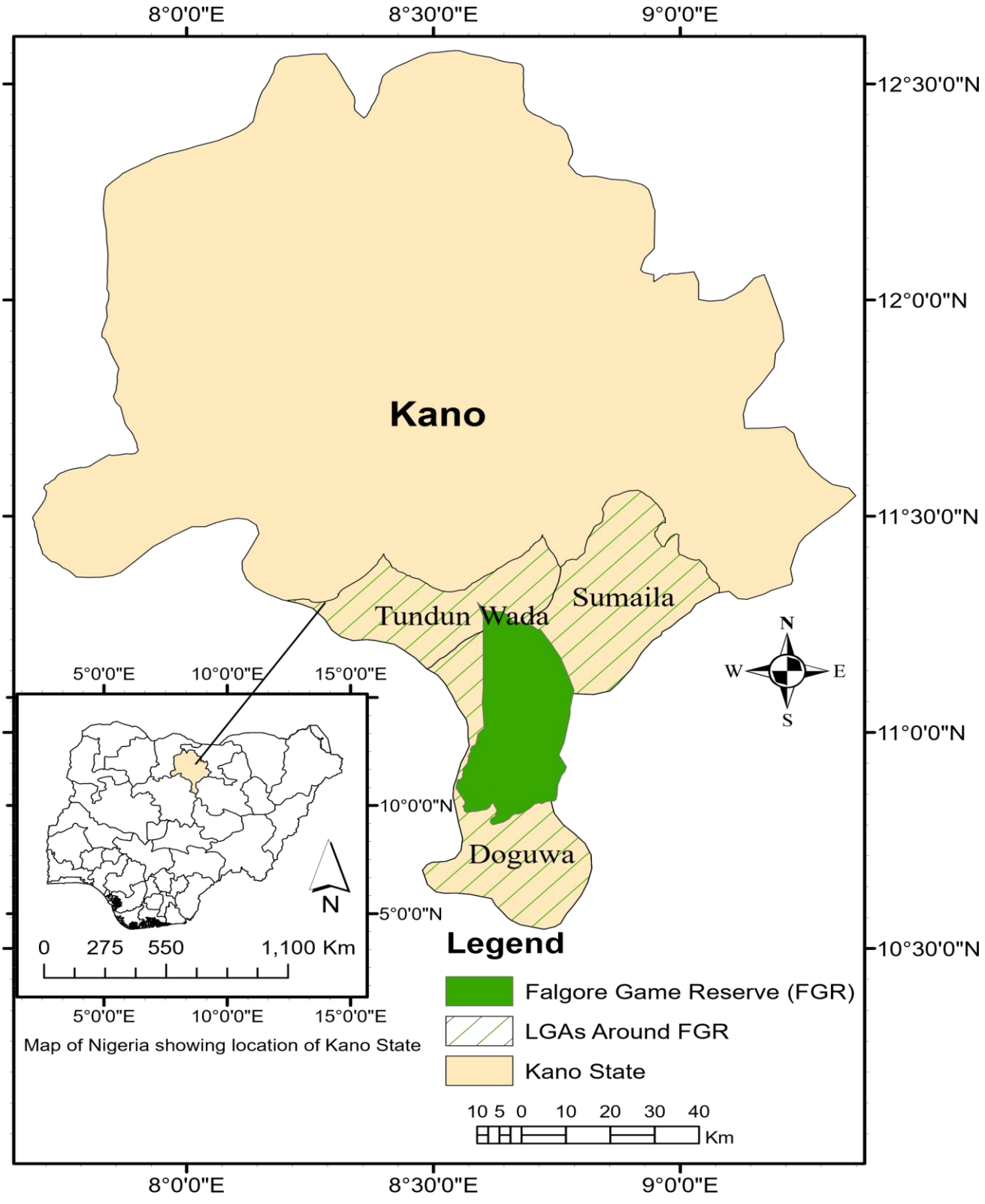


Figure 3. 1: Falgore Game Reserve and Neighbouring Local Government Areas

Temperature of the study area is fairly stable in comparison to rainfall pattern and distribution. However, the temperature varies and follow the rainfall and relief of the area with colder months starting from late October to March. The mean annual temperature of FGR is about 26^0C (Olofin, 2000).

3.1.3 Vegetation

The FGR is a gallery forest with a high density of tree species and high floristic diversity found within the open northern guinea savannah woodland vegetation type, and the Sudan Savannah in the northern tip (BirdLife International, 2007). The vegetation of the study area is dominated by trees such as *Isoberlinia, Khaya senegalensis, Vitex doniana, Anogeissus leiocarpus, Tamarindus indica, Detarium microcarpum, Afzelia africana, Anogeissus leiocarpa, Diospyros ebenum, Syzygium cordatum and Pterocarpus erinaceus* (Badamasi et al. 2010; BirdLife International, 2007). African fan palm (*Borassus aethiopum*) and Mango (*Mangifera indica*) dominates the river Kano bank, which bisects the reserve into two forming part of the dense woodland found in the study area. In addition, the reserve support different wild animal species that include roan antelope, side stripped jackal, duikers, baboons, civet cat and hyenas. Reptiles include frogs, snakes, monitor lizard, tortoises, and turtles. Birds such as heron, hammer kob, ground horn bill, pigeons, abessynian rollers also exist in the forest. The presence of perennial grasses and shrubs throughout the year provides feed for livestock production hence the reason for the dominance of pastoralists and agro-pastoralists in the areas that surround the reserve.

3. 1.4 Livelihood activities

Crop production, livestock rearing and extraction of forest resources are the major livelihoods activities in the study area. The main food crops grown are maize, rice and sorghum, while forest resources such as fuelwood, fruit nuts, honey, gum arabic, fodder and medicinal herbs

provide the locals with food and income through sale of various forest products. The common livestock kept by the inhabitants are cattle, shoats, and poultry. Over 75% of the population in the area are farmers with an average land size of 1ha per household. Poverty is a common phenomenon in the study area with about 80% of the population living below the poverty line (KNARDA, 2006).

3.1.5 Human Population

Kano State is the most populous state in Nigeria with a population of 9,383,682 people. The annual population growth rate of the state is 3% and therefore the population is projected to reach 12,198,786 by 2016 (FRN, 2010). The high population density (470/km^2) put the natural resources in the area under immense pressure arising from competition over limited resources and shifting land uses. The main inhabitants of Kano State are the Hausa and Fulani ethnic groups. The Fulani community is predominantly found in the areas around FGR especially in the southern and eastern parts of the reserve and their main source of livelihood is livestock keeping. The Hausa who are mostly farmers and fishermen inhabit the central and northern parts of the forest, extending to around Lake Tiga.

3.2 STUDY DESIGN

3. 2. 1 Sampling procedure

Multistage sampling technique was used in this study. In the first stage, three Local Government Areas (LGAs) around Falgore game reserve namely; Doguwa, Sumaila, and TudunWada were purposively selected because of the existence of a large portion of the reserve, and high number of forest-dependent communities within their territories. At the second stage, three villages, which are directly adjacent to FGR were purposively chosen from Tudun Wada and Sumaila, and four from Doguwa. More (four) villages were selected in Doguwa because of high population density and more communities neighbouring the reserve

as compared to the other two LGAs. Generally, these villages were selected due to their high dependence on non-timber forest resources from the reserve. They were also considered to have more stake in terms of access to and resource user rights over the available resources in the reserve. In total, 10 villages namely; Falgore, Yantabarmi, Dogon Kawo, Sabuwar Kaura from Doguwa, Ziria, Gomo, Diwa from Sumaila, Makwasa, Farurunruwa, and Nufawa from Tudun Wada were selected for the study (Table 3.1).

A formula by Taro Yamana (1967) was used to compute the appropriate sample size for the study, taking into consideration the population size of the household heads of the selected communities. The adoption of this formula was informed by the desire to draw a representative sample from the target population and also to minimize sampling error and bias.

The formula is express as:

$$n = \frac{N}{1+(e^2)N} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

n = is the sample size

N = is the definite population of the communities

e = is the significance level (0.05)

Using the above formula (equation 1), the sample size was computed to be 391 out of 18,133 households in the study area. The sample size was approximated to 400 respondents as indicated in Table 3.1 to take care of missing and improperly filled copies of questionnaire

$$n = \frac{18133}{1 + (0.05^2)18133} = 391$$

Table 3. 1: Sampling frame and sample size

S/No.	Local Government Areas	Forest-Adjacent communities	Sampling frame (Population of Household heads)	Sample size
1	Doguwa	Falgore Yantabarmi Dogon Kawo Sabuwar Kaura	2535 1250 1178 2090	56 27 26 46
2	Sumaila	Ziria Gomo Diwa	1544 2096 1780	34 46 39
3	Tudun Wada	Makwasa Farurunruwa Nata'ala	1888 2108 1664	42 47 38
Total	3 LGAs	10	18,133	400

Source: Author's computation from the lists of household heads provided by the Village heads

Proportionate sampling technique was used to determine the number of respondents to be drawn from each community based on the projected population of the communities. The 400 respondents who participated in the study were randomly selected from a list of households provided by the National Population Commission Kano and verified by the village heads of the selected communities. The randomization was achieved using random numbers generated using Stata version 13.

3. 3 DATA COLLECTION

A combination of methods of data collection was used in this study. The quantitative and qualitative data were collected through household interviews, focus group discussions and key informant interviews. The requisite data collected included the socio-economic characteristics of households, income generating activities, non-timber forest products collection activities, households' perception and attitude towards protected area forest resource conservation, as well as their willingness to pay to conserve and also to collect NTFPs from the reserve. Secondary data were obtained from Kano State Ministries of Agriculture and Environment, National Centre for Remote Sensing Kano, National population commission (NPC) and United

States Geological Survey (USGS). The secondary data included satellite images of FGR for the past three decades (1985-2015), household numbers and livestock populations.

3.3.1 Household interviews

A structured questionnaire composed of closed and open-ended questions (Appendix 1) was used to guide the household interviews, which were administered by the author and trained enumerators. A household was specified as a person or group of related or unrelated persons, who live together under the same roof or dwelling unit, and share the same domestic goods and services and are considered by themselves and others as a single family unit (Agbamu, 2005; Eichler and Albanese, 2007). The data collected included information on NTFPs used, quantities of NTFPs consumed, sale, sources and person(s) responsible for the NTFPs collection among the household members, respondents' perceptions and attitudes towards protected area conservation approach, as well as households' willingness to pay for NTFPs conservation. The interviews were conducted from September to December, 2015. The household head was the main target for the interview but in an event where the head was absent, the spouse or a representative was interviewed. Prior to the household interviews, the questionnaire was pretested and adjusted to ensure it was effective and efficient in capturing the required information. Face-to-face interviews were conducted as most of the respondents could not read, and therefore were unable to comprehend the questions to provide the answers. In addition, face-to-face interviews are known to generate a higher response rate than self-administered approach (Newman et al., 2002).

3.3.2 Focus group discussions

Nine focused group discussions, each comprising 10-12 participants, who had vast knowledge on NTFPs utilization, social and cultural norms of the communities were conducted in nine forest adjacent communities (Falgore, Yantabarmi, Dogon Kawo, Sabuwar Kaura, Ziria,

Gomo, Makwasa, Farurunruwa, and Nufawa) between July and August, 2015. The selection of the participants ensured that people from different age and gender were included. A check list (Appendix 2) of questions was used in order to get an in-depth information on common NTFPs collected by households, drivers of forest resource degradation, market and prices of various NTFPs in the study area. The FGDs were as also used in validation of information gathered from individual interviews.

3.3.3 Key informant interviews

Twelve key informant interviews involving village leaders, resource users, staff from Ministry of Agriculture and Ministry of Environment, Officials of FGR were conducted between July and August, 2015. The information collected included State forest policy, NTFPs extracted from the forest, and the kind of anthropogenic activities going on in the reserve. Similarly, information on opportunities and challenges facing FGR administration were elicited. The information collected from key informants was used to supplement the data collected from household interviews and FGDs.

3.3.4 Spatial and temporal forest cover change analysis

Satellite images of the Falgore game reserve obtained from United States Geological Survey (USGS) were used for the analysis of forest cover change in the last three decades. The Landsat-5 Thematic Mapper (TM), Enhanced Thematic Mapper plus and the Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) imageries for 1985, 1998, 2005 and 2015 were used to classify the vegetation cover types based on the criteria presented in Chapter 4 (Table 4.2). The images were screened to ensure the selected ones had minimal cloud cover. ERDAS imagine and Arc GIS were used to prepare and classify the current forest cover types and the changes during 1985-1995, 1996-2005 and 2006-2015 in hectares of various cover

types. Maps representing the forest cover classes of the periods under investigation were developed.

CHAPTER FOUR

SPATIAL AND TEMPORAL ANALYSIS OF FOREST COVER CHANGE IN FALGORE GAME RESERVE IN KANO, NIGERIA

ABSTRACT

Multi-temporal land-use and land cover data provides a historical vehicle for determining and evaluating long-term trends in bio-physical landscapes. Land-use and land cover assessment and mapping is one of the most useful applications of GIS for planning, management and development. This study analyses the spatio-temporal pattern of forest cover dynamics for three decades in Falgore game reserve in Kano Nigeria. The dynamics of forest cover transition during 1985-2015 was analyzed using multi-temporal Landsat imagery. The results show that moderate woodland dominated in 1985 (46%) and 2005 (57%), but was replaced by open woodland in 2015, which currently accounts for 58% of the total area of FGR. Dense woodland occupied the least area of the total forest estate that decreased from 17% in 1985 to 1% in 2015. The results further indicate that dense woodland, moderate woodland, and very open woodland decreased at an annual average rate of 3%, 1% and 0.4% respectively. Open woodland had expanded from 21127 ha in 1985 to 53392 ha in 2015. The main drivers of forest resource degradation in the area were found to be excessive fuelwood collection, overgrazing, agricultural expansion, and forest fire. These findings suggest that protection strategies employed in FGR were not effective as deforestation was evident in the reserve. The government of Nigeria and organizations involved in conservation of natural resources should therefore prioritize effective and efficient conservation strategies for present and future use of forest resources, in addition to promotion of alternative livelihood sources to communities proximate to the reserve. This will enhance the socio-economic well-being of the locals and sustainable conservation of biological diversity in the area.

Keywords: Forest cover, Land use and Land Cover Change; Game reserve; Falgore; Degradation

4.1 INTRODUCTION

The last few decades marked massive changes in land-use and land cover in forest ecosystems of Nigeria. These changes have been attributed to increase in human population, agricultural expansion and changes in socioeconomic well-being of the people, which have triggered unsustainable extraction of natural resources. Increasing human population and global climate change have been reported to be among the key factors that have contributed to vegetation cover losses and gains in seasonally dry tropical ecosystems globally (Lambin *et al*., 2003; Lepers *et al*., 2005). Forest ecosystems, including tropical deciduous forests and Savannas,

occupy about 14% of earth's terrestrial area (18.6 × 106 km^2) and constitute 15% of global vegetation carbon stocks (Melillo *et al*., 2002; Corbera *et al*., 2009). Despite their importance in providing ecosystem goods and services and sustaining household livelihoods, forest ecosystems worldwide are facing degradation. Among the nations with the highest deforestation rates, significant proportions of their forest losses have been reported on the Savanna woodland forests that are poorly protected (FAO, 2010; Green *et al*., 2013).

In Nigeria for example, forests occupy about 10 million hectares representing almost 10 percent of the total land area (92 377 km^2) (Usman and Adefalu, 2010). The total forest cover in Nigeria is made up of about 445 protected areas, distributed over four ecological zones. They include fresh water/mangrove; the lowland rainforest; the derived Savanna; and the Sahel/Sudan Savanna. Most of these forest reserves have however been degraded (USAID, 2008). This is because most of the protected areas lack adequate protection and management, therefore making it easy for illegal logging, encroachment by farmers, illegal grazing and excessive fuelwood collection, among other activities that degrade the forests. For instance, widespread poaching and encroachment by local people has been reported in Kainji Lake National park, Yankari Game Reserve and Old Oyo National Park (Oseni, 2007; USAID, 2008; Meduna *et al*., 2009). According to the Wildlife Conservation Society (WCS) (2010), there are over 600 illegal farms within the Afi Wildlife Sanctuary alone. Poor governance and lack of political good will to safeguard these nature reserves have negatively impacted on the once flourishing and ecologically diverse forest ecosystems of the State (Meduna *et al*., 2009). According to Akinbami *et al*. (2003) and MEA (2005), Nigeria is among the countries with the highest rate of primary forests loss world over, with an annual average rate of 5.7% compared to the world average of 3.3% per annum. For instance, the natural forest cover in the country decreased from 25,951 square kilometres in 1976 to less than 10,114 square kilometers in 2005, indicating a loss of about 53% of the total forestland. Forest ecosystem modifications perpetrate profound

negative impacts on sustainable food production, freshwater availability, species diversity and richness, climate and human well-being (Potter *et al*., 2007; Verburg and Overmars, 2009). Deforestation in Nigeria's National Parks and forest reserves is largely attributed to inadequate technical staff, lack of equipment, corruption and poor remuneration among other factors (Meduna *et al*., 2009).

Falgore game reserve which is the main focus of this study is facing both natural and human induced degradation (Badamasi *et al*., 2010) arising from illegal exploitation of resources such as felling of trees for fuel, fishing, uncontrolled hunting of game animals and unregulated grazing in the forest. The problems of FGR are more profound when considered on the basis of its potential ecological and economic services to the nation. The reserve provides a unique ecosystem that serves as an important freshwater catchment serving Kano, Jigawa, Bauchi, Yobe and Borno States, and Lake Chad, as well as provision of numerous NTFPs to the neighbouring communities (Yelwa, 2008).

Understanding the dynamics of natural resource and the associated drivers is necessary for generating valuable information for better decision making in their management (Lu *et al*., 2003). Changes in land-use and land-cover have been mainly linked to biodiversity loss, climate change, food insecurity, human health, and general environmental degradation (Dunjó *et al*., 2003, Heistermann *et al*., 2006). As indicated by Wasonga (2009), spatial and temporal analyses of changes in social and ecological conditions is key in targeting and prioritizing areas for development interventions. In addition, remotely sensed land-use data provides a historical vehicle for determining and evaluating long-term trends in bio-physical landscapes. Land-use and land cover assessment and mapping is one of the most useful applications of GIS technique for planning, management and development (Wasonga, 2009). Yang *et al*. (2007) reiterates the versatility of remotely sensed data in mapping out environmental degradation trends arising

from human activities and natural factors. At global scale, many studies have used remote sensing and geographic information system techniques to map out environmental changes. For instance, Diouf and Lambin (2001); Wasonga (2009); Tsegaye *et al*. (2010) in drylands; Shalaby and Ali (2012) in agricultural areas; Mwita *et al*. (2013) in wetlands; Liu *et al*. (2012); Mbau (2013), human-wildlife conflict and Laurin *et al*. (2013) in forestlands.

This study was conducted to analyze the spatio-temporal dynamics of forest cover change and the perceived drivers of forest degradation in Falgore game reserve over a period of three decades (1985-2015) using remote sensing techniques.

4.2 METHODOLOGY

4.2.1 Data collection

4.2.1.1 Household interviews, key informant interviews and focus group discussions

The information regarding the community perceptions on drivers of forest resources degradation in Falgore game reserve was collected from 400 sampled households through household interviews using a structured questionnaire (See details in Chapter three). In addition, twelve key informant and Nine FGDs, each comprising 10-12 participants were conducted, one in each of the selected nine villages. The information gathered were related to various causes of NTFPs degradation due to human and natural factors, and general drivers of land use and land cover change in the study area.

4.2.2 Satellite data acquisition and image processing

The Landsat-5 Thematic Mapper (TM), Enhanced Thematic Mapper plus and the Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) imageries for 1985, 1998, 2005 and 2015 used in this study were retrieved from the United State Geological Survey (USGS) database (http://glovis.usgs.gov/index.shtml (Accessed on 22 April 2016)). All the images

selected for the analysis had had 30 meter spatial resolution, were cloud free, and were those captured during the dry season to avoid overestimation of vegetation cover types (Table 4.1).

Table 4. 1: Attributes of the satellite imageries used to estimate vegetation cover

Attributes	1985	1998	2005	2015
Sensor	Landsat 5 TM LIT	Landsat 5 TM LIT	Landsat 7 ETM+LIT	Landsat 8 OL1/TIRS
Path/row	188/52	188/52	188/52	188/52
Spatial resolution	30metre	30m	30 m	30 m
Date of acquisition	3/3/1985	27/2/1998	2/3/2005	6/3/2015

Source: Authors' synthesis from USGS (http://glovis.usgs.gov/index.shtml)

4.2.3 Forest cover classification

Due to lack of standardized forest cover classification system for remotely sensed data in Nigeria, a classification scheme used by Anderson (1976); Wasonga (2009) and Badamasi *et al*. (2010) in their various studies for LULCC analysis was adopted. The vegetation cover was classified into four major classes based on tree and canopy density as shown in Table 4.2.

Table 4. 2: Forest cover classes based on tree and canopy density

Land cover category	Description of class type
Dense woodland	Areas dominated by trees (>70%)
Moderate woodland	Areas with 50-70% tree cover
Open woodland	Areas with moderately scatters trees (>10-49%)
Very open woodland	Areas with scattered trees (<10%)

Source: Authors' own classification adopted from Badamasi *et al*. (2010)

4.2.4 Data analysis

The acquired imageries were processed using Arc GIS 10.2 and ERDAS imagine 10 environments. Image pre-processing including geometric, atmospheric and topographic corrections were carried out to ensure spatial and temporal comparability of the datasets (Tewolde and Cabral, 2011). The imageries were geo-corrected and geo-referenced in order to allow for effective image processing as it is a prerequisite for successful land use/land cover

change analysis (Tewolde and Cabral, 2011). The 1998 image was used as the reference image for geometrical correction because of its good visual quality. All the bands of the imagery used in the study were resampled to a common pixel value in order to minimize the spatial scale differences between the bands of both datasets.

The iterative self-organizing data analysis (ISODATA) algorithm in ERDAS imagine software (version 9.2) was used to perform an unsupervised classification of 1985, 1998, 2005 and 2015 satellite images. The ISODATA clustering method uses the minimum spectral distance formula to form clusters (ERDAS Inc., 2014). The unsupervised ISODATA classification in this study used 10 classes, confidence threshold of 0.99, and 200 maximum iterations. The 10 classes were subsequently classified into four major forest cover classes as shown in Table 4.2.

4.2.5 Forest cover change analysis

Forest cover change was determined by quantifying the proportion of the area occupied by a particular forest cover type relative to the total forest cover. This was followed by the determination of relative change of various forest cover types during 1985 – 2015. This was achieved following Hansen *et al*. (2013) land-use and land cover formulae as presented in equations 1 – 3:

$$\Delta A = A2 - A1 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Where:

ΔA = Change area

A1 and A2 are the areas of the target vegetation cover type at date 1 and date 2

$$PAC = \left(\frac{\Delta A}{TA}\right) \times 100 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (2)$$

Where: PAC = Percentage area change

TA = Total area.

$$\text{Annual rate of cover change}\left(\frac{\text{ha}}{\text{year}}\right) = \frac{\Delta A}{N} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where N is the number of years under study.

4.2.6 Change detection matrix

In order to make a detailed analysis of the dynamics of forest cover change, transition matrices were developed. Transition matrices are tables with symmetric arrays, composed of the forest cover classes from the initial date in one axis and the same classes from the subsequent date in the other (date 1 and date 2). Each cell of the main diagonal of the matrix contains the surface area (ha) of each class of forest cover type that remained unchanged during the time period under consideration, while the remaining cells contain the estimated area of a given forest cover class that changed to a different class during the same period (Luenberger, 1979; Pontius *et al*., 2008). Therefore, the gross gain for each land use and land cover (LULCC) category is computed by subtracting the persistence from the column total, while the gross loss is derived by subtracting the persistence from the row total (Pontius and Malizia, 2004).

4.3 RESULTS AND DISCUSSIONS

4.3.1 Forest cover classes

The spatial and temporal patterns of various forest cover types for 1985 to 2015 are presented in Figure 4.1 and 4.2, while the quantitative spatial extent for forest cover types are shown in Table 4.3. The results reveal that moderate woodland was the dominant forest cover type in 1985 and 2005, accounting for about 46% and 57% of the total forest area, respectively. Open woodland was dominant in 1998 and 2015 covering about 50% and 58% of the reserve, respectively. Dense woodland occupied the least area that drastically decreased from 17% in 1985 to 1% in 2015. A corresponding decrease in area occupied by moderate woodland from 45% in 1985 to 29% in 2015 is an indication that forest cover has been declining in the reserve.

This reduction can be attributed to uncontrolled collection of non-timber forest products (NTFPs), climate variability, and natural and human induced forest fires as observed in many part of Africa (Kessy *et al*., 2016; Chan and Sasaki, 2014; Mayes *et al*., 2015). The results further reveal that very open woodland formed 14% of the total forest area of the FGR in 1985, but sharply reduced to 8% and 9% in 1998 and 2005. These gains in forest cover were attributed to forest succession on bare land as well as natural regeneration of trees on sites where trees were cleared for fuelwood and grazing in the reserve.

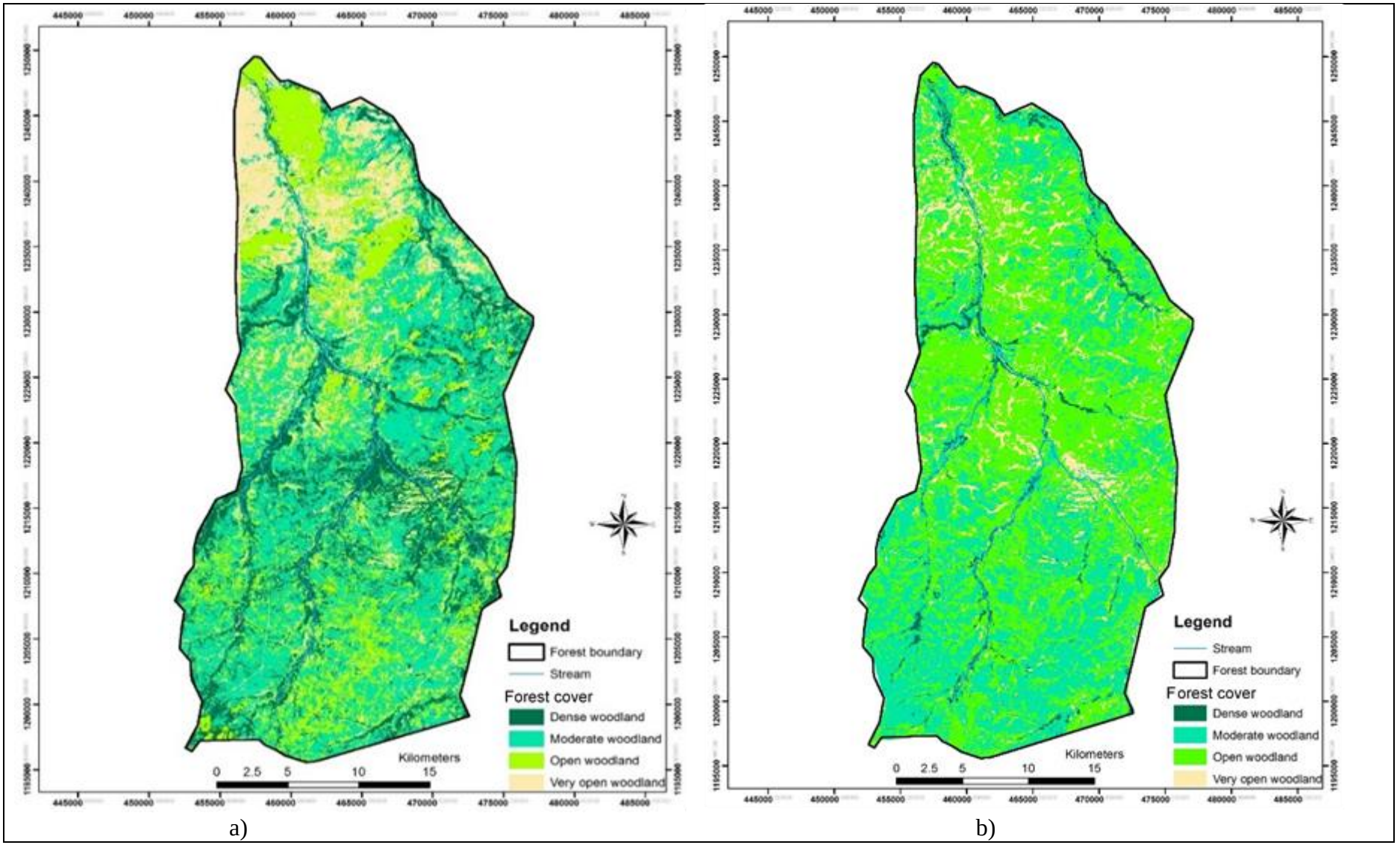
Table 4. 3: Forest cover types in Falgore game reserve during 1985 to 2015

Forest cover type	Area (ha)*			
	1985	1998	2005	2015
Dense woodland	15918.5(17)	3127.3(3)	2827(3)	787.41(1)
Moderate woodland	41941.5(46)	34524.9(38)	53086.1(57)	26375.3(29)
Open woodland	21127.3(23)	46783.6(51)	28234.6(31)	53392.7(58)
Very open woodland	13066.1(14)	7617.57(8)	7905.7(9)	11497.9(12)
Total	92053.4	92053.4	92053.4	92053.4

Source: Authors' own computation from satellite imagery analysis

*Percent forest cover are shown in parentheses

The forest cover maps of 1985, 1998, 2005 and 2015 shown in Figure 4.1 and 4.2 indicate that dense woodland was predominantly along river Kano tributaries, while very open woodland was mainly found in the northern tip of the reserve where the reserve borders Tiga artificial Lake. This could be due to the fact that flooding on the northern part of the reserve as a result of overflow from Lake Tiga suppresses density of the trees in the affected area (Badamasi *et al*., 2010). The map of 2005 (Figure 4.2 (a)) reveals more than 50% increase in moderate woodland diffusing eastwards and southwards of the reserve. However, in the map of 2015 (Figure 4.2 (b)) open woodland had diffused southwards with patches found everywhere in the



a) b)

Figure 4. 1: Forest cover in the Falgore game reserve during 1985 (a) and 1998 (b)

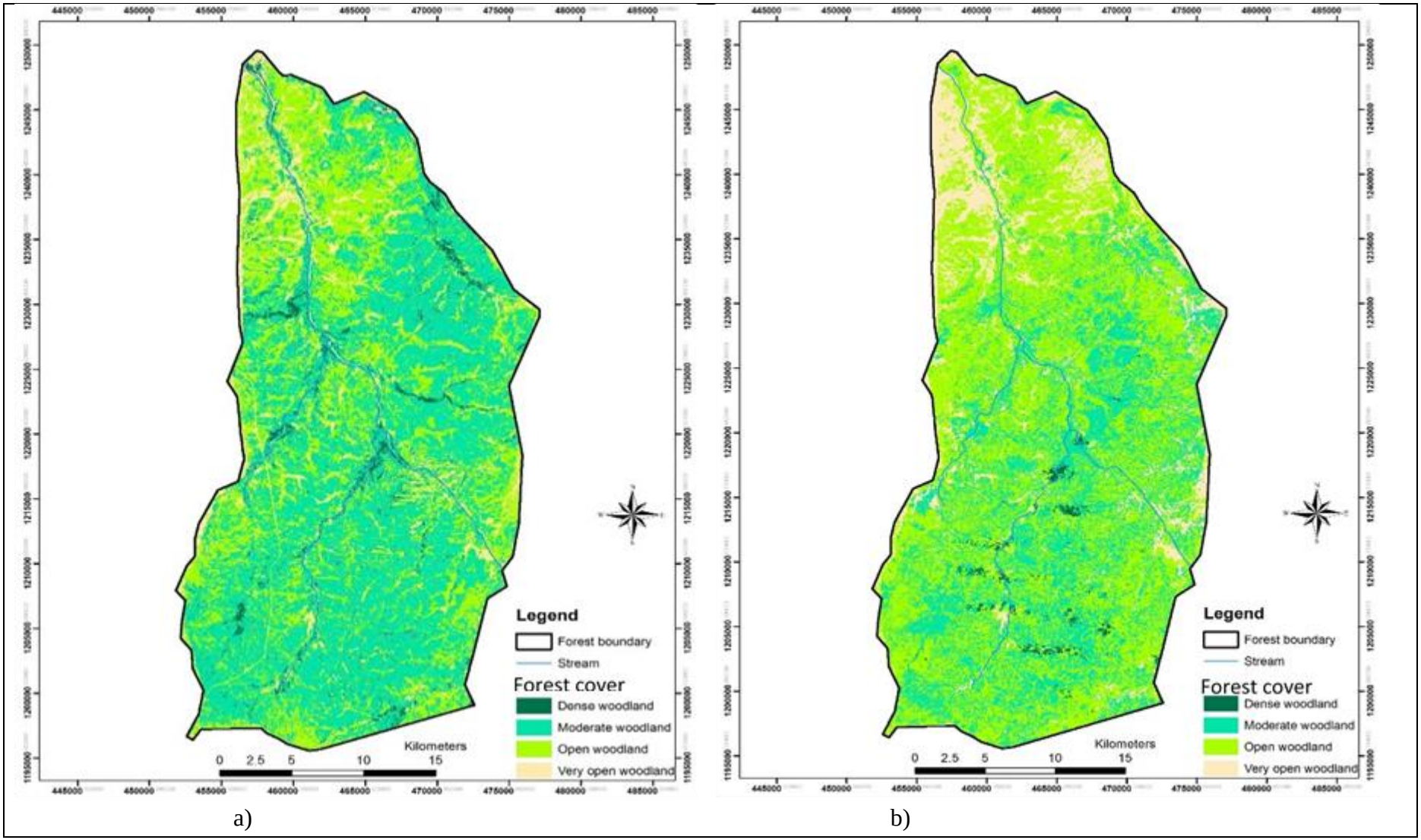


Figure 4. 2: Forest cover in the Falgore game reserve during 2005 (a) and 2015 (b)

reserve, further implying continuous deforestation in the study area. The decline in dense woodland during 2005-2015 is consistent with an increase in very open woodland from about 9% in 2005 to 12% in 2015. It can also be observed from Figure 4.1 (a and b) that the reserve suffered its greatest degradation between 1985 and 1998 especially around the northern and eastern part. However, there was a gain in the general tree densities in 2005. Figure 4.1 and 4.2 shows that the degradation trend continued and spread across the reserve as depicted in wide spread of very open woodland. These changes in forest cover types during this period signify a high rate of deforestation. This finding supports those of Food and Agriculture Organization (FAO, 2001, 2005), that deforestation rate in Nigeria increased from 2.38% per year in the 1990s to 5.7% in 2005.

4.3.2 Extent of forest cover change during 1985 to 2015

Table 4.4 shows the annual average rates of change of the forest cover types during the study period. The results indicate that dense woodland, moderate woodland, and open woodland experienced higher rate of change compared to the very open woodland during the period under study. For example, between 1985 and 2015, dense woodland, moderate woodland and very open woodland decreased by 15131 ha, 15566 ha and 1568.2 ha, respectively, indicating annual average rates of 3%, 1%, and 0.4% respectively. On the other hand, open woodland increased by 32265.2 ha at an annual average rates of about 5%. The open woodland changed most during the period under study, showing a general increase between 1985 and 2015, notwithstanding the declined in 1998. The reasons for the decrease in dense woodland and moderate woodland could be partly because these are the areas targeted for commercial timber logging as revealed by the key informants and participants of focused group discussions.

Table 4. 4: Extent of change of forest cover types in Falgore game reserve during 1986 to 2015

Forest cover type	Extent of change (ha (%)*					
	1985-1998	1998-2005	2005-2015	1985-2015	Relative change (%)	Annual rate of change (%)
Dense woodland	-12791.2(-13.9)	-300.3(-0.33)	-2039.6(-2.2)	-15131.1(-16.4)	-95	-3
Moderate woodland	-7416.6(-8.1)	18561.2(20.2)	-26710.8(-29)	-15566.2(-16.9)	-37	-1
Open woodland	25656.3(27.9)	-18549(-20.2)	25158.1(27.3)	32265.4(35.1)	153	5.1
Very open woodland	-5448.5(-5.9)	288.1(0.31)	3592.3(3.9)	-1568.2(-1.7)	-12	-0.4

Source: Authors' own computation from satellite imagery analysis; *Percent forest cover change are shown in parentheses

Generally, the observed increase in the extent of forest cover changes during 1985 to 2005 was linked to settlement of the Fulani cattle herders in the reserve. Upon sedentarization, the community has been felling trees to construct houses and at times cut the branches and shrubs to feed their livestock. In addition, the Fulani over-relies on forest resources to meet their economic and food needs, especially at times of scarcity occasioned by droughts. As indicated by Yelwa (2008), FGR serves as a safety net to neighbouring communities by offering alternative source of income and food for households during the off-farming season.

4.3.3 Forest cover transition matrix during 1985 to 2015

Transition matrix was used to predict the behaviour and pattern of various forest cover types during the period (1985 to 2015) under investigation as indicated in Table 4.5. The figures in bold (Table 4.5), shows the area of forest cover type that remained unchanged (persistent) at a given period, while the gain column and loss row show the amount of increase and decrease in a particular forest cover type respectively. More specifically, the results reveal that out of the that out of the 15918.5 ha of dense woodland in 1985, 2095.5 ha remained unchanged, while 6972 ha, 6444 ha and 407ha, and 407 ha changed to moderate woodland, open woodland and very open woodland, respectively. Furthermore, the total dense woodland gain and loss during that period were 1031.8 ha and 13823 ha respectively (Table 4.5 (a)). These findings supports

those of Onojeghuo and Blackburn (2011) who reported that Niger Delta region of Nigeria had suffered its biggest deforestation and forest cover transitions between 1998 and 2015 due to uncontrolled fuelwood extraction, timber logging and oil exploration in the region.

Table 4. 5: Forest cover change dynamics from 1985 to 2015

1985-1998	(a)					
Cover type	DW	MW	OW	VOW	Total 1985	Loss
DW	**2095.5**	6972	6444	407	15918.5	13823
MW	689.5	**19267**	20650	1335	41941.5	22674.5
OW	0	5640	**12907**	2580.3	21127.3	8220.3
VOW	342.3	2645.9	6782.6	**3295.3**	13066.1	9770.8
Total 1998	3127.3	34524.9	46784	7617.6	92053.4	
Gain	1031.8	15257.9	33877	4322.3		
1998-2005	(b)					
Cover type	DW	MW	OW	VOW	Total 1998	Loss
DW	**801.5**	1977.3	154.3	194.2	3127.3	2325.8
MW	1194.9	**24419.7**	7225.4	1684.9	34524.9	10105.2
OW	775.4	24977.1	**17483**	3548.4	46783.6	29300.9
VOW	55.2	1712	3372.2	**2478.17**	7617.57	5139.4
Total 2005	2827	53086.1	28235	7905.67	92053.4	
Gain	2025.5	28666.4	10752	5427.5		
2005-2015	(c)					
Cover type	DW	MW	OW	VOW	Total 2005	Loss
DW	**126.7**	1274.7	1338.2	87.4	2827	2700.3
MW	592.8	**18704.4**	31791	1997.7	53086.1	34381.7
OW	39.6	5371.5	**17298**	5525.3	28234.6	10936.4
VOW	28.3	1024.7	2965.1	**3887.6**	7905.7	4018.1
Total 2015	787.4	26375.3	53393	11498	92053.4	
Gain	660.7	7670.9	36095	7610.4		
1985-2015	(d)					
Cover type	DW	MW	OW	VOW	Total1985	Loss
DW	**321**	6385	8555	658	15919	15598
MW	331	**13867**	25297	2447	41942	28075
OW	110	4758	**13294**	2965	21127	7833
VOW	25	1366	6247	**5428**	13066	7638
Total 2015	787	26376	53393	11498	92054	
Gain	466	12509	40099	6070		

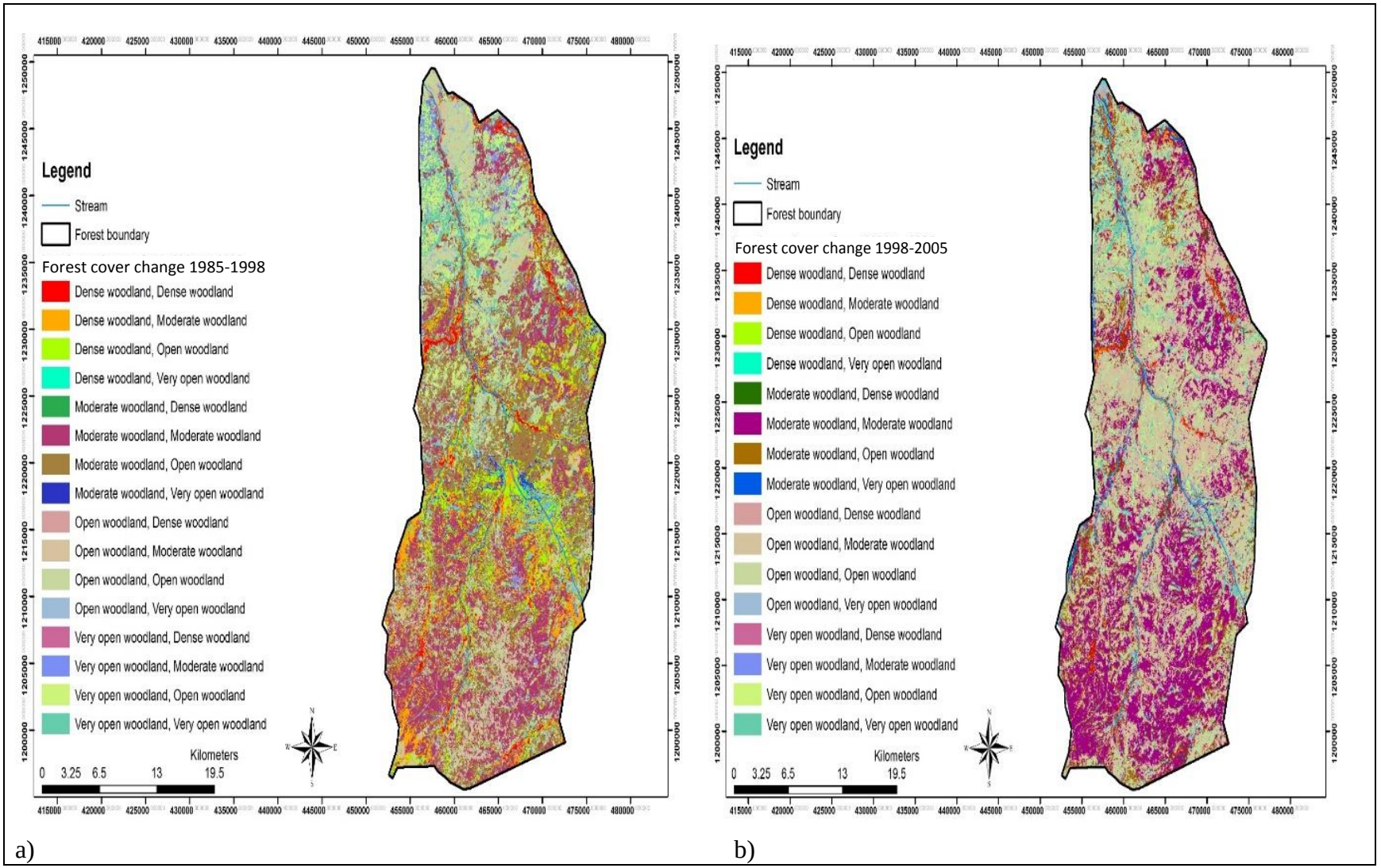
Source: Authors' own computation from satellite imagery analysis, DW – Dense woodland, MW – Moderate woodland, OP – Open woodland VOW – Very open woodland

Moderate woodland accounted for about 34524.9 ha in 1998, out of which 24419.7 ha remained unchanged, while 1194.9 ha, 7225.4 ha and 1684.9 ha had changed to dense woodland, open woodland and very open woodland, respectively. In addition, out of the 13066.1 ha of very open woodland in 1985, 5428 ha remained unchanged by 2015, while 25 ha, 1366 ha, and 6247 ha changed to dense woodland, moderate woodland and open woodland respectively. Very open woodland markedly shrunk from 13066 ha in 1985 to 11498 ha in 2015. Open woodland increased from 21127 ha in 1985 to 53393 ha in 2015 at the expense of dense woodland, moderate woodland and very open woodland, which decline by 8555 ha, 25297 ha and 6247 ha in 2015, respectively. These changes might be due to natural factors (rainfall) and a number of anthropogenic factors such as indiscriminate felling of trees to pave way for agriculture, fuelwood, and overgrazing as indicated by the communities during the FGDs.

The spatial and temporal patterns of the forest cover transitions are shown in Figures 4.3 and 4.4. It can be observed that between 1985 and 1998, most of the areas under dense woodland were found around the banks of river Kano, eastern and southern parts of the forest were replaced by very open woodland and moderate woodland. Between 2005 and 2015, the major transition was the replacement of moderate woodland by open woodland in central and southern parts of the reserve due to indicating excessive harvesting of fuelwood, felling of trees for construction, as well as collection of plant based NTFPs by the local communities living around the forest. The forest cover maps further indicate that forest resource degradation mostly occurred along river Kano, eastern, northern tip, and southern part of the reserve.

The larger part of the FGR was degraded, implying that deforestation remains a major problem in the study area. Forest loss were predominantly in the northern, central and eastern parts of the reserve. This was essentially as a result of increased pressure on forest resource by the locals in order to meet their livelihoods needs. Between 1985 and 1998, dense woodland reduced by about 80% indicating the highest decrease during the period under study. On the

other hand, open woodland recorded the highest gain (153%) between 1985 and 2015 at an annual average rate of about 5%. This results shows that the nature of forest cover loss and gain in FGR is quite dynamic, hence indicating instability in forest cover types, as well as inefficiency in management strategies employed in the reserve.



a) b)

Figure 4. 3: Forest cover change matrix during 1985 to 1998 (a) and 1998 to 2005 (b)

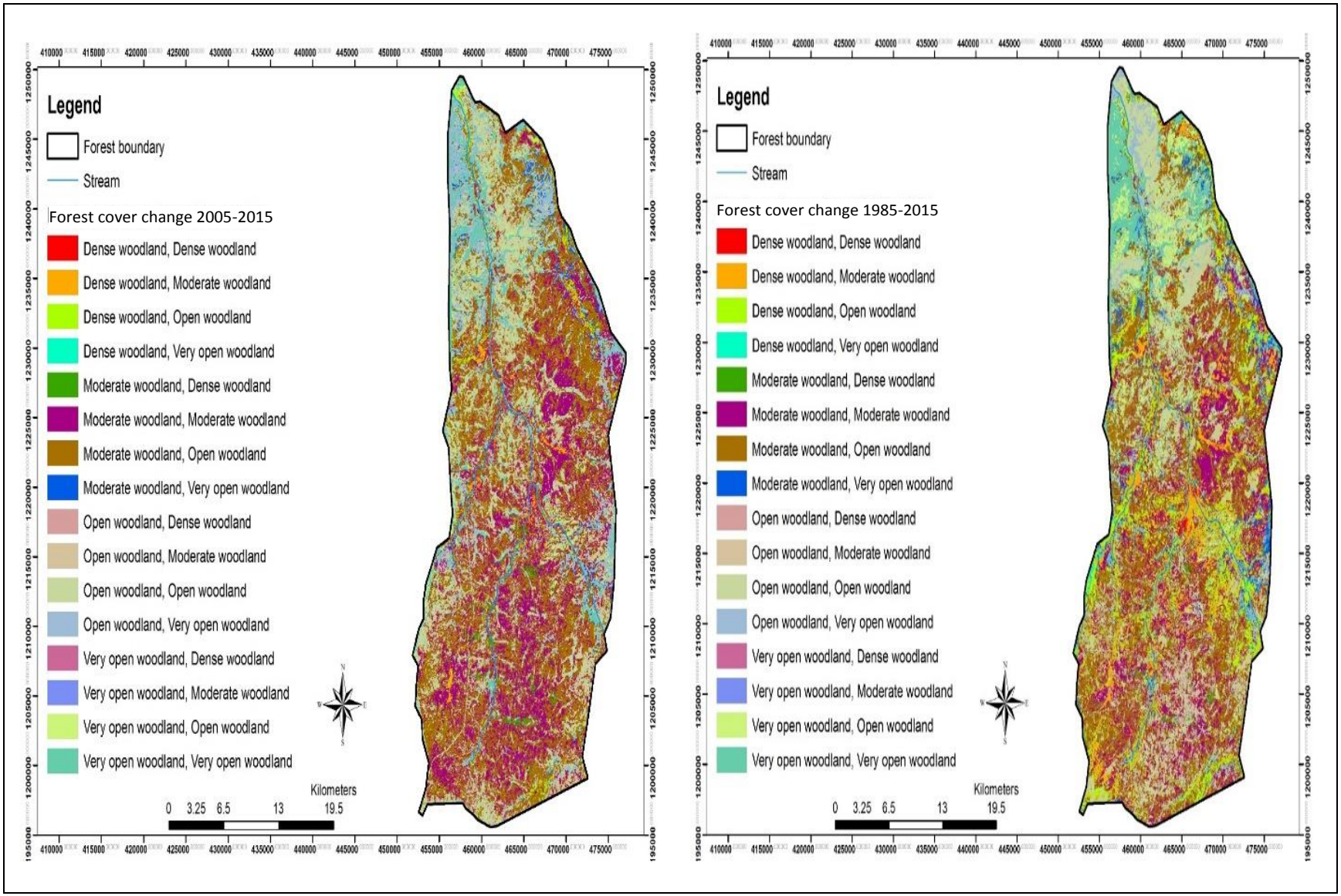


Figure 4. 4: Forest cover change matrix during 2005 to 2015 (a) and 1985 to 2015 (b)

4.3.4 Drivers of forest resource degradation as perceived by the communities

The main drivers of forest resources degradation as perceived by the respondents were forest fire, unregulated grazing, expansion of crop cultivation, fuelwood collection, forest fire/illegal hunting of game animals and harvesting of medicinal plants (Table 4.6). Most (60%) of the households in all the communities indicated that forest fire frequently occurred in the reserve especially during dry season. They further opined that forest fire was mainly caused by game hunters, illegal honey collectors, and the military men deployed to protect the reserve against cattle rustlers and armed robbers along Kano-Jos highway. This is because both honey collectors and game animal hunters often set fire in order to subdue their target with smoke, which most of the times result in destructive fire incidences in the reserve. The perceptions of the households on the effect of fire on forests ecosystem corroborate those of Kessy *et al*. (2016) and Mohammed *et al*. (2010) who observed that human induced forest fire was the major causes of forest degradation in REDD+ project villages in Tanzania and National Parks in Nigeria.

Majority (86%) of the respondents indicated that unregulated grazing in the reserve pose serious conservation threats to forest resources in the area. They reported that Fulani herdsmen who illegally settled in the reserve often engage in other destructive activities such as crop cultivation, honey collection and hunting of wild animals thereby causing deforestation and NTFPs degradation. The negative impact of poor grazing management on NTFPs quality and quantity in the FGR support the earlier finding of Badamasi *et al*. (2010) who reported that Fulani cattle keepers usually ignite fires in the FGR to clear the vegetation to give way to fresh pasture growth. This further suggests the need for quick measures that would address the illegal settlement and livestock keeping in the reserve to ensure sustainable conservation of the forest. Expansion of crop cultivation especially around the eastern part (Sumaila LGA) of the reserve was represented as one of the key drivers (66%) of forest resource degradation in the study

area. Nevertheless, a reasonable percentage of households from Sumaila (41%) and Tudunwada (39%) opposed such claim.

Table 4. 6: Community perceptions on anthropogenic causes of forest resources degradation

Drivers		Percentage of respondents		df	$\chi 2$
	Community	Yes	No		
Forest fire	Doguwa	75(59)	52(41)	2	0.895^{NS}
	Tudunwada	87(58)	63(42)		
	Sumaila	78(63)	45(37)		
Unregulated grazing	Doguwa	113(89)	14(11)	2	2.719^{NS}
	Tudunwada	131(87)	19(13)		
	Sumaila	101(82)	45(37)		
Expansion of crop cultivation	Doguwa	100(79)	27(21)	2	13.102***
	Tudunwada	92(61)	58(39)		
	Sumaila	73(59)	50(41)		
Fuelwood collection	Doguwa	116(91)	11(9)	2	1.468^{NS}
	Tudunwada	134(89)	16(11)		
	Sumaila	115(93)	8(7)		
Illegal hunting of game animals	Doguwa	42(33)	85(67)	2	0.421^{NS}
	Tudunwada	47(31)	103(69)		
	Sumaila	36(29)	87(71)		
Harvesting of medicinal plants	Doguwa	89(70)	38(30)	2	5.519**
	Tudunwada	85(57)	65(43)		
	Sumaila	80(65)	43(35)		

Source: Household interviews (N = 400); *** = Significant at 1%, ** = Significant at 5%; NS = Non-significant; Figures in parentheses are percentages

These results agree with those of Arnold and Perez (2001) and FAO (2007) that subsistence agriculture expansion accounts for one-third of deforestation in tropical and sub-tropical Africa and Asia. Majority (91%) of the interviewed households reported that illegal collection of fuelwood for subsistence and income generation, which often involved cutting down of trees was the major cause of forest degradation in the FGR. In their study, May-Tobin (2011) and

Ogunsawo and Ajala (2002) reported that fuelwood is the primary source of domestic cooking energy for rural and urban households, as well as some industrial users in developing countries such as Nigeria. The authors also found that the high cost of alternative cooking energy largely contributed to indiscriminate cutting down of trees thereby causing forest degradations.

Only 31% of the interviewed households considered illegal hunting of game animals as a serious threat to conservation. However, it could have far reaching impacts considering that most of the illegal hunters also engaged in cutting down of trees to prepare animal traps or built temporary settlements in the reserve. Harvesting of medicinal plants was also perceived by the communities as one of the causes of forest resource degradation in FGR. Most of the interviewed households from Doguwa (70%) and Sumaila (65%) were of the opinion that extraction of medicinal resources is destructive to the forest; while slightly less than half of the respondents from Tudun Wada indicated that medicinal plants extraction cause no harm to the forest. As indicated by Belcher and Schreckenberg (2007) and Ndoye *et al.* (2016), uncontrolled extraction of trees roots and bark in forestlands often leads to the death of the affected trees thereby reducing the resource base, as well as negatively impacting on the ecosystem service provisioning.

4.4 CONCLUSIONS AND RECOMMENDATIONS

4.4.1 Conclusions

- It is evident that there has been a significant change in forest resources in FGR between 1985 and 2015, which is mainly attributed to unsustainable exploitation of NTFPs and poor enforcement of conservation policies.
- The key hotspots of forest resource degradation, which include the northern tip, central and eastern parts of FGR coincide with excessive fuelwood collection, timber logging and poor grazing management as reported by the communities.

- Besides harvesting of medicinal plants, expansion of crop cultivation, illegal hunting of game animals and forest fires, the leading drivers of forest resource degradation in FGR are fuelwood collection and unregulated grazing. This is because majority of forest proximate communities rely on fuelwood for energy and other household heating requirements, in addition to illegal settlement of the pastoral households in the reserve, which is mainly motivated by availability of pasture for livestock.

4.4.2 Recommendations

- Public enlightenment and awareness campaign about the negative consequences of forest resource degradation on the environment and livelihoods is indispensable for building the right behaviour and attitude change with respect to exploitation of forest resources among the communities proximate to FGR.
- Forest restoration efforts should target the degraded hot spots in the northern tip, central and eastern parts of the reserve.
- The government should establish more cattle routes and grazing reserves, while strengthening the existing ones to address the problem of illegal invasion of forest reserve especially during the dry spells.
- The government and other conservation agencies should promote the use of alternative cooking energy such as biogas and kerosene, in the study area. This would help reduce overreliance on fuelwood by the communities, thereby reducing the rate of deforestation in the study area.

CHAPTER FIVE

ECONOMIC VALUATION OF SELECTED NON-TIMBER FOREST PRODUCTS IN FALGORE GAME RESERVE IN KANO, NIGERIA

ABSTRACT

Forest resources are a major source income for communities living adjacent to Falgore Game Reserve (FGR). However, exploitation of non-timber forest products (NTFPs) is not properly regulated across savanna agro-ecological zones of the country, thereby threatening the livelihoods of those who rely on them, as well as sustainability of the reserve. This study used contingent valuation method (CVM) to determine the households' willingness to pay (WTP) for the collection of NTFPs in FGR. Multistage sampling technique was used to select a total of 400 respondents for the study. The results revealed that on average the households were willing to pay between $3 and $7 per month for collection of various NTFPs. Fuelwood ($7), honey ($5) and gum arabic ($4) were the top three most valued products respectively. The results of OLS regression indicates that sex, level of education household size, contact with extension agents, membership to social group, households' income, and distance to market and FGR significantly influenced the households' WTP for the NTFPs. These results show that there is an opportunity for a win-win situation if collection of NTFPs were to be legalized and regulated to avoid overexploitation. Such arrangements would enable communities to benefit from forest resources and they in turn, will have the incentive to conserve the forest. The government on the other hand would benefit from revenue generated from collection of NTFPs.

Keywords: Willingness to pay, NTFPs, Game Reserve, Conservation

5.1 INTRODUCTION

Non-timber forest products (NTFPs) are products of plant or animal origin that have economic or consumption value sufficient to encourage their collection and removal from the forest. They can also be referred to as those resources or products that are extracted from forests and utilized within the household, marketed, or have social-cultural and religious significance (Falconer and Koppell, 1990). These products support livelihoods of billions of people through provision of cheap building materials, income, fuelwood, food, livestock feed and traditional medicines. The revenue generated from sales of NTFPs normally increases household dependency on NTFPs that are commercially extracted (Te Velde *et al*., 2006; Shackleton *et al*., 2011).

The estimated number of rural household who are depend on NTFPs, for income generation, range from 200 million in Asia and the Pacific to 600 million in Africa, approximating to about

1 billion worldwide (Sunderlin *et al*., 2005; Timko *et al*., 2010). Mongaka *et al*. (2001) reported that in Namibia, non-timber forest products have a value in excess of $180 million a year, more than 450 times revenue generated from commercial timber logging. In Tanzania, the forest sector employs about 3 percent of paid labor and over 3 million in the informal sector are selling NTFPs (Kaale *et al*., 2000). As indicated by Adepoju and Salau (2007) and Amadi *et al*. (2016) rural communities in Nigeria derive substantial revenue from the collection, processing, and marketing of NTFPs, which greatly reduce the level of poverty and food insecurity in the country. Similarly, Nweze and Igbokwe (2000) reported that about 36% of forest dependent communities in south-eastern Nigeria usually collect NTFPs from forestlands around them on daily basis. This contributes not less than 50% of their households' income and has a considerable cushioning effect, especially during periods of hardship.

There is an increasing interest in research and investment on NTFPs globally, this is due to the general consensus that sustainable utilization of these products can lead to a win-win situation for poverty reduction and biodiversity conservation (Golam *et al*., 2008; Fisher *et al*., 2011; Amiri *et al*., 2015). The rationale is that NTFPs extraction, in contrast to other resource uses such as logging, or mining is less destructive and allows for local communities to earn income without necessarily destroying the forest ecosystem. This can be questioned, however, since the impact of NTFPs extraction varies from one product to another, harvesting technology and time of harvest (Gunatilake *et al*., 2006). In addition, incentives such as high monetary values of certain NTFPs may lead to their overexploitation, particularly those that can be sold in the international markets. This kind of problem may sometimes result in very high costs in terms of damage to forest ecosystems and subsequent erosion of species biodiversity and richness (Kengen, 1997).

It is therefore clear that attaching monetary value to various NTFPs can alter their use pattern and generally the level of exploitation. As observed by Pearce (2001), measurement of the

economic value of biodiversity is a fundamental step in conserving the resources. This is because "the pressure to reduce biodiversity is so high such that the chances that we will introduce incentives for the protection of biodiversity without demonstrating its economic value are much less than if we do engage in valuation". Thus, determination of monetary value to forest resources, would not only provide policy makers with the benchmark for an alternative land use option (Bodin *et al*., 2006), but also justify investments in conservation efforts. It is against this background the current study attempted to know whether the forest dwellers place any economic value on NTFPs that they collect and use so as to deliberately target such stocks of resources for conservation to ensure their availability for both the present and future generations. An answer to this fundamental question will provide an important indication whether the involvement of communities that depend on forest resources in the conservation of NTFPs would be a good policy as well as reveal its implications for welfare of the communities and conservation of NTFPs. This study was conducted in Falgore Game Reserve to estimate the monetary value of six major non-timber forest products and determine the factors influencing the communities' willingness to pay for their collection.

5.2 METHODOLOGY

5.2.1 Data collection

Primary data were collected using a structured questionnaire administered to the 400 selected households, and nine focus group discussions, each comprising10-12 participants guided by a checklist of questions (detailed sampling procedure is provided in Chapter 3). The information gathered using the questionnaire included socioeconomic characteristics of the respondent's such as sex, age, household size, membership to a social group, contact with an extension agent and educational status and primary and secondary occupation, quantity of NTFPs consumed and or sold as well as income generated from the sales. In addition, information was collected on the willingness to pay (WTP) for collection of NTFPs from FGR. The respondents were

asked if they would be willing to pay a specified amount of money to collect NTFPs for domestic use in order to regulate illegal collection and overexploitation of non-timber forest products in the reserve. Depending on whether the respondent accepted or rejected the initial bid presented, the amount was then gradually increased or decreased until his/her maximum WTP was elicited. The final price offered was considered as the respondent's WTP for collection of NTFPs. In order to separate the genuine WTP from what is termed as protest bid, the respondents were asked to provide reasons for their unwillingness to pay for NTFPs collection (zero WTP). The initial bids used in this study were based on the prevailing market prices of the products in question, which was further validated by the communities through FGDs. This was done in order to minimize the protest bid among interviewed respondents.

5.2.3 Theoretical framework of contingent valuation method

The contingent valuation method (CVM) is widely used to value goods and services the market fails to value (Blumenschein *et al*., 2001). The CVM is increasingly being used to value private market goods and services such as organic food products, NTFPs and indigenous vegetables (Chukwuone and Okorji, 2008; Amiri *et al*., 2015). The CVM is derived from the concept of willingness to pay i.e. the amount an individual is willing to pay to maximize his/her utility or willing to accept as compensation so as to improve his utility as a result of damage, or absence of the public good (Whitehead, 2005). The contingent valuation method, which is usually used to estimates the values of non-marketed environmental goods is based on the theory of rational choice and utility maximization (Reynisdottir *et al*., 2008). However, revealed preference method, which is widely seen by many as better option for environmental services that are traded in the market are based on the observation of individual choices in existing markets that are related to the environmental service in question; meaning that economic agents "reveal" their preferences through their choices (Pascual *et al*., 2010). Market failure and distortion of commodity price information gives CVM more application flexibility than revealed preference techniques

(Ellingson and Seidl, 2007). Although CVM may not be a perfect tool for generating revealed preferences information because it does not give all the necessary answers for ecosystem monitoring, it provides researchers with a hypothetical market for a public good in the absence of a real market. Nevertheless, the contingent valuation approach has clear advantages over revealed preference methods in which actual behaviour is used to develop estimates of value. It allows researchers and policy makers to carry out ex-ante policy analysis and also considered to be more flexible than the revealed preference methods (Whitehead, 2005; Pettorelli *et al*., 2012).

This study analysed the economic value of selected NTFPs from FGR to quantify the relationship between the household attributes and the probability of their WTP for an initial offered bid values. In CVM, the respondents' preferences are modelled in a simple utility framework following Hanemann (1984).

For example, if a respondent is presented with the possibility of obtaining a change in an environmental public good q from q^0 to q^1, the utility or satisfaction of a given respondent is therefore given by equation (1):

$$U_i = U_i\,(q^0, y, z, \varepsilon) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where U_i is the utility of the respondents i; y is the income; z is a vector of market goods, prices and characteristics of the individual; and ε is the stochastic error term that is unobservable.

Let us assume that there are two states of the world corresponding to different levels of NTFPs quality improvement: Given q^0 is the quality of NTFPs before the new conservation policy and q^1 is the quality after the implementation of the new conservation policy; if the respondent view the new policy as an improvement that would increase his utility then the probability that a respondent will decide to pay for NTFPs collection is the probability that the conditional

indirect utility function for the proposed conservation policy change is higher than the conditional indirect utility function for the status quo as presented by equation (2):

$$U_i^1\ (q^1, y, z, \varepsilon_1) \geq U_i^0(q^0, y, z, \varepsilon_0) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where q^0 is the quality of NTFPs before the change in conservation policy, while q^1 is the quality of NTFPs after the change in conservation policy.

The utility function of the i^{th} respondent which is assumed to be a function of observable household characteristics; resource endowment and environmental goods quality, X_{ti}, and the error term ε_{ti} can be expressed as:

$$U_i^t = f(X_{ti}) + \varepsilon_{ti}, t = 0,1 i = 1,2 \ldots\ldots n \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The probability that a given respondent is willing to pay a certain amount of money for NTFP collection is given by:

$$Prob(Y_i = 1) = Prob(U_i^1 > U_i^0) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

By substituting equation 4 for 3, the equation will be transformed to:

$$Prob(Y = 1) = Prob(\propto_1 X_i + \varepsilon_{1i} > \alpha_0 X_i + \varepsilon_{0i}) \ldots\ldots\ldots\ldots (5)$$

By rewriting equation 5, we get:

$$Prob(Y = 1) = Prob[(\varepsilon_{1i} - \varepsilon_{0i}) > X(\alpha_0 - \alpha_1)] \ldots\ldots\ldots\ldots\ldots (6)$$

Assuming $U_i = \varepsilon_{1i} - \varepsilon_{0i}$ and $\beta = \alpha_0 - \alpha_1$, we have

$$Prob(Y = 1) = Prob(U_i > X_i\beta) = f(X_i\beta) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where f is the cumulative distribution function. This provides the structural model for estimating the respondent's willingness to pay using either dichotomous or ordinary least

squares (OLS) regression model, depending on the assumption on the distribution of the error term (ε), as well as computational convenience (Green, 2005).

5.2.4 Data analysis

The type of regression is dependent on the type of dependent (Y) variable. For example, ordinary least square regression model (OLS) is used when the dependent variable is continuous, logistic regression when the dependent is categorical with 2 categories, and multinomial regression when the dependent is categorical with more than 2 categories (Koutsoyiannis and Foufoula-Georgiou, 1993). In the current study the dependent variable is continuous, hence best suited for ordinary least square regression model (OLS). The choice of OLS for this study was because of its ability to yield Best Linear Unbiased Estimator (BLUE). The OLS regression is widely used to calculate the size and significance of the effects of a number of independent variables on a dependent variable (Koutsoyiannis and Foufoula-Georgiou, 1993; Gujarati, 2007). Before OLS regression analysis can be performed, the OLS assumptions concerning the original data must be made (Leibenstein, 1957). Ignoring the regression assumptions contribute to wrong validity estimates (Antonakis and Deitz, 2011). When the assumptions are not met, the results may result in Type I or Type II errors, or over- or under-estimation of significance of effect size (Osborne, 2003).

In this study OLS regression model was used to determine the factors that influenced households' WTP for NTFPs. Following Gujarati (2007) the OLS equation for the determinants of households' WTP for the collection of NTFPs from FGR was expressed as follows:

$$WTP_i = \propto + \beta_i \sum_{i=1}^{n} X_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where WTP is the amount of money the i^{th} respondent is willing to pay for NTFPs; α is the intercept; X is a vector of independent variables (socioeconomic attributes of the respondents); β is a vector of the coefficients to be estimated and; Ɛ is a vector of stochastic disturbances assumed to be normally distributed with E(Ɛ)=0 (Gujarati, 2007).

5.2.5 Model for estimation of mean willingness to pay for an open-ended question

The value (WTP_i (i = 1……i.....n)) for environmental goods and services using open-ended question usually produce a set of values for n respondents in the sample. The mean value of this estimate is used to measure the monetary value of given goods and services. The open-ended WTP model is specified as follows (Seller *et al*., 1985):

$$Mean\ WTP = \frac{\sum_{i=1}^{n} WTP_i}{n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (9)$$

The total value of the environmental goods in question is usually obtained by multiplying the mean WTP by the population size of the resource users in study area. Alternatively, the total value can also be derived using estimated bid function. In the current study the value of the selected NTFPs were computed based on the total population (number of households = 21812) neighbouring FGR (KNSG, 2015).

5.2.6 Explanatory variables used in OLS regression model

Table 5. 1: Definition of explanatory variables used in OLS regression model

Explanatory variable	Definition	Average recorded and percentage	Hypothesized influence on dependent variable
Age of household head	Age of household head in years	38	+
Household size	Number of people currently living in the house as a family	8	-
Farm size	Area of farmland owned by household in hectares	2	+
Monthly income	Average monthly households' income measured in USD	165	+
Distance to main market	Distance covered from home to market in km	6	+/-
Distance to FGR	Distance covered from home to FGR in km	3.64	+/-
Gender of household head	Sex of the household head. Binary: 1 = male, 0 = female	86 for 1	+
Education of household head	Level of education attained by household head. Categorical: 1 for informal, 2 for primary, 3 for secondary, 4 for tertiary	35 for 2	+
Main occupation of household head	The main income generating activity of the household. Categorical: 1 for farming, 2 for trading, 3 for employment 4 for NTFPs extraction, 5 for craft and artisan	50 for 1	-
Interaction with extension agent	Access to extension services Binary: 1 for yes and 2 for No	63 for 1	+
Membership of social group	A binary variable: 1 for members and 0 for non-members	67 for 1	+

Source: Household interviews (N = 400)

5.3 RESULTS AND DISCUSSIONS

5.3.1 Socioeconomic characteristics of the respondents

Table 5.1 shows the socio-demographic characteristics of the sampled households. The results indicate that the average age of the interviewed household heads was 38 years, while the

average household size was eight persons per family. These results indicate that most of the sampled respondents were within the productive age and had considerable family labour required for extraction of forest resources, implying that age and household size were likely to have positive influence on households' WTP for NTFPs collection. The average farm size recorded in the study area was 2 ha per household, implying that most of the households were land poor thus required additional sources of livelihood to meet their families' basic needs. The mean monthly household income was $165, but further analysis indicates that most (60%) of the households were poor, living on less than USD 1.25 per day per capita. This shows that majority of the households in the study area were likely to rely more on natural resources around them in order to supplement their income from other sources, hence they would be more willing to pay for NTFPs collection.

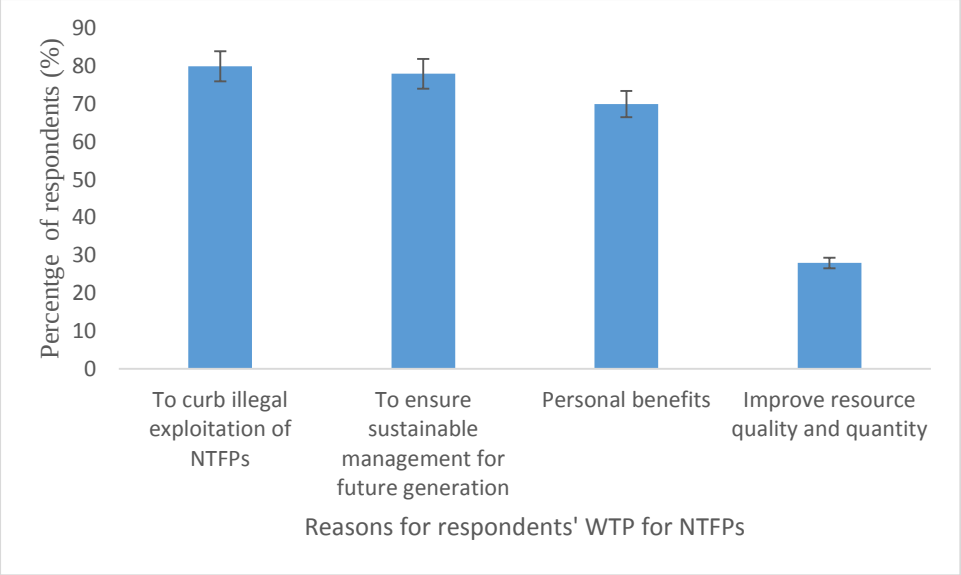
The average distances covered by households from homestead to nearest main market and FGR were approximately 6 km and 4 km, respectively. This shows that most of the respondents were living relatively near to the reserve and markets, and therefore were likely to pay for the collection of NTFPs from FGR given the ease of access of the products and ready market. The majority (86%) of the respondents were male-headed households. The dominance of male household heads among the sampled population reflects the cultural norms of the predominantly Muslim communities in the far northern Nigeria, where women interaction with non-family members is highly restricted. About 65% of the respondents had primary, secondary and or tertiary education. Therefore most of them would be expected to be ready to pay for extraction of NTFPs, because educated people are expected to be more environmentally conscious than their less educated counterparts. As noted by Kilonzo (2009) in a study conducted in Nyanganje forest reserve in Morogoro , a unit increase in the respondents' level of education, significantly decreases their tendency to extract wild fruits and vegetables, honey, poles, wild mushrooms and medicinal plants. This is because professional skills usually

increase working efficiency and productivity of households, thereby making them more entitled to a prestigious job and higher income (Mhapa, 2011), and therefore less likely to depend on NTFP.

About half (50%) of the households were mainly engaged in farming as their primary occupation. They also undertook other income generating activities such as trading, employment, and extraction of forest resources. Most (63%) households reported that they interacted with extension agents on monthly basis, and therefore were expected to be willing to pay for collection of NTFPs. The results further revealed that majority (67%) of the respondents were members of one or more social groups, given that such groups promote awareness creation and dissemination of information, such households were therefore likely to be more conscious of environmental conservation than those which do not belongs to any group. This was expected to translate to higher WTP for the NTFPs.

5.3.2 Households' reasons for willing to pay for non-timber forest products

The reasons for households' willingness to pay for non-timber forest products collection suggest that their responses were informed by some social, economic, environmental and cultural benefits at individual or community levels (Figure 5.1). The results indicate that over 70% of the sampled respondents were willing to pay for the collection of NTFP because of the need to reduce illegal resource exploitation, sustainable management of NTFPs for future generation (bequest value), as well as personal benefits. This implies that the community was aware and worried about the current state of NTFPs in FGR, and is therefore willing to support policies which would lead to a change in the current situation. In addition to this, is the desire of the households to maximize their individual utility through economic benefits they derived from the forest resource collection. These findings support those of Bello (2015) who reported that very few households protested against payment of monetary incentives for change in environmental quality in the rainforest zone of Nigeria.



Source: Household interviews (N = 400)

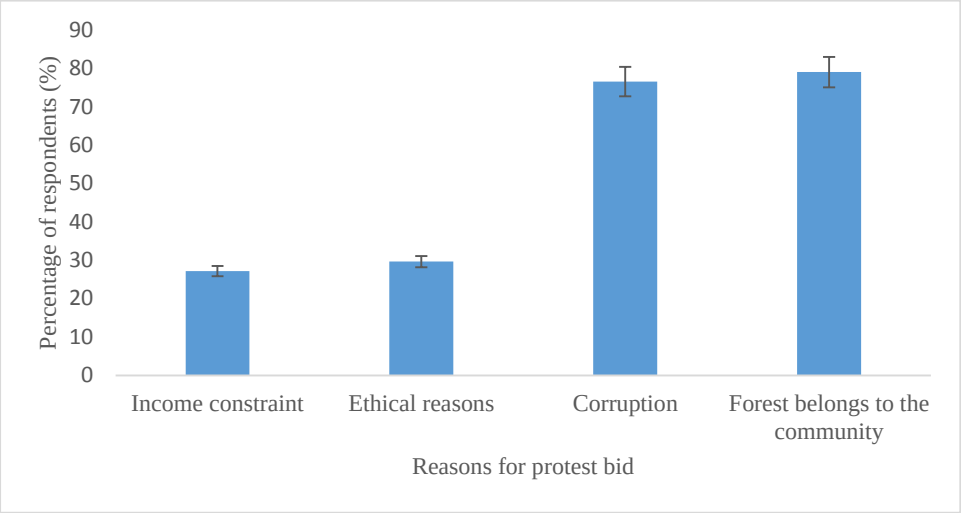
Figure 5. 1: Reasons for households' willingness to pay for non-timber forest products

About 28% of the respondents indicated protection of resource quality and quantity as the main reasons for their WTP for NTFP collection. This result is in agreement with the study's a priori expectation that households which depend on NTFPs for their livelihoods are more likely to support policies aimed at improving the quality of environmental goods and services. This could be attributed to the awareness that unsustainable resource exploitation may negatively affect their wellbeing.

5.3.3 Protest bids by the respondents

About 80% of the respondents' WTP for NTFPs collection was considered genuine, while 20% of them were considered as protest bid. Protest bid occurs whenever individuals who oppose or do not approve of the survey fail to respond, give invalid but positive bids (outliers), or place a zero value on a good that they actually value (Halstead *et al*., 1991 and Bolt, *et al*. 2005). However, some zero values reflect the true respondents' preferences over any proposed change in the quality of environmental goods and services (Strazzera *et al*., 2003). The WTP values were also considered protest bids whenever unreasonable monetary values were placed on

NTFPs because the presence of such values results in outliers in the expressed WTPs thereby affecting the mean WTP estimation, which may either lead to over-or-underestimation of environmental resources. Figure 5.2 shows the reasons for respondents' protest bid for NTFPs collection in FGR.



Source: Household interviews (N = 400)

Figure 5. 2: Reasons for respondents' unwillingness to pay for NTFPs collection

The results indicate that most (79%) of the interviewed households were unable to place any monetary value on NTFPs because they felt that the forest was a common resource belonging to the local communities. Fear of corruption as indicated by majority (76%) of the respondents was the second most important reason behind the communities' protest bid (Figure 5.2).

The protest bidders reported that their unwillingness to pay for NTFPs collection was because of income constraints (30%) and ethical reasons (27%) that meant inability to place monetary values on natural resources. The negative attitudes shown by the households who protested against the bids were probably because either most of them were living far from the reserve or they did not directly benefit from NTFPs, and therefore had no interest in their conservation. In addition, this could be attributed to the respondents' low level of education and knowledge about the effects of environmental degradation on their economic wellbeing.

5.4 Economic value of non-timber forest products in Falgore game reserve

5.4.1 Fuelwood

The results of the descriptive analysis of the maximum amount that the respondents were willing to pay for NTFPs collection in FGR are presented in Table 5.2. The findings illustrate that 55% of the interviewed households were willing to pay between $2 and $4 per month for the collection of fuelwood in FGR, and only 10% were willing to pay between $10 and $20 per month. The minimum, maximum and mean WTPs to pay for fuelwood were $1, $20 and $7 per month, respectively, showing a high degree of variation in the maximum amount of money the respondents were willing to pay for the resource. The observed divergence could be attributed to the variations in households' level of income and the demand for fuelwood. The monetary value of fuelwood harvested from FGR based on the projected number of households (KNSG, 2015) was estimated at $152,684 (₦38,171,000) per month. This was not surprising because majority of the interviewed households depended on fuelwood for domestic cooking, other households heating requirements and sale. The monthly value ($152,684) recorded in this study is quiet low compared to $2083333 reported by Schaafsma *et al.* (2011) from the Eastern Arc Mountains of Tanzania. This variation may be interpreted to mean that households living next to East Arc Mountain of Tanzania could probably have been more environmentally conscious or rather derived more value from the collection of fuelwood and hence attached more value to it compared to their counterparts living around FGR.

5.4.2 Honey

The respondents were willing to pay between $0 and $16 per household per month for honey collection, while the mean WTP was $5 (₦1,000) per household per month. The monthly value of honey in FGR, based on the average WTP, was found to be $109060 (₦27,265,000) per month. Considering the current market value of $7 (₦2000) per litre of honey, the expressed WTP was relatively low but could also be regarded as reasonable when compared to

households' level of income. Another explanation for the low willingness to pay for honey extraction is the fact that wild honey collection and sale is not very popular among households living next to FGR, which was attributed to lack of technical know-how and capital to invest on conventional honey extraction methods that is allowed in the reserve. The seasonal availability of honey could also serve as a disincentive to pay more for it extractions.

Table 5. 2: Households' willingness to pay for non-timber forest products ($ per month)

Bid amount ($)	Percentage of respondents WTP for NTFPs					
	Fuelwood	Honey	Gum arabic	Fodder	Medicinal herbs	Fruits
0		4(1)	9(3)	8(2)	7(2)	9(3)
1	25(8)	17(5)	133(42)	113(35)	151(47)	91(29)
2	38(12)	132(41)	24(7)	62(20)	57(18)	75(23)
3	6(2)	14(5)	34(11)	13(4)	19(6)	13(4)
4	137(43)	52(16)	49(15)	24(7)	13(7)	65(20)
6	27(8)	20(6)	22(7)	18(6)	18(9)	25(8)
8	20(6)	30(9)	18(6)	14(4)	22(7)	19(6)
10	14(4)	10(3)	3(1)	5(2)	4(1)	2(1)
12	18(6)	18(6)	11(3)	25(8)	4(1)	9(3)
14	12(4)	4(1)	3(1)	10(3)	10(3)	2(1)
16	13(4)	18(6)	13(4)	21(7)	6(2)	9(3)
18		-	-	6(2)	8(2)	-
20	9(3)	-	-	-	-	-
WTP statistics ($)						
Minimum	1	0	0	0	0	0
Maximum	20	16	16	18	18	16
Mean	7	5	4	3.5	2	3
NTFP Value/Month	152684	109060	87248	35000	43624	65436

Source: Household interviews (N = 400); Number of household heads = 21,812; Cattle population = 10,000)

5.4.3 Gum arabic

Gum arabic is an organic adhesive material which is extracted from the various species of Acacia tree such as *Senengalia senegal* through wounding its branches and stem or natural extraction as result of physiological stress. It is among the NTFPs with high value and

economic potential. Gum arabic collection is among the major economic activities practiced by households living in the savannah woodland ecosystem of Nigeria (Badamasi *et al.*, 2010; Jimoh, 2013). In this study, majority (60%) of the respondents were willing to pay between $1 and $3 per month per household, while the mean WTP was $4 (₦1,000) per month per household. The estimated monetary value of the products per month based on the projected number of households was therefore $87,248 (₦21,812,000) (Table 5.2). Although gum arabic has high economic and market potential in northern Nigeria due to its domestic and industrial uses, the respondents were willing to pay a lower amount of money for the product in comparison to fuelwood and honey. This is probably because gum arabic is less attractive due to the opportunity costs in relation to other NTFPs and also the long distance covered to collect it, as well as lack of reliable market for it in the study area. Additionally, availability of gum arabic is also seasonal and it is difficult to extract because of the thorny nature of the trees, as well as the low quantities collected may be uneconomical.

5.4.4 Fodder

Falgore game reserve provides local communities particularly the Fulani herdsmen with fodder for livestock especially during the dry season when pasture in the farms and communal grazing sites is scarce. This demonstrates the likely tendency for the interviewed households to pay high price for grazing in the reserve. The results showed that more than half (55%) of the respondents were willing to pay between $1 and $2 per head of cattle per month. The mean WTP for fodder collection was $3.5 (₦875), whereas the monthly value based on the average number of cattle (10000) grazing in the reserve per month (KNARDA, 2015) was $35,000 (₦8,750,000). These findings show that, on average, the respondents were willing to pay a reasonable amount of money in order to maximize their utility for livestock grazing in the reserve. This is not surprising considering the fact that majority of the inhabitants of the study

area are the pastoralists who rely to a great extent on the forest for grazing and fodder collection (Yelwa, 2008).

5.4.5 Medicinal herbs

The economic value of medicinal herbs presented in Table 5.2 reveal that majority (65%) of the respondents were willing to pay between $1 and $2 per month for the collection of medicinal herbs. The mean WTP for medicinal herbs was $2 (₦500) per month per household, and the monthly value was $43,624 (₦10,906,000). Although the monetary value placed on medicinal herbs by the respondents was low in comparison to conventional medicines, it demonstrates that the local communities recognize the medicinal value of the plant resources in the forest, and are therefore willingness to pay for their conservation. In contrast, the mean WTP for medicinal herbs estimated per household per month was higher than the one reported by Oluwalana and Momoh (2015), while assessing households' WTP for medicinal plants conservation in Benue state, Nigeria. This may imply that households living proximate to the forest in Kano state rely more on medicinal plants for their households' healthcare needs than their counterparts in Benue state.

5.4.6 Fruits

Fruits in the context of this study refer to wild edible fruits that are found in the forest and are consumed by households and or sold in the market for income generation. The common fruits gathered from FGR are fruit nut from African fan palm tree (*Borassus aethiopum*), which is either eaten as fruit or the seeds are sprouted and young shoots (*Marucci* in Hausa) are chewed as an aphrodisiac, and normally sold in the local markets. Other fruits include guava, mango, and tamarind, which are commonly eaten raw. In Nigeria, like any other developing countries, these wild fruits form part of the daily diets of many rural households as they are usually taken as dessert before or after meals (Uusiku, *et al*., 2010). Most (52%) of the respondents were willing to pay between $1 and $2 per month for the fruits. About 20% were willing to pay $4

per month, while very few (3%) were willing to pay a maximum of $16 per household for the fruits per month. The mean WTP was $3 (₦750), thus the monthly value based on the mean WTP was $65436 (₦16,359,000). The monetary value of fruits recorded in this study demonstrates their importance a source of livelihood for many households, as well as their potential for poverty alleviation in the study area. This explains the rationale for households' acceptance to pay high fees for the fruits collection and biodiversity conservation in the reserve.

5.5 Factors influencing households' willingness to pay for non-timber forest products

The results of households' WTP for the collection of various NTFPs in FGR regressed against a set of respondents' socio-demographic characteristics are presented in Table 5.3. Out of ten explanatory variables fitted in OLS regression model, nine were found to have either significant positive or negative influence on the households' WTP for non-timber forest products conservation.

The results revealed a significant and positive relationship between male headed households and WTP for collection of gum arabic ($P < 0.1$), honey ($P < 0.01$) and medicinal herbs ($P < 0.01$), indicating that male headed households were more likely to pay higher prices for the resources than their females counterparts. The findings from focus group discussions showed that women do not normally collect gum arabic, honey and medicinal herbs, and as a result, were less likely to be interested in the conservation of these NTFPs compared to men. In contrast, Chukwuone and Okorji (2008) reported that women were more willing to pay for forest conservation in the rainforest zone of Nigeria because they depended on the forest for NTFPs. The age of the household head had a positive and significant influence on the WTP for honey and fruits collection. This suggests that older household heads were more likely to pay higher amount of money for honey and fruit collection compared to younger household heads. The positive attitude displayed by older household heads can be linked to the fact that age is directly linked to ones' attachment to the natural environment and awareness of benefits from

natural resources. This finding contradicts those of Boccaletti and Nardella (2000) and Chukwuone and Okorji (2008) who found no significant effect of age on WTP for forest resource conservation in Italy and Nigeria.

The level of education of the household head had a positive and significant ($p < 0.01$) influence on their WTP for collection of fuelwood, gum arabic, fodder, fruits and medicinal herbs in FGR. This indicates that as the individuals became more educated their understanding of the economic and consumptive value of NTFPs, as well as the need for biodiversity conservation increases, hence the more willingness to pay higher premiums for conservation than their younger counterparts. Khosravi and Sabouhi (2011) and Tao *et al*. (2012), in their studies associated the higher households' WTP for NTFP to their educational status. They argued that education paves the way for well-paying jobs, diversification in on-farm and off-farm activities, as well as better understanding of the negative consequences of forest resource degradation on the environment and human wellbeing.

The household size was found to have negative but significant influence on the respondents' WTP for fuelwood, fruits and medicinal herbs ($p < 0.01$) and fodder ($p < 0.1$). This implies that the willingness to pay for the NTFPs decreased with the increase in family size. This suggests that the probability of a household with a large family size rejecting the proposed policy change was higher than that of the smaller households. This is logical because a unit increase in family size would result in an increase in both the recurrent and capital expenditure of the family, which is likely to reduce the amount of money that a household would be willing to give up for collection of NTFP. Similar findings were reported by Tao *et al*. (2012), Molaei and Kavoosi (2011) in China, and Amiri *et al*. (2015) in Iran, while assessing the value of forest ecosystems.

Table 5. 3: Factors influencing households' WTP for the collection of major NTFPs from FGR

Explanatory variable	Non-timber forest products					
	Fuelwood	Gum arabic	Honey	Fodder	Fruit nuts	Medicinal herbs
Constant	1038.00(3.590)***	-971.75(-4.066)***	302.20(1.072)**	-759.52(-1.703)*	462.43(1.703)*	-608.91(-5.059)***
Sex	65.95(0.632)	91.65(0.496)*	258.16(2.815)***	150.69(0.752)	62.25(0.362)	43.84(2.188)***
Age	-0.56(-0.133)	1.75(0.471)	11.09(2.986)***	-8.838(-1.217)	7.025(1.743)*	0.93(0.440)
Level of education	559.51(10.453)***	1120.82 (18.233)***	81.19(1.541)	872.39(13.574)***	772.41(13.362)***	054.77(29.545)***
Household size	-39.60 (-3.225)***	117.77(1.241)	-13.09(-1.338)	-15.94(-1.707)*	-31.99(-2.960)***	-13.12(-2.405)***
Contact with extension agent	33.70 (2.196)***	245.76(1.355)	124.82(9.422)***	170.02(0.869)	-101.87(-0.637)	16.87(0.169)
Membership of social group	-235.51(-2.196)***	-241.26(-1.836)*	216.76(1.412)	337.61(2.838)***	-332.82(-1.912)**	201.17(2.999)***
Household income	0.2(1.070)***	0.12(1.150)***	0.21(0.829)***	0.13(0.925)	0.31(0.223)**	0.11(1.702)**
Distance to main market	22.75(2.411)***	-11.53(-1.343)***	0.69(0.086)*	0.71(0.082)	-13.73(-1.517)*	3.47(0.790)
Distance to FGR	-110.70(-4.760)***	123.67(0.777)	-79.02(2.887)***	85.82(2.783)***	-99.02(-4.809)***	6.75(0.617)*
Main occupation	37.43(1.217)	-20.21(-0.743)	14.67(0.552)	-4.15 (-0.151)	5.37(0.187)	-1.11(-0.135)
Number of observation	319	319	319	319	319	319
Prob>F	39.630***	51.900***	49.003***	66.805***	47.362***	180.083***
R2	59%	66%	66%	71%	63%	90%

Source: Household interviews (N = 400); t-values are shown in parentheses; *** = Significant at 1%, ** = Significant at 5%; NS = Non-significant;

The results also indicate significant ($p < 0.01$) positive relationship between households' WTP for collection of fuelwood and honey, and interaction with extension agents. This implies that households that had access to extension services were likely to be more environmentally conscious and would therefore be willing to pay a higher premium for NTFP extraction than their counterparts with no or less access to extension services. This would be expected because efficient extension service delivery at the local level has a direct effect on households' access to environmental information and awareness on the expected benefits of forest resource conservation.

Membership to social groups showed a negative and significant relationship with respondents' WTP for fuelwood ($p < 0.01$), gum arabic ($p < 0.05$) and fruits ($p < 0.1$). These is probably because individuals who are members of social groups are expected to be more exposed to diversified sources of livelihoods and therefore likely to be less dependent on NTFPs. Membership to the social group was however positively correlated with households' WTP for fodder and medicinal herbs collection ($p < 0.01$). This finding supports those reported by Gebremariam *et al*. (2013) that membership to a social group and social position increases individuals' sense of responsibility, thus, instrumental to households' higher WTP premium for nature conservation.

The households' monthly income had positive and significant ($P < 0.01$) influence on their WTP for the collection fuelwood, gum arabic and honey. Similarly, households' income was positively and significantly ($p < 0.05$) correlated with higher WTP premium for collection of fruits and medicinal herbs. The positive influence of households' income on WTP for NTFPs implies that a percentage change in individuals' monthly income would result in a similar percentage increase in their WTP premium for NTFPs collection, other variables held constant. This further indicates that households with low income would be willing to pay less than those with high income. This may be linked to the fact that households with low income derive

significant part of their income from sale of NTFPs, hence they were more likely to resist any policy change that regulate access and utilization of NTFPs from FGR compared to their high income counterparts. This finding support those of Amponin *et al*. (2007) and Amiri *et al*. (2015) who reported that households with higher income were more willing to pay for ecosystem services than the less wealthier ones.

Distance to the nearest main market had a significant positive relationship with household willingness to pay for fuelwood ($P < 0.01$) and honey ($P < 0.1$) (Table 5.3). This was consistent with this study's hypothesis that distance to market may not necessarily affect the individuals' WTP for fuelwood and honey. This could be explained by the fact that majority of the rural households in Nigeria use fuelwood as their primary source of domestic energy, and therefore those in remote areas have high demand for the product. On the contrary, the distance to main market showed negative and significant influence on WTP for gum arabic and fruits, implying that the farther the distance to market, the less likely the households would be willing to pay for collection of gum arabic and fruits. This is perhaps because most of the respondents have to cover long distances (about 150km) to access the market for these products, thus the little interest in paying for their collection. Contrasting results were however reported by Nouhoheflin *et al*. (2004) who pointed out that individuals are utility maximizers, hence the distance to market has little or no impacts on their WTP for improvement in environmental goods and service.

Distance from the respondents' homes to FGR negatively and significantly ($p < 0.01$) influenced their WTP for fuelwood, honey, and fruits. This suggests that households that lived farther away from FGR were less likely to pay a high premium for fuelwood, honey and fruits collection, and or forest conservation in general. This agrees with the finding of Chukwone and Okorji, (2008) that poor access to the natural resource is a disincentive for conservation among resource users. However, distance to FGR had a positive and significant influence on

households' WTP for fodder ($P < 0.01$) and medicinal herbs ($P < 0.01$). This may be because those who live far from the forest may not have easy access as those living nearer, and therefore would be willing to pay a high premium to have access. In addition, it could be because both the Fulani herdsmen who graze in the reserve and the herbalists are traditionally known to cover long distances in search of products of their interest, hence distance may have little influence on their WTP premium for the forest products.

5.6 CONCLUSIONS AND RECOMMENDATIONS

5.6.1 Conclusions

- This study has shown that households attach importance to the NTFPs mainly for their monetary value. Given that the cost of obtaining these resources from other sources such as individual farms and markets are high, they are more willing to pay for their collection from FGR.
- Households who live next to the FGR, having known the importance of NTFPs for their wellbeing, are willing to conserve them for present and future generations through payment for their collection. Communities are willing to pay more money for fuelwood and honey collection from the reserve because majority of the households rely on fuelwood for most of their domestic energy needs and because these two products have high market value.
- It is evident that by levying NTFPs collection, and in the presence of requisite administrative and institutional framework, Falgore game reserve would generate substantial revenue for both local and state governments, as well as contribute significantly to households' income.
- Wealthier and educated household heads are more willing to pay for NTFPs conservation because they have little or no budget constraints and they are more aware

of the benefits they would derive from forest conservation compared to their poorer and less educated counterparts.

5.6.2 Recommendations

- Introduction of levy for NTFPs extraction is recommended given that majority of the households living in communities close to FGR are willing to pay for forest conservation.
- Key to successful implementation of NTFPs collection levy is the establishment of a joint committee comprising of both government officials and community leaders in order to raise confidence among community members who have distrust for government officials as shown in the findings of this study.
- Policy makers and other stakeholders should promote the use of alternative domestic cooking energy such as biogas among communities proximate to FGR in order to reduce pressure on the forest wood resources.

CHAPTER SIX

UTILIZATION OF NON-TIMBER FOREST PRODUCTS AND THEIR CONTRIBUTION TO INCOME OF HOUSEHOLDS PROXIMATE TO FALGORE GAME RESERVE IN KANO, NIGERIA

ABSTRACT

In the recent decades, there has been growing interest in the contribution of non-timber forest products (NTFPs) to livelihoods, development and poverty alleviation among rural populations. This has been prompted by the fact that communities living adjacent to forest reserves rely to a great extent on the NTFPs for their livelihoods, and therefore any effort to conserve such resources should as a prerequisite understand how the host communities interact with them. Using multistage sampling technique, 400 households were sampled to explore the utilization of non-timber forest products (NTFPs) and their contribution to households' income in communities proximate to Falgore game reserve (FGR) in Kano State, Nigeria. Communities living around FGR were found to mostly rely on the reserve for firewood, medicinal herbs, fodder and fruits for domestic use and sale. Income from NTFPs accounted for 20% - 60% of the total income of most (68%) of the sampled households. The utilization of NTFPs was significantly ($P \leq 0.05$) influenced by age, sex, household size, main occupation, distance to forest and market, as well as household farm size. The findings suggest that NTFPs play an important role in supporting livelihoods, and therefore provide an important safety net for households during periods of hardship. It is suggested that stakeholders should prioritize technical and financial support programs that would promote off-farm income generating activities, as well as alternative source of domestic energy, in communities neighbouring FGR. These would reduce pressure on forest resources, while ensuring secure household livelihoods.

Keywords: Forest conservation; Forest products; Income from NTFPs; Household livelihoods

6.1 INTRODUCTION

Forests provide products for different uses at both household and industrial levels (Appiah *et al*., 2009). These products are grouped into timber and none timber products. Whereas timber products are highly valued worldwide, the non-timber forest products (NTFPs), which play an important role in sustaining livelihoods of communities living around the forests have been given minimum attention. Although NTFPs may not be the most important income generating activity for local people living close to forests, they contribute significantly to households' income, food security and healthcare, as well as provide multiple social and cultural values (Endamana *et al*., 2016). In spite of the known economic contributions of NTFPs, a major

challenge persists in the accurate evaluation of NTFPs as a revenue component for the livelihoods of local people (Ngalim, 2011). The importance of NTFPs in household' income is not well known due to the absence of a systematic and rigorous data collection system at the national level in many developing countries (FAO, 2001).

The role of NTFPs varies from one place to the other depending on the economic and cultural contexts. In developed countries, for instance, forests are generally used for industrial and commercial purposes, as well as biodiversity conservation. In developing countries especially in Africa and Asia, they are mostly utilized for subsistence and household income generation (Cocksedge, 2006; Endamana *et al*., 2016), and largely considered a safety net that fill in the gaps due to shortfall in agricultural production or other forms of emergency (Shackleton and Shackleton, 2004; Paumgarten, 2005; Angelsen *et al*., 2014). It is therefore believed that extraction of NTFPs by households can enhance the economic and social wellbeing of communities living in and around forestlands.

It is estimated that about US$ 90 billion worth of NTFPs is extracted annually worldwide, and about one-third of the same is consumed in the local economies without it entering the formal markets (Pimental *et al*., 1997; Mahapatra and Tewari, 2005). The NTFPs contribution to rural households' income has been found to be significant in many parts of the world. For example, Shackleton *et al*. (2007) found that the share of households' income from NTFPs revenue is sometimes equal to or more than the school teachers minimum wage in Central and West Africa. They further reported that the fruits and game meat traders from the Democratic Republic of Congo earned between USD 16 and 160 per week while producers earned about 50-75% of that amount in a week.

In Nigeria, Jimoh *et al*. (2013) observed that the rural households derived up to 80% of their incomes from the sale of NTFPs. In addition, Ogunsawo and Ajala (2002) and Zaku *et al*.,

(2013) reported that over 70% of the Nigeria's households depend directly on fuelwood as their main source of energy, with daily consumption estimated at 27.5 million kg/day. Thus, harvesting and processing of NTFPs in many areas in the country has shifted from subsistence exploitation and sales at the local markets to international cross-boundary trade. For example, in the high forest zones of Eastern and Western Nigeria, harvesting of game meat and snails for sale are now major income generating activities almost all year round (Onuche, 2011). In the savannah zone of central and northern Nigeria, honey, fuel-wood, locustbean seeds, gum arabic and charcoal making generate substantial income to the rural households (Jimoh *et al*., 2013). In addition, NTFPs contribute significantly to households' healthcare and food security in Nigeria similar to other African countries such as Kenya and Tanzania (Schaafsma *et al*., 2014 and Mbuvi and Boon, 2009).

Utilization of non-timber forest products (NTFPs) by communities close to the forest has been promoted both as a way of enhancing local livelihoods and biodiversity conservation (Leisher *et al*., 2010). However, the effectiveness of achieving these goals has been contested (Belcher and Schreckenberg, 2007). This is because in the absence of requisite measures to ensure judicious use, utilization of NTFPs at times lead to over-exploitation of the NTFPs and therefore threatens plant diversity (Brummit and Bachman, 2010). Therefore, any effort aimed at optimizing NTFPs extraction and enhancing local subsistence and cash income from NTFPs requires site-specific studies to generate information on how the forest adjacent communities relate with the forest resources in order to inform design, entry point and approach in conservation interventions.

The world is now grappling with a myriad of problems, among them the increasing poverty situations in many countries, especially among the rural communities who depend on natural resources for their livelihoods. These communities are mostly located in remote areas where most of the services and amenities are limited. Hence, more often than not they find themselves

heavily reliant on the natural resources within their proximity. Studies aimed at assessing the relationship between communities living close to forest and NTFPs, particularly with respect to the benefits derived by households from forest resources are very important, especially in informing policy formulations and sustainable management of forest resources. Hence, the importance and relevance of this study is not only to fill the knowledge gaps but also to guide decisions and practice. This study provides answers to the following research questions: What are the different NTFPs utilized by households living close to FGR, and who are involved in their collection? What is the contribution of NTFPs to the household income? How do different socio-economic factors influence the NTFPs' collection and utilization in the study area?

6.2 METHODOLOGY

6.2.1 Data collection

Data was collected through household interviews using a structured questionnaire, and focus group discussions guided by a checklist of questions (detailed sampling procedure is provided in Chapter 3). The questions asked were related to various NTFPs used by households, main actors in the collection of different NTFPs, value of NTFPs consumed and sold by the households, various sources of households' income, contribution of NTFPs to households' income, demographic and socio-economic attributes of the respondents such as sex, age, household size, and educational status and primary and secondary occupation, membership to social group, and contact with extension agents.

6.2.2 Data analysis

Both descriptives and inferential statistics were used in the data analysis. Descriptive statistics such as frequency, percentages, and bar chart were generated to show the contribution of NTFPs to households' income. Analysis of variance (ANOVA) was used to determine the differences between the households' mean income from agriculture (sales of crop and

livestock), off-farm income and NTFPs income in the study area. The means of the households' incomes from agriculture, off-farm activities and NTFPs were separated using the Fishers' Least significant difference (LSD) procedure as described by Hayter (1986).

Logistic regression analysis was used to determine factors that influence collection and utilization of NTFPs by households. This is because the dependent variable in this study was dichotomous that assumed two values; 1 if the respondent was collecting and utilizing NTFPs from FGR and 0 if otherwise. This kind of variable is normally estimated using logit or probit models, both of which estimate parameters using maximum likelihood approach. While probit model assumes normal distribution of error term, the logit model takes a logistic distribution of the error term. This study used the binary logit model due to consistency of parameter estimation associated with the assumption that the error term in the equation has a logistic distribution (Maddala, 1983; Baker, 2000; Gujarati, 2007). Prior to logistic regression analysis, normality and multicollinearity tests were carried out. The multicollinearity problem was addressed by dropping a variable if found to be correlated with other variable (s), taking into consideration the relevance and power of the variables in explaining the dependent variable. The model based on the logistic probability as expressed by Gujarati (2004) is specified as follows:

$$\phi_i = E\left(\gamma_i = \frac{1}{x_i}\right) = \frac{1}{1 + e^{-(\beta_i + \sum_{i=1}^{K=n} \beta_{ij} + x_{ij})}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

ϕ_i = the probability of household i collecting NTFPs from FGR.

γ_i = NTFPs utilization by household.

i, x_{ij}= factors influencing household collection and utilization of NTFPs.

i and β_{ij} = the parameters to be estimated.

By denoting z equal to $\beta i + \sum_{j=1}^{k=n} \beta_{ij}$ in equation (1), the equation can further be rewritten to get the probability of NTFPs utilization status of household as follows:

$$\phi_i = E\left(\gamma_i = \frac{1}{x_i}\right) = \frac{1}{1 + e^{-z_i}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

From equation (2) above, the probability of a household collecting NTFPs is given by (1 - ϕ). The equation (2) is further transformed as follows:

$$(1 - \phi_i) = \frac{1}{1 + e^{z_i}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The odds ratio of the equation (3) would, therefore, be $\phi_i/(1 - \phi_i)$ as shown in equation (4) below:

$$\frac{\phi_i}{1 - \phi_i} = \frac{1 + e^{z_i}}{1 + e^{-z_i}} = e^{z_i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The natural logarithm of equation (4) above give rise to equation (5)

$$\ln\left(\frac{\phi_i}{1 - \phi_i}\right) = \beta + \sum_{j=1}^{k=n} \beta_{ij} + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The explanatory variables (X_i) used in the model were:

x_1 = Age of household head in years; x_2 = Sex dummy variable = 1 if male; 0 if female; x_3=Household size (number of persons per household); x_4 = Main occupation; x_5 = Level of education dummy variable 1 = formal education, 0 if otherwise; x_6 = Farm size (ha); x_7 = Membership to a social group; x_8 = Distance to FGR (km); x_9 = Distance to market (km); and x_{10} = Household monthly income ($).

Table 6. 1: Definition of hypothesized variables for the binary logit regression model

Variable	Definition	Expected influence on the dependent variable
Utilization of NTFPs by the household from FGR	Dependent variable (Yes = 1, No = 0)	
Age of household head	Age of household head/representative in years	-
Sex of the household head	Male = 1, Female = 0	-
Household size	The number of persons per household	+
Main occupation	On-farm activities = 0, Off-farm activities = 1, Forest resource extraction = 2	-
Education level of the household	Highest education level attained by household head (Formal education = 0), Informal education =1)	+
Farm size	Size of farm owned by household in hectares	+
Membership to social group	If household head or representative is a member of social group =0, If not a member social group =1	+
Distance to FGR	Distance from home to FGR in kilometres	-
Distance to market	Distance from home to market in kilometres	+
Household income	The amount of money earned per month by households in USD	+

Source: Author's computation

6.3 DESCRIPTION OF INDEPENDENT VARIABLES USED IN THE MODEL

6.3.1 Age of the household head

Age was measured as a continuous variable defined as the actual number of years of the household head. Younger household heads were expected to be more involved in collection of NTFPs than the elderly counterparts since the former may be more active hence can cope with the intensive labour demand for NTFPs collection. In addition, the aged household heads may be risk averse with regard to violating the rules of FGR protection, thus, may unlikely engage in collection of NTFPs from the reserve. Although age could have both positive and negative influences on NTFPs collection by the communities, this study hypothesized that age of the household head would negatively affect the collection of NTFPs from FGR.

6.3.2 Sex of the household head

Given their preferences and roles in the family, men and women are likely to access and utilize different resources from the forest. This is particularly true in traditional societies where males and females have specific roles and activities (Cavendish, 2000). For example, the collection of firewood and medicinal plants are jointly carried out by both men and women in most part of Africa (Vedeld *et al*., 2004), while the collection of honey and gum arabic are exclusively done by men. However, due to cultural barriers in the study area, which limits women participation in NTFPs collection from the forest, men are more likely to take the risk of going into the forest compared to women. It was therefore hypothesized that male-headed households were more likely to collect forest resources than female headed households. Sex was a dummy variable where a value of 1 was assigned to male headed households, and 0 to female headed households.

6.3.3 Household size

Household size represents the actual number of individuals living in a household and who depend directly on the resources of the household head. This variable is expected to have direct influence on the amount of food, income and demand for natural products from their immediate environment. The family size also determines the available family labour. This implies that the bigger the household size, the higher the domestic demand for NTFPs and the more readily available labour for NTFPs collection from the forest would be (Masozera and Alavalapati, 2004). It was therefore assumed that larger households are more likely to collect NTFPs from the reserve than the smaller counterparts. Household size was measured as the total number of persons living under same roof.

6.3.4 Main occupation of the household head

The main occupation represents the major economic activity the household head is engaged in for cash income and subsistence. According to FAO (2001), approximately 59% and 62% of

the population in Africa and Asia live in rural area respectively, and over 70% engage in agriculture as their main source of livelihood. In Nigeria for example, agriculture accounts for about 75% of the total households' income, contributing between 50% and 70% to the rural household food security (Daneji and Suleiman, 2011). Because of the fewer livelihood options in the rural areas that can supplement household main sources of income and food, they are therefore expected to rely more on forest resources especially during periods of scarcity. Those households which are engaged in other livelihood activities such as trading and formal employment were therefore hypothesized to dependent less on NTFPs compared to their counterparts whose main occupation is farming.

6.3.5 Education level of the household head

The level of education attained by the household head is expected to influence the nature of his or her economic activity, and consequently their level of income. The achieved social and economic status of the educated household heads who are employed by the government or private sector is expected to restrict their involvement in extraction of forest resources. This is because education would make it easier for households to comprehend negative externalities and passive user values of natural resources (Muchapondwa, 2003). Besides providing the much needed income employment also deters people from engaging in other time consuming activities such as extraction of forest resources. The uneducated or less educated household heads were therefore expected to engage more in collection of NTFPs than their educated counterparts.

6.3.6 Farm size

This was defined as the farmland owned by a household, and was measured in hectares. Farm size plays an important role in crop production as it influences the amount of land put under production, therefore the amount of food produced. Households with limited farmland may not be able to produce adequate food for their family, hence may rely heavily on forest resources

around them as their safety net to complement food deficits. It was hypothesised that household heads with large farm size may not heavily depend on NTFPs collection from FGR as they may have enough food for their domestic use and surplus for sale.

6.3.7 Membership of social group

Social or farmer groups serve as platforms for sharing information, as well as collective action in food production and marketing. Household heads who are members of a social group were expected to be less likely involved in extractive activities such as NTFPs. From exposure and capacity building through groups, members are expected to be not only more aware of the benefits of forest conservation, but also capable of bridging food deficits through other alternative sources other than collection of NTFPs.

6.3.8 Distance from home to FGR

The distance to FGR was expected to negatively influence households' collection of NTFPs from FGR. This implies that the longer the distance of a household from FGR, the less likely its members will collect NTFPs from the reserve. As noted by Gunatilake, (1998) people living closer to the forest have a higher dependency on forest resources than those living far from the forest. The author attributed this to difficulties in accessing the forest due to high transportation costs.

6.3.9 Distance from home to market

Distance to nearest market was a continuous variable, measured as distance covered in kilometre from respondents' home to the nearest market. This variable was expected to positively influence collection of NTFPs by households especially for those products that are collected for sale. Households that live close to a market were expected to be more likely to collect and depend on NTFPs compared to those living far from markets. However, as observed

by Masozera and Alavalapati (2004), access to markets may open up better income generating activities thereby making people less dependent on forest resources.

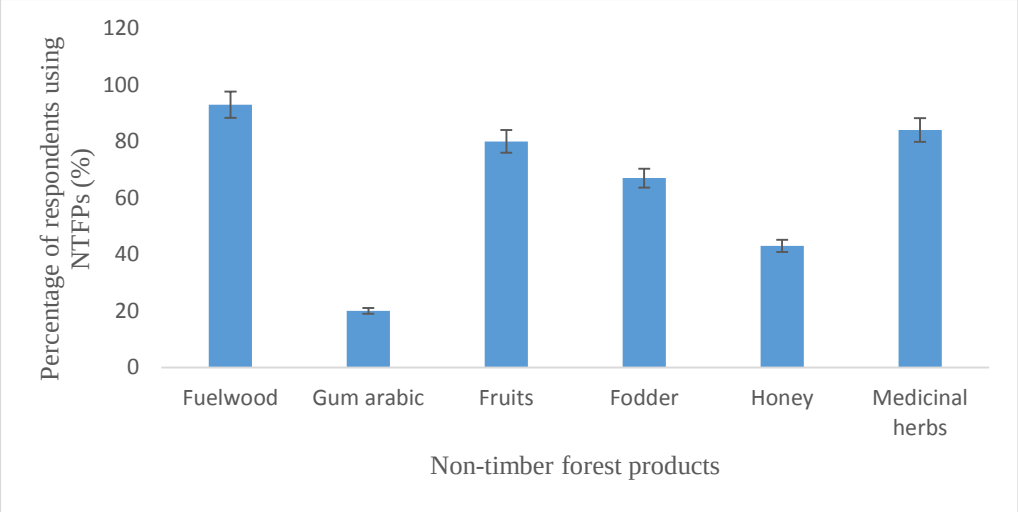
6.3.10 Household income

The level of households' income determines the kind of choices they make with regards to their livelihood and adaptation options. It was expected that households with high income would choose to invest more in other sectors of the economy rather than relying on NTFPs collection. Furthermore, households with high income usually have a strong purchasing power that enable them to buy more food to compensate for low harvests and therefore are unlikely to depend on extraction of natural resources to meet food deficits. As noted by Cavendish (2000) and Vedeld *et al*. (2004) the low-income households will rely heavily on natural resource extraction from forestlands around them.

6.4 RESULTS AND DISCUSSIONS

6.4.1 Non-timber forest products collected by households from Falgore game reserve

Harvesting and selling of NTFPs is one of the major income generating activities among households living close to FGR. Figure 6.1 shows the main non-timber forest products collected by households from FGR. The results indicate that fuelwood (99%) and medicinal herbs (84%), fruits (80%) and fodder (67%) were the most commonly collected NTFPs by households in the study area. The high proportion of respondents extracting fuelwood and medicinal herbs may be attributed to the fact that fuelwood is the main source of domestic cooking energy in the study area. This is because other sources of energy such as electricity and gas are beyond the reach of majority of the households, which are poor (Adedayo *et al*., 2010). Meanwhile, the inadequacy, distant and high cost of health services may be responsible for the high proportion of people using traditional medicine in the rural areas of Nigeria as shown by the results of this study.



Source: Household interviews (N = 400)

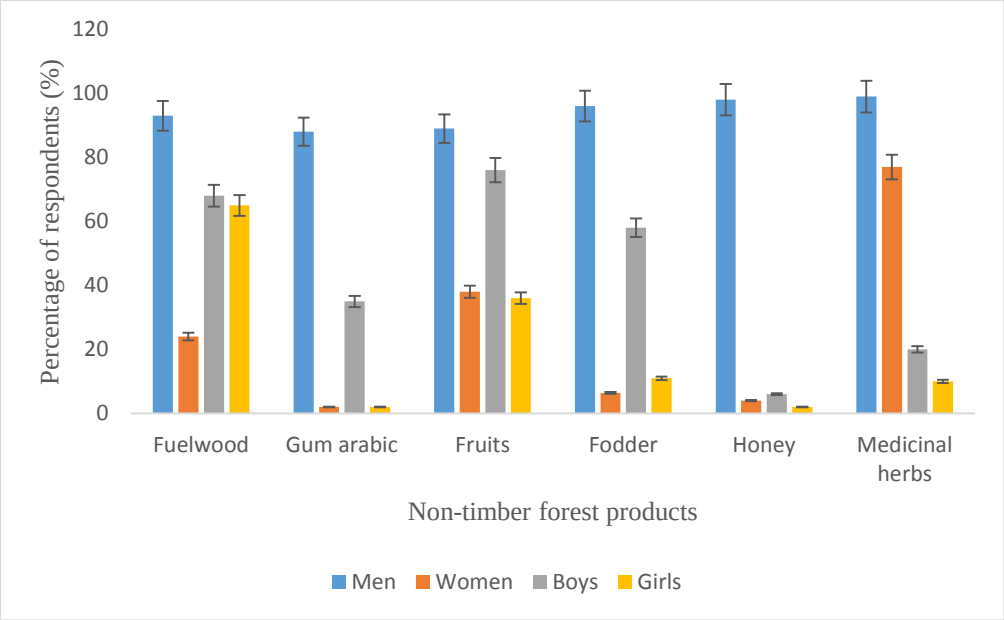
Figure 6. 1: Non-timber forest products collected by the households from Falgore game reserve

This finding confirms the report by World Health Organization (WHO, 2002) that majority of the world's human population, especially in developing countries depend on traditional medicine. Gum arabic and honey were the least collected NTFPs by the households in the study area. This may partly be explained by the fact that collection of these products requires skills and capital which most of the sampled households claimed not to have.

6.4.2 Gender involvement in Non-timber forest products collection from Falgore game reserve

Figure 6.2 presents collection of NTFPs from FGR by gender. The results revealed that all gender (men and women, boys and girls) were involved in the collection of NTFPs. As observed by Agrawal *et al*. (2013) evidence from Africa, Asia, and Latin America suggests that both men and women actively participate in NTFPs collection depending on the socio-cultural environment in which they live and their physical capacity. In the current study, men were the dominant extractors of NTFPs. Most (94%) of the collectors of fuelwood (92%), gum arabic (88%), fruits (88%), fodder (96%), honey (98%) and medicinal herbs (99%) were men.

The dominance of men in NTFPs collection could be explained by the fact that in Northern Nigeria men have more access rights to forest resources than women. For instance, in many societies, women are often barred from participating in physical work and those which involve traveling long distances into the forest because of religious and cultural reasons (Coulilay-Lingani *et al*., 2009; Daneji and Suleiman, 2010; Agarwal *et al*., 2010). As reported by Das *et al*. (2011) and Agrawal *et al*. (2013), products such as honey and gum arabic are traditionally known to be collected mainly by men among the communities living in forest fringes of western, eastern and southern Africa (Das *et al*., 2011; Agrawal *et al*; 2013).



Source: Household interviews (N = 400)

Figure 6. 2: Collection of non-timber forest products by gender groups

In the current study, women were also engaged in the collection of medicinal herbs (77%) and fruits (38%). The high participation of women in collection of plant medicine could explained by the fact that more women are actively involved in traditional medicine practice as reported by the key informants. However, women participation in the collection of fuelwood, gum arabic, fodder and honey was found to be low due to cultural norms which preclude women from physical work, especially away from the homestead. This finding is contrary to the

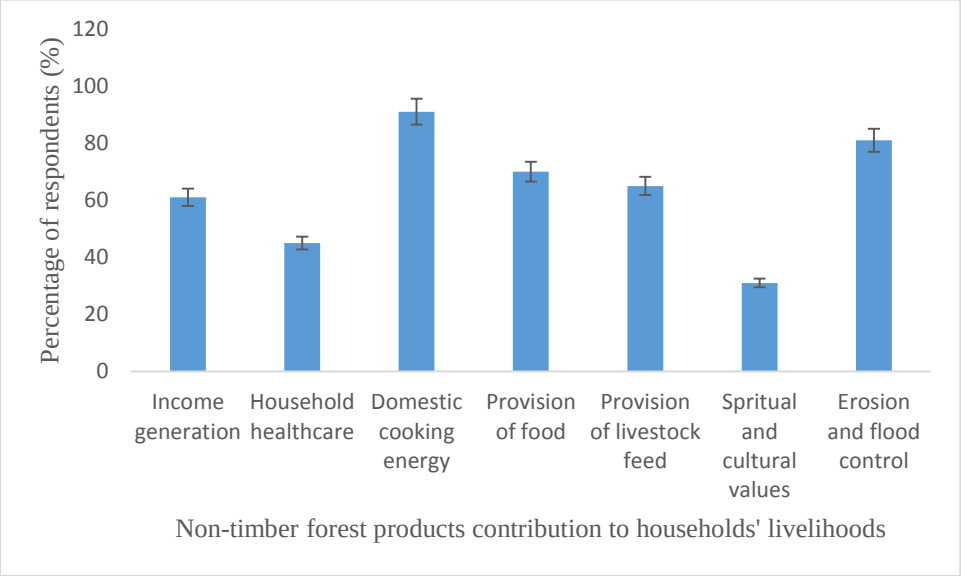
observation from a review article conducted in South Africa (Paumgarten, 2005) that women collect 73% of total NTFPs in comparison to men. Also comparable to this finding are the results of a study by Jimoh and Haruna (2007) showing high participation of women in NTFPs extraction in Onigambari forest reserve, Oyo State, Nigeria.

Boys were found to be actively involved in the collection of fuelwood (68%), fruits (76%), fodder (58%) and gum arabic (35%), whereas girls were mainly involved in the collection of fuelwood (65%) and fruit (36%). These findings show that whereas all gender are involved in extraction of NTFPs, certain products are collected more by a particular gender than the other, indicating some sort of specialization or division of labour in the household. This type of specialization by gender is depicted in the results by Davenport *et al*. (2012) from their study conducted in West Africa, that women were more involved in processing and marketing activities along the value chain of NTFPs than extraction.

6.4.3 Contribution of non-timber forest products to households' livelihoods

Rural households living adjacent to FGR depend on NTFPs, particularly for income generation, household healthcare, domestic cooking energy, food (wild vegetables and fruits), livestock feed, spiritual and cultural values, as well as regulatory services such as control of soil erosion and flooding (Figure 6.3). Although most of the NTFPs collected by households are mainly used for subsistence, approximately 61% of the surveyed households reported selling NTFPs for their livelihoods sustenance. As indicated by Cavendish (2000) and Vedeld *et al*. (2004), low income rural households heavily rely on extraction of natural resources from forests around them to supplement their income from farm and off-farm activities. Most (91%) of the sampled households considered fuelwood provision as the most important contribution of FGR to their livelihoods. These results corroborate those of Ogunsawo and Ajala (2002) who reported that

over 70% of the urban and rural households in Nigeria depend on fuelwood as their main source of domestic energy for cooking, with daily consumption estimated at 27.5 million kg/day.



Source: Household interviews (N = 400)

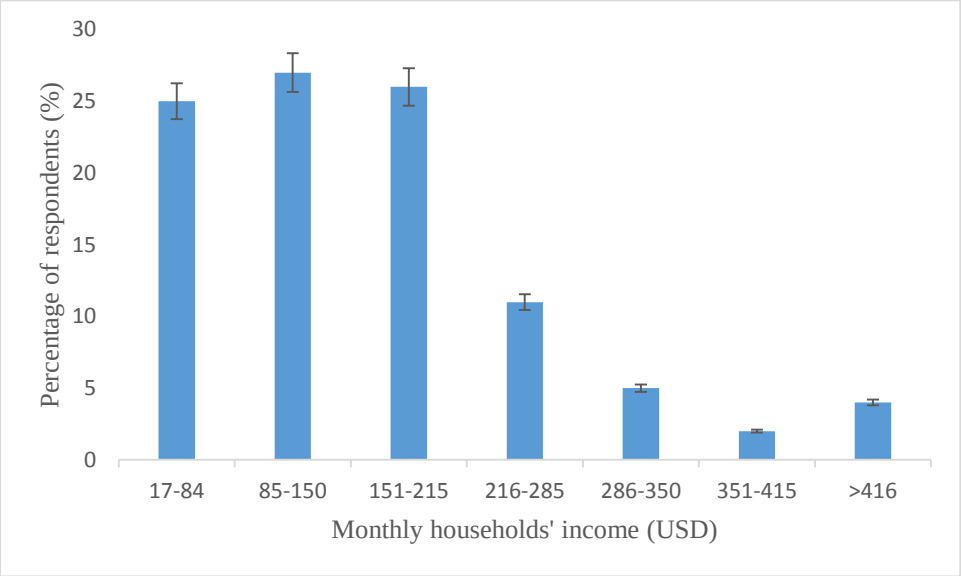
Figure 6. 3: Contribution of non-timber forest products to households' livelihoods

The findings of this study further revealed that 70% of the interviewed households derived significant part of their households' food from collection of NTFPs from FGR in form of wild leafy vegetables and fruits. This finding supports those of Bankole (2016) and Jimoh and Haruna (2007) who reported that rural households in Nigeria rely on forest resources around them as the natural food aid during periods of food shortage occasioned by crop failure. Forty five percent of the respondents indicated that plant medicine collected from FGR is important for households' healthcare and income when sold in the local markets (Figure 6.3). Contribution of the forest resources to spiritual values of local community was considered least important despite the fact that some of tree species and water bodies in the reserve were used by the communities for specific rituals and ceremonies. About 81% of the respondents indicated the importance of the forest in soil erosion control and modification of microclimate of the area. They believed that the amount of rainfall they received was largely due to the

influence of the forest. However, households who owned livestock often considered pasture and fodder from FGR as the most important contribution of the forest to their livelihoods.

6.4.3.1 Non-timber forest products contribution to households' income

Figure 6.4 presents the income of the sampled households from various sources. The results shows that the average income of the households was $165, with majority (53%) earning $17-150, and only a few (4%) earning ≥$420 per month. These results show that majority (59%) of the respondents are poor (living below USD 1.5 per day), and therefore are liklely to rely more on NTFPs to supplement their other sources of food and income.



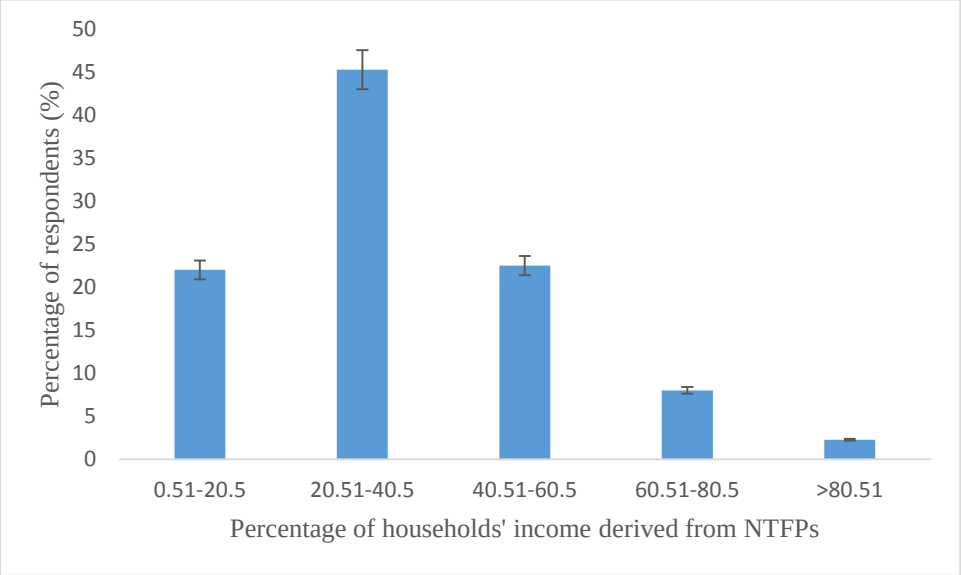
Source: Household interviews (N = 400)

Figure 6. 4: Monthly income (USD) of the respondents

6.4.3.2 Percentage share of household income from non-timber forest products

The share of household income from sale of fuelwood, gum arabic, fodder, fruits, medicinal herbs and honey is presented in Figure 6.5. The results revealed that on average NTFPs contribute up to about 30% of the total household income in the study area, with majority (68%) of the households deriving between 20 and 60% of their income from the sales of NTFPs. These results imply that NTFPs constitute an important component of the rural households' economy

by contributing one-third of the total households' income in the study area. The results of the current study concur with those of Wunder (1999) and Mulenga *et al*. (2011) that rural communities in Africa rely on forest resources for subsistence or sale to obtain cash.



Source: Household interviews (N = 400)

Figure 6. 5: Monthly contribution of Non-timber forest products to the households' income

6.4.3.3 Mean households' income from various sources

The results of analysis of variance between mean incomes from sources are presented in Table 6.2. The results showed that the average monthly income of the households from sales of crop and livestock ($75) was significantly (P< 0.01) higher than that from NTFP ($67) and off-farm ($60) activities. However, the average income derived from NTFPs was also significantly higher (P < 0.05) than that from off-farm activities. This implies that the contribution of NTFP to households' income and therefore the role they play in providing safety-net to forest-proximate communities is of paramount importance especially to those households who have limited access to complementary economic opportunities. The findings of the current study agree with those of Malleson *et al*. (2014) who reported income from NTFP and the farm as

the major components of households' income in Nigeria and Cameroun. They also observed higher income from NTFPs among households in remote areas than those living in the town. This was attributed to lack of alternative sources of income among the former making them to rely more on sale of NTFPs.

Table 6. 2: Mean households' income (USD) generated from non-timber forest products and other sources

Sources	Minimum ($)	Maximum ($)	Mean ($)	SE	F-value
Agriculture	20	264	75	0.87	6.97***
Off-farm	12	210	60	0.58	
NTFPs	18	248	67	0.45	

Source: Household interviews (N = 400), *** = Significant at 1%,

6.4.4 Socio-economic and demographic factors influencing utilization of non-timber forest products by households

Besides policies and regulations, the NTFPs collection and utilization is mainly influenced by the inherent social, economic and cultural characteristics of the individuals or the community in question. The results of binary logit regression of the factors influencing utilization of NTFPs in FGR are presented in Table 6.3. The results indicate that sex, household size, distance to FGR and distance to the main market had significant positive ($P \leq 0.01$) influence on households' utilization of NTFPs. On the contrary, the age of household head, main occupation and farm size had significant ($P \leq 0.05$) but negative influence on household collection and utilization of NTFPs. The negative influence of age on NTFPs utilization suggests that younger people were more likely to extract NTFPs than their older counterparts. This is because NTFPs collection activities in FGR are illegal, time consuming and tedious, which may not favour the older generations as opposed to the youth who may be more energetic and willing to take risks of violating the rules governing extraction of NTFPs from FGR. A report by Central Bank of Nigeria (CBN, 2012) however shows that younger households in rural areas of Nigeria were

forced to resort to forest resource extraction, especially game hunting and fuelwood collection because of poverty.

The sex of the household head showed a positive and significant ($P \leq 0.01$) relationship with NTFPs extraction. Although there was no equal representation of sampled respondents based gender, the male headed households, which accounted for about 86% of the respondents were found to be more likely to collect NTFPs from FGR than their female counterparts. This is attributed to cultural norms of the communities in the northern part of Nigeria, which restrict women participation in activities away from home such as collection of forest products. Similar findings were reported by Mustapha (2012) that majority of women in rural of Nigeria were mainly charged with domestic responsibilities ranging from cooking to caring for children with little or no participation in other economic activities.

Household size positively influenced NTFPs extraction from FGR, implying that larger households were more likely to rely on the NTFPs than the smaller households partly owing to higher demand for basic needs associated with the former. This finding corroborates those of Kabubo-Mariara and Gachoki (2008) who reported that large households adjacent to forests in Kenya derive more resources from the forests given that they are capable of spreading the available labour across various activities than the smaller households.

The main occupation of household heads had a negative influence on NTFPs extraction, implying that households which earned more income from farming and off-farm activities were less likely to rely on NTFPs compared to those who earned less from these activities. The farm size was found to be inversely related to NTFPs collection and utilization by the households, implying that households with large farm holdings were less dependent on NTFPs. Probably because they were more likely to have adequate food supplies to carter for their family needs and a surplus for sale. This finding is consistent with that of Kabubo-Mariara and Gachoki

(2008) who reported that land-poor families in Kenya were not able to produce enough food for their subsistence and income needs, hence largely depended on the forest products to complement their livelihoods.

Table 6. 3: Factors influencing households' utilization of non-timber forest products

Households' attributes	β	S.E	Wald	P-value
Constant	4.374	0.791	3.556	0.000
Age of household head	-0.095	0.014	4.741	0.000
Sex of household head	1.871	0.435	1.472	0.000
Household size	0.090	0.035	6.477	0.011
Main occupation	-0.184	0.098	3.550	0.060
Education of the household head	0.157	0.151	1.071	0.301
Household farm size	-0.438	0.132	11.02	0.001
Membership to social group	-0.215	0.304	0.502	0.479
Distance to FGR	-0.204	0.068	9.043	0.003
Distance to market	-0.042	0.017	6.262	0.012
Income	0.001	0.000	2.179	0.140

Source: Household interviews (N = 400), χ^2 = 107.58***, *** = Significant at 1%, (-2) Log likelihood = 342.3, Nagelkerke R^2 = 0.35,

The distance from respondents' home to FGR negatively influenced households' extraction and utilization of NTFPs, meaning that households closer to the forest used more NTFPs than those farther away, probably because of ease of access for those nearer to the forest. Similarly, distance to the main market had a negative relationship with households' utilization of NTFPs. This could be explained partly by the fact that rural communities that live far from the market centres are more likely to have limited livelihood options and therefore would depend on farming and extractive activities such as collection of NTFPs to meet their subsistence needs. In contrast, communities living closer to the market centres tend to have a wide range of business opportunities and therefore may be less interested in the collection of NTFPs. It may also be that returns to labour and agricultural income are higher among communities that are closer to markets hence making them better off than their rural counterparts making them less likely to participate in extraction of NTFPs. As reported by Angelsen and Kaimowitz (1999),

higher rural wage and greater off-farm employment opportunities reduce reliance on environmental resources by the communities.

6.4 CONCLUSIONS AND RECOMMENDATIONS

6.4.1 Conclusions

- Based on the findings of this study, it is clear that the FGR supports households' livelihoods through provision of various NTFPs such as fuelwood, medicinal herbs, fodder for livestock, honey, gum arabic, and fruits for domestic use and sale to generate income. Extraction of NTFPs from FGR thus acts as a safety net, particularly when there is a shortfall in agricultural production, to minimize risk and also to fill the gap of food deficit in the study area.
- The NTFPs contributes significantly to households' income in the study area, as 68% of the households raise up to 40% of their income from these products.
- Although men, and women, boys and girls are all involved in NTFPs collection to some extent, collection of various NTFPs is largely differentiated by gender as certain NTFPs are collected more by particular gender than the others.

6.4.2 Recommendations

- In order to reduce household overreliance on NTFPs for food and income generation, it is recommended that government and agencies involved in conservation should prioritize technical and financial support programs such as small and medium enterprises to communities neighbouring FGR in order to supplement households' income from agriculture.
- In the long-run, diversification into formal sector employment, coupled with education and skill development, is recommended to reduce household overreliance on NTFPs for food and income generation.

- For effective conservation of NTFPs, interventions should target groups which were found to have more stake, such as the men and youth, in planning and implementing sustainable utilization and management of forest resources. In addition, interventions aimed at conserving the forest should consider both in-situ and ex-situ conservation of the most utilized products in order to relieve pressure on the wild stock.

CHAPTER SEVEN

COMMUNITY PERCEPTIONS AND ATTITUDES TOWARDS PROTECTED AREA CONSERVATION APPROACH: EMPIRICAL EVIDENCE FROM FALGORE GAME RESERVE IN KANO, NIGERIA

ABSTRACT

Protected areas are used globally to conserve wild flora and fauna of important value to mankind. Despite the widespread adoption of this approach, its appropriateness and effectiveness in ensuring sustainable conservation has been a point of debate for decades. Specifically, its protectionist approach that often excludes local communities from accessing the critical natural resources has been a big concern. This study assessed the perceptions and attitudes of the communities living in the fringes of the Falgore Game Reserve in Kano, Nigeria towards the protected area conservation approach. The findings from 400 respondents indicate that perceptions and attitudes of the communities were influenced mainly by their knowledge about the goals of protected area, availability of non-timber forest products (NTFPs), enforcement of protection rules and discriminative access to NTFPs. Majority (64%) of the interviewed households held positive perceptions and attitudes towards conservation of the forest. Communities' perceptions and attitudes towards FGR were positively influenced by age, education level, contact with extension agents and membership to social groups. The respondents' sex and distance to FGR were, however, negatively related to their perceptions and attitudes towards the conservation approach. Households who held negative perceptions and attitudes towards FGR, such as the youth, women and those with low level of education, highly doubted the future of FGR. These results provide a reason for targeting the youth, women and the less educated in the awareness campaign for sustainable NTFPs conservation.

Keywords: Non-timber forest products; Perceptions; Attitudes; Protected area; Conservation; Kano, Nigeria

7.1 INTRODUCTION

Introduction of protected areas (PAs) in the world can be traced back to the establishment of Yellowstone National Park in the United States in 1872 in response to uncontrolled degradation of biodiversity and ecosystem services in the area (Pretty and Smith, 2004; Chape *et al*., 2008). Since then, the number of PAs around the world has continued to increase. For instance, by 2005, there were 144,296 protected sites world over, covering a total area of about 19,381,000 km², or 12.9% of the earth's land area (Fisher *et al*., 2009). These areas are meant to serve as

reserves for biodiversity and regulating use of important wild flora and fauna. However, managing these reserves has become a challenge over the years (Fisher *et al*., 2005).

More than 99 % of the protected areas around the world are faced with various threats such as poaching, encroachment by crop cultivation and unsustainable harvesting of non-timber forest products (NTFPs) (Barve *et al*., 2005). In addition, conflicts between local communities and states over resource user rights and access are common worldwide, particularly over non-timber forest resources. Over the years, these conflicts have become more frequent due to several factors, among them, population growth, urbanization and the realization that resources are finite, as well as the desire of the States to ensure sustainable management of natural resources (Blaikie and Springate-Baginski 2007).

Many game reserves in Nigeria have been designated and managed on top-down basis, and therefore rarely consider pertinent social, cultural, and political issues, which can only be addressed through community participation in conception and implementation of conservation strategies. Establishment of PAs in Nigeria has often meant exclusion of communities from extracting natural resources that are important for their livelihoods, and in many cases, some communities have been forced out from their lands with little or no compensation (Anthony, 2007). Such actions often resulted in adverse social impacts on local communities, and consequently lead to negative attitudes towards state led conservation strategies (Garcia-Frapolli *et al*., 2009). Aswani and Weiant (2004) observed that when local communities are excluded from the management of protected areas and their needs and aspirations ignored, it becomes extremely difficult to enforce conservation policies.

Socio-economic and demographic factors such as sex, income, age, education status and household level of dependence on natural resources have been reported to significantly influence attitudes and perceptions of natural resource users (Ayodeji, 2009; Taruvinga and Mushunje, 2010). For instance Wunder *et al*. (2014) reported that educational status of the

resource users could make them more conscious but at the same time less utility maximization towards natural resource conservation. The perceptions of the communities on conservation are therefore site and context specific (Allendorf *et al*., 2012; Baral and Heinen, 2007; Shibia, 2010). This therefore necessitates the need for location specific research if the twin goal of sustainable rural livelihoods and biodiversity conservation is to be achieved. In addition, understanding communities' perceptions and attitudes towards natural resource conservation is crucial in informing entry point for community-based natural resource management, as well as mitigating resource –based conflicts (Meijaard *et al*., 2013).

The objective of this study was therefore to assess the perceptions and attitudes of local communities towards protected area conservation approach; and determine the socio-economic factors influencing local peoples' perceptions and attitudes towards FGR and conservation of non-timber forest products.

7.2 METHODOLOGY

7.2.1 Data collection

Primary data was obtained through household survey using a structured questionnaire, and focus group discussions guided by a check list of questions. The questions asked were related to socioeconomic and demographic attributes of the respondents, household utilization of NTFPs, and attitudes, and perceptions towards FGR. The household socio-demographic information considered for the study included gender, age, household size, membership to a social group, contact with extension agents, level of education, as well as primary and secondary occupation of the households.

Questions on perception and attitudes concerning the NTFPs and resource utilization focussed on the benefits derived from the forest, restrictions on resource use, illegal resource collection, NTFPs resource degradation, among others. Responses to perception statements posed to

respondents were measured on a 5-points Likert scale depending on the respondent's extent of agreement with the statements. The selected statements were assigned scores as follows: strongly agree= 5; agree = 4; don't know = 3; disagree = 2; and strongly disagree = 1. The statements on the respondents' attitude were based on the level of satisfaction with the management of FGR. This was also measured on a 5-points Likert scale as follows: very dissatisfied =1; dissatisfied = 2; neutral = 3; satisfied = 4; and very satisfied =5 (Kothari and Garg, 2014). Scores were finally categorized into very positive and very negative perceptions, and very favourable to very unfavourable attitude, while any score between the two extremes represented a neutral position. A total score for each respondent was therefore summed up for both perceptions and attitudes.

The perceptions and attitude statements were sixteen (16), hence the highest score value for positive perceptions and attitude was 80, and the least was 16. Therefore, 16 * 5 = 80 represented the most positive response possible; 16 * 3 = 48, neutral response; and 16 * 1 = 16, most unfavourable response possible.

7.2.2 Data analysis and model specification

Descriptive statistics such as frequency distribution, percentages, pictogram and measures of central tendencies were generated from the data on socioeconomic and demographic characteristics of the respondents. The chi-square test was used to determine the difference in communities' perceptions and attitudes towards FGR in the three LGAs considered in the study.

Multiple linear regression was used to determine the socioeconomic and demographic factors influencing households' perceptions and attitudes towards FGR and conservation of NTFPs. Multiple linear regression is best suited for continuous variable, hence the respondents' perception and attitudes was computed as continuous variables. In order to avoid the

multicollinearity problem, a correlation analysis was carried out to identify variables that were significantly ($r \geq 0.5$) correlated with one another prior to performing multiple linear regression analysis. Where variables were found to be significantly correlated to each another, one was dropped taking into consideration its relevance and prediction ability of the dependent variable. Thus, the variables with higher t-values were retained for the regression analysis.

Using Multiple linear regression method, the hypothesis of no significant relationship between socioeconomic and demographic characteristics of the households and their attitudes toward FGR and NTFPs conservation was tested at 5% level of significance with (n-k) degrees of freedom (Gujarati, 2004). The multiple linear regression model as expressed by Gujarati (2004) was specified as follows:

$$Y_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where: βo is the intercept, β_i measures the change in y with respect to Xi, holding other factors fixed.

Y = dependent variable (total score of household perception toward FGR)

X_1 = Age of household head in year

x_2 = Sex household head measured as dummy variable (1 if male; 0 if female)

x_3= Household size (number of persons in the household)

x_4 = Main occupation of the household head

x_5= Educational level of household head (1 if educated; 0 if otherwise)

x_6 = Farm size (ha)

x_7 = Contact with extension agent (Yes = 1; No = 0)

x_8 = Membership to social group

x_9 = Distance to FGR (km)

x_{10} = Monthly households' income ($)

$\beta 1 - \beta k$ = the parameters of the coefficient to be estimated

ε_i = error term.

7.3 RESULTS AND DISCUSSIONS

7.3.1 Socio-economic and demographic characteristics of sampled households

Socioeconomic and demographic factors such as age, education, occupational status, income, household size, proximity and access to natural resource are known to exert significant influence on the attitudes and perceptions of the people towards any conservation initiative. The results presented in Table 7.1 show that more than half (53%) of the respondents were between the age of 30 and 49 years, and less than one-third (23%) of the respondents were below 30 years of age. The respondents who were above 50 years of age were 19%, while the mean age of the respondents was 38 years. This implies that majority of the respondents were relatively young and therefore expected to hold positive perceptions and attitudes towards natural resource conservation. This is because the youth are expected to be more informed than their older counterparts, and therefore are likely to be aware that the on non-timber forest products need to be conserved for the future.

The average household size of the respondents was 8 persons. About 63% of the respondents had a family size of 6-15 persons, while 29% had 1-5 persons. Only 9% of the respondents had more than 15 members in their families. These variations in household size of the respondents could largely influence their demand for NTFPs, as their needs would be expected to vary with their socioeconomic and demographic characteristics (Rodrigues *et al*., 2011).

Table 7.1 shows that majority (66%) of the interviewed households had a farm size of between 0.25 and 2.24ha, while the average farm size was approximately 2 ha. This implies that most of the respondents were subsistence farmers who may not produce adequate food to carter for their dietary and income requirements, and therefore most probably rely on natural resources around them to meet the deficits.

Table 7. 1: Socioeconomic and demographic characteristics of the respondents

Household attribute	Frequency	Mean±STD
Age		
20-29	90(23)	38±11.34
30-39	128(32)	
40-49	86(21)	
50-59	74(19)	
60-69	22(5)	
Household size (persons)		
1 5	114(29)	8±2
6 10	180(45)	
11 15	70(17)	
16-20	34(8)	
21-25	2(1)	
Farm size (ha)		
0.25-1.24	145(36)	2±0.5
1.25-2.24	117(29)	
2.25-3.24	91(23)	
3.25-4.24	32(8)	
4.25-5.24	15(4)	
Distance to FGR (km)		
0.25-2.25	158(40)	3.64±2.34
2.26-4.25	97(24)	
4.26-6.25	89(22)	
6.26-8.25	49(12)	
8.26-10.25	7(2)	
Household income (USD)		
17-84	100(25)	165±10.5
85-150	109(27)	
151-215	101(26)	
216-285	44(11)	
286-350	21(5)	
351-415	8(2)	
≥416	17(4)	
Proportion of income derived from NTFPs (%)		
0.51-20.50	88(22)	34.84±8.27
20.51-40.50	181(45)	
40.51-60.50	90(23)	
60.51-80.50	32(8)	
≥80.51	9(2)	
Male	344(86)	
Female	56(14)	
Marital status		
Married	377(94)	
Single	20(5)	
Divorce	3(1)	

Table 7. 1: Socioeconomic and demographic characteristics of the respondents

Household attribute	Frequency	Mean±STD
Educational level		
Informal education	135(34)	
Primary	140(35)	
Secondary	97(24)	
Tertiary	28(7)	
Main occupation		
Farming	149(37)	
Trading	74(19)	
NTFP extraction	114(28)	
Employment	9(2)	
Craft and artisans	54(14)	
Contact with extension agent		
Have contact	253(63)	
Have no contact	147(37)	
Main source of NTFPs		
FGR	304(76)	
Own farm	62(16)	
Market	34(8)	
Procedure for NTFPs collection from FGR		
Seeking permission	100(35)	
Illegal collection	204(67)	

Source: Household interviews (N = 400); *Percentage of households' attribute are shown in parentheses

The average distance from the households' homesteads to FGR was 3.6km and approximately 64% of the sampled respondents lived between 0.25 and 4.25 km away from the reserve. This shows that most of the sampled households could access and utilize NTFPs from FGR and thus were expected to have positive and favourable attitude towards FGR due to the possible benefits. As noted by Sundriyal *et al*. (2004), the community attitudes towards forest resources vary depending on the average distance to forest, availability of resources and access rights.

The monthly income of more than half (53%) of the respondents ranged from USD 85-215 (₦26,000-65,000), whereas about a quarter (25%) of the respondents had a monthly income of USD 17–84. The mean household income was USD 165 (₦49,952) per month. This indicates that most of the interviewed households were low and medium income earners who are likely to find it difficult to meet their family needs, considering the average household size of 8

persons. Thus, most of these households are more likely to depend on sales and consumption of natural resources around them. They are therefore most likely to have negative attitudes toward the protectionist approach of NTFPs conservation that excludes them from exploiting the resources.

Most (68%) of the respondents derived between 20-60% of their total household income from NTFPs. This finding is consistent with those of Ojo (2007) and Ejidike and Ajayi (2013) who reported that majority of the rural households in Nigeria derived more than 50% of their total income from forest products. Although peoples' attitudes and perceptions towards a given management strategy is a function of costs and benefits of the approach to them, from these findings, one would expect a reasonable number of the sampled population to have positive attitudes towards conservation of the NTFPs.

Gender distribution of the sampled household revealed that there were more male headed-households (86%) than female-headed households (14%) (Table 7.1). The fewer number of female respondents was attributed to the seclusion of women as is the norm in predominantly Muslin communities of northern Nigeria. However, as reported by Vedeld *et al*. (2007), gender of the head of the household may affect the types of resources that they collect from the environment. This is particularly true in traditional societies where males and females have specific roles, activities, as well as user rights.

Most (94%) of the sampled household were married, 5% were single and only 1% were divorced (Table 7.1). This implies that a higher percentage of respondents had family responsibilities, hence required more sources of livelihoods to carter for their household needs. This could affect their attitude towards protected area system of conservation as they would be expected to be more reliant on the NFTPs for their livelihoods, and therefore may not welcome any strategy that would restrict access to the resources. Ideally, households' attitudes and

perceptions pertaining to NTFPs conservation and utilisation are expected to be influenced by the education level of the respondents. As noted by Muchapondwa (2003), educated people are expected to be more informed and aware of potential benefits to be derived from the forest than their less educated counterparts. The results of this study showed that majority (66%) of the respondents had formal education while the remaining 34% had informal education. Technically, this finding implies that all the respondents were exposed, and thus, were expected to have a better understanding of the benefits of FGR and the protection policy, thereby leading to a positive attitude towards the system.

The occupational structure of the interviewed households revealed that about 66% of the respondents relied on natural resources (farming and forest resources extraction) for their livelihoods. This finding concurs with that of Musa *et al*. (2012) who reported that over 70% of the Nigeria's rural dwellers engage in agriculture and forest resource extraction as their primary occupation. About 63% of the sampled households had contact with extension agents on a periodic basis. This indicates that most of the respondents were likely to be aware of the importance of natural resource conservation and therefore were expected to perceive protected area conservation approach positively. As observed by Madumere (2000) and Agbogidi and Ofuoku (2005), effective utilization of agricultural extension education programs can help in raising awareness among forest-dependent communities on sustainable management of their environments.

The majority (76%) of the respondents sourced their NTFPs from FGR, while 16% and 8% obtained NTFPs from their own farms and market, respectively (Table 7.1). These results corroborate those of Shackleton *et al*. (2007) who reported that majority of the rural inhabitants in South Africa sourced their NTFPs from forestlands adjacent to their communities. Most (67%) of the sampled households collected NTFPs products from FGR without permission

despite the reserve's protection status. This implies that such households are unlikely to positively view conservation policies that would regulate access to the forest.

7.3.2 Households' perceptions towards protected area NTFPs conservation

The perceptions of communities towards FGR and conservation of its non-timber forest products are presented in Table 7.2. A greater proportion (72%) of the sampled households agreed that the establishment of FGR is necessary if biological diversity of the forest is to be conserved. However, some of the respondents from Doguwa (18%), Tudunwada (33%) and Sumaila (19%) were opposed to the conservation approach. This finding indicate that the community generally entrust the state with conservation of FGR partly because of the fear of tragedy of the common scenario if the reserve is to be manage by community as revealed by the communities during the FGDs.

In assessing whether the local people should be responsible for the protection of FGR, the results indicated that majority of the respondents from Doguwa (73%), Tudunwada (68%) and Sumaila (67%) were against community-based forest resource management approach. This was attributed to the fear of free riding, and also mismanagement, which may eventually lead to the tragedy of the common scenario with the tendency of users pursuing individual interests at the expense of conservation. Furthermore, most (63%) of the interviewed residents reported that they were satisfied with the forest user rights given to them by the management of FGR to collect NTFPs from the reserve for household consumption only. They indicated that the period of time allocated to collect resources was very limited and hence needed to be reviewed. This implies that communities were somewhat happy with the State management of the forest reserve.

Table 7. 2: Households' perceptions towards protected area conservation in Falgore game reserve

Perception statements	Percentage of respondents							
	LGAs	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	df	$\chi 2$
FGR is necessary	Doguwa	7	11	5	28	49	8	16.17***
	Tudunwada	17	16	3	29	35		
	Sumaila	11	8	4	39	38		
Local people should protect the forest	Doguwa	32	41	5	18	9	8	14.40**
	Tudunwada	22	46	5	21	6		
	Sumaila	27	40	4	16	13		
PA recognize indigenous peoples' rights	Doguwa	8	22	6	47	17	8	13.97**
	Tudunwada	9	29	6	34	22		
	Sumaila	4	21	7	54	14		
Participatory NTFPs conservation is necessary	Doguwa	5	12	6	49	28	8	19.95***
	Tudunwada	10	20	5	33	32		
	Sumaila	4	14	12	32	38		
Illegal collection of NTFPs causes forest degradation	Doguwa	5	17	6	43	29	8	15.25**
	Tudunwada	4	12	2	48	34		
	Sumaila	5	6	3	58	28		
Restriction of access is key to sustainable conservation	Doguwa	6	15	5	38	36	8	0.09**
	Tudunwada	6	11	7	48	28		
	Sumaila	5	6	3	58	28		
There is need for NTFPs collection fees	Doguwa	12	12	3	50	23	8	12.98NS
	Tudunwada	11	14	6	40	29		
	Sumaila	7	6	3	60	24		
Adequate time for NTFPs collection is needed	Doguwa	19	35	11	26	9	8	19.79***
	Tudunwada	23	21	25	25	6		
	Sumaila	23	17	25	25	10		
Indiscriminative access to NTFPs is needed	Doguwa	18	31	17	13	21	8	18.16***
	Tudunwada	18	14	27	26	19		
	Sumaila	18	17	26	20	18		

Source: Household interviews (N = 400); NTFP- Non-timber forest products; FGR – Falgore game reserve; LGAs – Local government areas; PA – Protected area; *** = Significant at 1%, ** = Significant at 5%; NS = Non-significant

The majority (Doguwa (77%), Tudunwada (65%) and Sumaila (70%)) of the sampled respondents perceived joint forest resource conservation by stakeholders as one way of reducing illegal resource collection from the reserve (Table 7.2). This clearly indicates the need for community involvement in natural resource management in the study area in spite their acceptance of State management. The results of the households' perceptions on the negative consequences of illegal exploitation of NTFPs from FGR revealed that the quality and quantity of NTFPs stock is declining and if left unchecked such trends may consequently affect the livelihoods of those depending on the products for their social and economic wellbeing. However, the communities associate illegal collection of NTFPs to outsiders and Fulani pastoralists who have illegally settled in the reserve for many decades.

Majority of the respondents in Doguwa (74%), Tudunwada (77%) and Sumaila (86%) favoured restricted access to NTFPs as key to successful conservation of the forest. Similarly, about 75% of the sampled households expressed their readiness to pay for non-timber forest products collection from FGR if required (Table 7.2). This was attributed to the fact that most of the respondents considered illegal resource exploitation detrimental to sustainability of their livelihoods. This shows how critical the forest is to the households living close to the forest, especially during the dry spells and droughts when food is in short supply. Besides the limited time allocated for NTFPs collection, the respondents indicated that forest officials tend to favour local leaders while issuing NTFPs collection permits. Such perceptions may ultimately lead to non-compliance with the rules and regulation governing the use of the forest by the community. Generally, the results presented in Table 7.2 it is clear that majority of the respondents had positive perceptions toward establishment of FGR.

7.3.3 Households' attitudes towards Falgore game reserve

It has been widely acknowledged that communities living in and around the vicinity of PAs are critical to the success of conservation efforts (Wiggins *et al*., 2004; Robertson and Lawes, 2005). Therefore, their attitudes towards conservation and understanding of the environmental policies are critical in informing conservation approaches. The respondents' attitudes towards FGR and NTFPs conservation are presented in Table 6.3. More than half of the respondents from Doguwa (52%) and Tudunwada (53%) were not satisfied with capacity or adequacy of the available game guards in providing full protection of the reserve. This finding concur with that of Tudunwada (2012) and Badamasi *et al*. (2010) who reported that the Falgore game reserve was lacking well-trained and adequate staff and even the ones available were poorly remunerated and ill equipped to perform their duties.

Participation of local people in conservation activities enables clear definition of resource users' rights, as well as benefits sharing where necessary, thus promoting collaborative management of resources in protected areas. The results on the level of satisfaction of local people's involvement in the decision-making process regarding the conservation of NTFPs in FGR showed that most of the surveyed households from Tudunwad (63%) and Sumaila (55%) were dissatisfied with the low level of communities' involvement in the decision-making processes. This implies management decisions regarding conservation strategies are carried out by forest officials with little or no participation from communities who are important stakeholders. This approach has the potential of aggravating non-compliance with conservation regulations.

Table 7. 3: Households' attitude towards Falgore Game Reserve

Attitude statements	Percentage of respondents							
	LGAs	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	df	$\chi 2$
There are adequate game guards	Doguwa	35	17	6	14	28	8	25.09***
	Tudunwada	46	7	14	5	28		
	Sumaila	36	5	13	11	35		
Local people are involved in conservation activities	Doguwa	34	2	9	25	30	8	50.28***
	Tudunwada	40	1	22	5	32		
	Sumaila	36	11	9	12	32		
Local people contribute to NTFPs conservation	Doguwa	26	2	10	18	44	8	14.66**
	Tudunwada	24	4	21	15	36		
	Sumaila	23	7	11	20	39		
It is necessary to apply penalties against illegal resource exploiters	Doguwa	21	5	14	18	42	8	12.64NS
	Tudunwada	26	2	12	11	49		
	Sumaila	32	2	7	15	44		
Information sharing between forest wardens and community is satisfactory	Doguwa	27	5	10	24	34	8	13.82**
	Tudunwada	31	2	16	15	36		
	Sumaila	30	21	2	17	30		
Protected area is the best conservation system	Doguwa	22	5	9	30	34	8	10.25NS
	Tudunwada	22	3	11	25	39		
	Sumaila	29	2	15	29	25		
There is quality and quantity of NTFPs under PA conservation approach	Doguwa	8	13	6	30	43	8	15.03**
	Tudunwada	9	10	5	33	43		
	Sumaila	7	14	7	22	60		

Source: Household interviews (N = 400), NTFP- Non-timber forest products, FGR – Falgore game reserve, LGAs – Local government areas, PA – Protected area, *** = Significant at 1%, ** = Significant at 5%; NS = Non-significant

Most (57%) of the interviewed households expressed high level of satisfaction with the local people's contribution towards NTFPs conservation in FGR (through protection of illegal exploitation of resources, excessive fuel wood collection and information sharing with game guards). This shows the value the communities attach to the forest and their willingness to conserve it.

The local respondents shared the same opinion about the application of penalties against illegal resource extractors by the officials of FGR. Majority (60%) of them indicated that the game guards duly meted out the punishment meant for the illegal resources collectors. More than half of the interviewed households from Doguwa (58%) and Tudunwada (54%) were satisfied with the level and process of information sharing often used by the forest officials to reach out to communities close to FGR. However, more than half (51%) of the sampled respondents from Sumaila were not satisfied with efficiency and effectiveness of the procedure of information sharing. They opined that inadequate information sharing between the forest reserve managers and local people remained the main source of resource use conflicts in the area.

The results of the local peoples' view on the efficiency and effectiveness of protected area system of natural resource conservation indicates that many (61%) of the sampled households were satisfied with the approach and considered it as the best system for conservation of FGR. The majority (77%) of the respondents showed satisfaction with the current quality and quantity of the available NTFPs in FGR under the state management. This was further supported by the local communities' perception that FGR would have been degraded under communal tenure rights. This implies that despite the deterioration and resources degradation due to natural and anthropogenic factors, the locals still appreciate the condition of the reserve, as well as the role of the State in conservation.

7.3.4 Factors influencing households' perceptions and attitudes towards protected area conservation system

Table 7.4 presents the results of multiple regression of factors influencing household perceptions and attitudes towards protected area conservation. Out of the ten predictor variables fitted in the model, six variables (age of household head, gender, education of household head, membership to social group, contact with extension agents and distance to FGR had significant influence on households' perceptions and attitudes towards FGR and NTFPs conservation strategies. On the other hand, household size, main occupation, farm size and households' income did not significantly influence households' perceptions and attitudes towards FGR. Whereas age, education, contact with extension agents and membership to social group had positive and significant influence on households` perceptions and attitudes towards protected area conservation approach, gender and distance from home to FGR had negative influence on the respondents' favourable attitudes towards protected area conservation approach in FGR.

The age of the household head had a positive and significant influence on perceptions and attitudes towards FGR as was hypothesized. This implies that the older generation were likely to view conservation positively compared to the youth. Similar findings were reported by Beyene *et al.* (2014) who found significant positive relationship between age of household heads and their perceptions on using Bamboo to combat deforestation in Benishangul Gumuz Region, Ethiopia. This implies that older persons are likely to be less utilitarian and may also have better understanding of the environmental regulations than the younger counterparts.

Sex of the household heads was negatively associated with a favourable attitude towards protected area conservation. Most (70%) of the male-headed households were willing to pay for NTFPs collection from the reserve and to support participatory forest resource conservation. On the other hand, less than 25% of the female-headed households were willing to support

participatory forest resource conservation and also most of them were not willing to pay for NTFPs collection from FGR. This can be explained by the fact that women may perceived the forest as less important than men because most of the women in the study area do not collect NTFPs from the reserve due to cultural reasons. Men, on the other hand view the forest as a critical resource base for their livelihoods, particularly those who derive large proportion of their household incomes from sale of NTFPs.

Table 7. 4: Factors influencing households' perceptions and attitudes towards protected area conservation

Households' attributes	β	Std. Error	t-value
Constant	56.2310	3.0062	18.70***
Age of household head	0.1242	0.0445	2.79***
Sex of household head	-2.6222	1.2047	-2.18***
Household size	-0.1387	0.1057	-1.31
Main occupation	-0.3731	0.2541	-1.47
Education level of household head	4.3173	0.5264	8.20***
Farm size	0.3950	0.3888	1.02
Contact with extension agent	3.7636	1.0569	3.56***
Membership to social group	4.9856	1.0306	4.84***
Distance to FGR	-1.0819	0.2262	-4.78***
Household income	1.496 E-005	0.0000	0.83

Source: Household interviews (N = 400); F-value = 48.19***; R^2 = 55.33%, *** = Significant at 1%, ** = Significant at 5%; NS = Non-significant

Sex of the household heads was negatively associated with a favourable attitude towards protected area conservation. Most (70%) of the male-headed households were willing to pay for NTFPs collection from the reserve and to support participatory forest resource conservation. On the other hand, less than 25% of the female-headed households were willing to support participatory forest resource conservation and also most of them were not willing to pay for NTFPs collection from FGR. This can be explained by the fact that women may perceived the forest as less important than men because most of the women in the study area do not collect NTFPs from the reserve due to cultural reasons. Men, on the other hand view the forest as a critical resource base for their livelihoods, particularly those who derive large proportion of their household incomes from sale of NTFPs.

The education level of the household head positively influenced the positive attitudes and perceptions of the respondents towards conservation, implying that the more educated the persons were, the more likely they would support conservation of the forest. This finding agrees with that of Bogale (2011) who noted that households with higher education and training expressed more willingness to pay for ecosystem services than less educated ones. This may be attributed to the fact that less educated households may have low understanding of environmental policy and natural resource users' rights. You may then find more uneducated household heads engaging in illegal resource exploitation in protected areas than educated households who may have the tendency to comply with regulations of resource exploitation.

The results show significant positive relationship between the sampled households' perceptions and attitudes towards conservation and their interaction with extension agents, implying that household heads who belonged to social groups were more positive towards protected area forest conservation approach.. This was not a surprise as quality interaction with extension agents helps in sharpening households' understanding of negative consequences of environmental degradation and its impacts on human well-being. This finding is consistent with that of Koenig *et al.* (2011) who reported that social networks among members of a group can build community resilience and increase the adaptive capacity for environmental management.

An inverse relationship between household heads' perceptions and distance to FGR was observed, an indication that households living near the forest are likely to be more positive to conservation of the forest as compared to their distant counterparts. This may be partly due to the fact that households nearer to the forest could be more dependent on the NTFPs and therefore attach more value to their conservation than those living farther away from the forest. This finding is inconsistent with those of Taruvinga and Mushunje (2010) who reported a positive relationship between household participation in wetland conservation and distance

from farmers' field to the wetland. They noted that households living nearer to the wetland being highly dependent on the resource may be reluctant to support policies that may restrict their access to the wetlands.

7.4 CONCLUSIONS AND RECOMMENDATIONS

7.4.1 Conclusions

- The results show that most of the respondents were aware of the benefits of the conservation of FGR, and also supported the need to conserve the forest. Protected area forest conservation approach is popular among the households and therefore considered by the majority as the best management option for NTFPs conservation in FGR.
- Despite the community acceptance of the protection of the FGR, they would be willing to partner with government in the area of biodiversity conservation, specifically on participatory forest management, in order to supplement the efforts of the state and also to ensure sustainability of the conservation in the area.
- This study shows that younger household heads oppose protected area system of conservation compared to their aged counterparts, this is partly because of the overreliance of the former on NTFPs. This has adverse implications for sustainable conservation both in the short and long run.
- Social networks among community members in form of membership to social groups, as well as extension services are critical in awareness creation and instilling positive perceptions and attitudes towards conservation among the communities living close to the forest.

7.4.2 Recommendations

- It is recommended that policy makers and conservation agencies should take advantage of the positive attitudes and perceptions of the communities towards conservation of

FGR as an entry point to promote participatory forest management in the study area. This will help in ensuring proper enforcement of forest conservation regulations, as well as equitable distribution of costs and benefits arising from conservation among stakeholders.

- To avoid apathy and illegal resource exploitation, the issuance of NTFPs collection permit to local residents should be transparent and non-discriminative.
- Development of effective and efficient channels of information sharing between the community and the FGR officials is recommended to ensure informed decisions and inclusivity in conservation matters.
- Public awareness creation should target the youth, less educated and women. This should be aimed at not only addressing the negative attitudes towards conservation by these groups but also to ensure sustainable exploitation by the less educated that are likely to be more dependent on the forest resources, as well as the youth that would still rely on these resources in the future.
- There is need to promote participation of households in social groups, awareness creation on the benefits of forest conservation as a way of ensuring positive attitudes towards natural resource management among the forest-proximate communities in the study area.

CHAPTER EIGHT

SUMMARY CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

- The main drivers of forest cover loss in FGR are indiscriminate fuelwood collection, and unregulated grazing because majority of the forest proximate communities rely on fuelwood for domestic energy needs and sale to generate income, and the forest serves as the only dry season grazing refuge for the Fulani herdsmen.
- The main hotspots of forest cover change are the north, central and eastern parts of the forest reserve. These are the areas affected most by anthropogenic activities such as charcoal making for subsistence and income generation, as well as illegal grazing by the neighbouring communities.
- The respondents' willingness to pay for conservation of NTFPs in FGR is dependent on the known, as well as foreseen benefits that are likely to accrue from their conservation. For instance, communities are willing to pay more money for fuelwood and honey collection from the reserve because majority of the households rely on fuelwood for most of their domestic energy needs and because these two products have high market value.
- Wealthier and educated household heads are more willing to pay for NTFPs conservation because they have little or no budget constraints, and are more aware of the benefits they would derive from forest conservation.
- This study has revealed that levying NTFPs collection from FGR by the forest department would provide a good opportunity for an additional source of revenue for the government as the community are willing to pay for the collection of NTFPs from the reserve.

- Lack of transparency and accountability as well as disputed access rights are the major setbacks limiting household corporation in forest conservation in the study area.
- Falgore game reserve supports households' livelihoods through provision of NTFPs such as fuelwood, medicinal herbs, fodder for livestock, honey, gum arabic and fruits for domestic use and sale to generate income. This provides a safety net for households, particularly when there is a shortfall in agricultural production.
- Collection of NTFP is differentiated by gender. For instance, males participate more in honey and gum arabic extraction than their female counterparts because extraction of the two products require traveling long distances into the forest, and sometimes spending days or weeks in the forest. In addition to cultural barriers to their participating in such activities, majority of the female household heads may not be willing to take such risks.
- Extraction of non-timber forest products represent an important source of income for communities proximate to FGR given that they contribute about 40% of the total income of about 68% of the households in the study area.
- The results show that most of the respondents are aware of the benefits of the conservation of FGR, and also support the need to conserve the forest.
- Protected area forest management approach is considered by majority of the households as the best management option for NTFPs conservation in FGR. This is because the community believe that if they were to be entrusted with the management of the reserve it may end up being an open access resource therefore leading to tragedy of the commons, a situation where individual benefits are pursued at the expense of the environment.

- The communities would be willing to partner with government in the area of biodiversity conservation, specifically participatory forest management in order to ensure sustainability of efforts by the state.
- Poor communication and discriminative issuance of permits for extraction of NTFPs by forest officials are contributing to illegal resource exploitation among households who believe that they are unjustly restricted from gaining access to the reserve.
- Social networking and interaction with extension agents are key in instilling positive perceptions and attitudes towards forest conservation. This is because social groups provide a platform for sharing information and capacity building on sustainable natural resource management and general community wellbeing.

8.2 Recommendations

The following recommendations arise from the results and conclusions of this study:

- Restoration of forest cover should target the degradation hotspots in the central, eastern and northern parts of the forest as they are most prone to overexploitation.
- Promotion of alternative domestic cooking energy, such as biogas to communities proximate to FGR is recommended in order to reduce pressure on the forest wood resources.
- The government needs to establish more cattle routes and grazing reserves, while protecting the existing ones to address the problem of illegal invasion of forest reserves in the state.
- Introduction of negotiated fees for collection of forest products is recommended given that majority of the household are willing to pay forest conservation in the study area.
- Key to successful implementation of NTFPs collection levy is the establishment of a joint committee comprising of both government officials and community leaders in

order to restore confidence of the communities who have distrust for government officials as revealed in this study.

- To avoid apathy and illegal resource exploitation, the issuance of NTFPs collection permit to communities should be transparent and non-discriminative.
- There is need for government and conservation agencies to promote off-farm alternative income generating activities to extraction of NTFPs to reduce overreliance on the forest resources for income generation. This would help shift focus to conservation rather than exploitation of the NTFPs given that the expected income was the main motivation behind the positive attitude and willingness to pay for NTFPs and forest conservation.
- It is recommended that policy makers and organizations involved in conservation should take advantage of the positive attitudes and perceptions held by the communities towards protected area conservation approach as an entry point to promote participatory forest management in the study area to ensure proper enforcement of forest protection rules, as well as equitable distribution of costs and benefits of forest conservation among stakeholders.
- Public enlightenment and awareness campaigns should give more emphasis to the youth, less educated and women who hold negative perceptions and attitudes towards protected area conservation. This should be aimed at not only addressing the negative attitudes towards conservation by the state, but also to ensure sustainable exploitation by groups such as the less educated that are likely to be more dependent on the forest resources, as well as the youth who would still rely on the resources in the future.
- Interventions should be directed towards establishment and strengthening social and development groups as they are important in knowledge and capacity building dissemination on sustainable natural resource management.

- Capacity building of local communities on conventional methods of extracting honey is suggested based on the general observation which shows that local communities lack the required skills and knowledge on conventional honey harvesting despite its potential for income generation with little or no harm to the forest ecosystem.
- Strategies aimed at improving NTFPs extraction and conservation in FGR should deliberately target men as they are key actors in extraction of forest resources, especially honey and gum arabic.

REFERENCES

Adedayo, A. G., Oyun, M. B. and Kadeba, O. (2010). Access of rural women to forest resources and its impact on rural household welfare in North Central Nigeria. *Forest policy and economics*, **12(6)**, 439-450.

Adepoju, A. A. and Salau, A. S. (2007). Economic valuation of non-timber forest products (NTFPs). https://mpra.ub.uni-muenchen.de/2689/1/MPRA_paper_2689.pdf. (Retrieved 2nd April 2015).

Adger, W. N., Brown, K., Cervigni, R. and Moran, D. (1995). Total economic value of forests in Mexico. *Ambio*. **1**, 286-296.

Adhikari, M., Nagata, S. and Adhikari, M., (2004). Rural household and forest: an evaluation of household's dependency on community forest in Nepal. *Journal forest resource*. **9**, 33–44.

Agbamu, J. U. (2005). Problems and prospects of agricultural extension service in developing countries. In: Adedoyin, SF (ed.). Agricultural extension in Nigeria. Ilorin: Agricultural Extension Society of Nigeria, pp. 159-169.

Agbogidi, O.M. and Ofuoku, A.U. (2005). State of forestry research and education in Nigeria. In: Popoola, L., Mfon, P., Oni, P.I. (Eds.), Proc. 30th Annual Conference FAN held in Kaduna, Kaduna State between 7th and 11th of November 2005, pp. 484–490.

Agrawal, A., Cashore, B., Hardin, R., Shepherd, G., Benson, C. and Miller, D. (2013). Economic contributions of forests. In *Background paper prepared for the United Nations Forum on Forests.* http://www.un.org/esa/forests/pdf/session_documents/unff10/EcoContrForests.pdf (retrieved 15 August 2016).

Ahenkan, A. and Boon, E. (2010). Assessing the impact of forest policies and strategies on promoting the development of non-timber forest products in Ghana. *Journal of Biodiversity*, **1(2)**, 85-102.

Ahenkan, A. and Boon, E. (2011). Improving nutrition and health through non-timber forest products in Ghana. *Journal of Health, Population and Nutrition*, **29(2**), 141-148.

Akinbami, J. F., Salami, A. T. and Siyanbola, W. O. (2003). An integrated strategy for sustainable forest energy environment interactions in Nigeria. *Journal of environmental Management*, **69(2)**, 115-128.

Allendorf, T. D., Aung, M. and Songer, M. (2012). Using residents' perceptions to improve park-people relationships in Chatthin Wildlife Sanctuary, Myanmar. *Journal of environmental management*, **99**, 36-43.

Alo, C. A. and Pontius, R. G. (2008). Identifying systematic land-cover transitions using remote sensing and GIS: the fate of forests inside and outside protected areas of Southwestern Ghana. *Environment and Planning B: Planning and Design*, **35(2)**, 280-295.

Amadi, D.C.A., Zaku, S. S., Maiguru, A., Idiege, D.A. and Sobola, O.O. (2016) Contributions of Non-Timber Forest Products (NTFPs) to Rural Community Empowerment in

Gashaka-Gumti National Park, Taraba State, Nigeria *FUW Trends in Science & Technology Journal*, **1(1)**, 108-110.

Amiri, N., Emadian, S. F., Fallah, A., Adeli, K., & Amirnejad, H. (2015). Estimation of conservation value of myrtle (Myrtus communis) using a contingent valuation method: a case study in a Dooreh forest area, Lorestan Province, Iran. *Forest Ecosystems*, **2(1)**, 30.

Amor, D. and Pfaff, A. (2008). Early history of the impact of road investments on deforestation in the Mayan forest. Working Paper, Nicholas School of the Environment and Sanford School of Public Policy, Duke University, Durham, NC, USA, p. 15.

Amponin, J. A., Bennagen, E., Hess, S. and Dela-Cruz, J. (2007). Willingness to pay for watershed protection by domestic water users in Tuguegarao City, Philippines. *Poverty Reduction and Environmental Management (PREM) Working Paper 07/06 ASEAN Center for Biodiversity*, pp. 2007-06.

Amusa, T. O., Jimoh, S. O., & Azeez, I. O. (2017). Socio-economic factors influencing marketing of non-timber forest products in tropical lowland rainforests of south-western Nigeria §. *Southern Forests: a Journal of Forest Science*, **79(2)**, 161-168.

Anderson, J. R. (1976). A land use and land cover classification system for use with remote sensor data (Vol. 964). US Government Printing Office, p. 28.

Angelsen, A. and Kaimowitz, D. (1999). Rethinking the causes of deforestation: lessons from economic models. *World Bank Research Observer*, **14**, 73–98.

Angelsen, A., Jagger, P., Babigumira, R., Belcher, B., Hogarth, N.J. and Bauch, S. (2014). Environmental income and rural livelihoods: a global-comparative analysis. *World Development*, **64**, 12–28

Anonymous, (2010). Global Forest Resources Assessment, 2010-Main Report. FAO Forestry Paper 163. Rome Italy, p. 340.

Anthony, B. (2007). The dual nature of parks: Attitudes of neighbouring communities towards Kruger National Park, South Africa. *Environmental Conservation*, **34(3)**, 236–245.

Antonakis, J. and Dietz, J. (2011). Looking for validity or testing it? The perils of stepwise regression, extreme-scores analysis, heteroscedasticity, and measurement error. *Personality and Individual Differences*, **50(3)**, 409-415.

Appiah, M., Blay, D., Damnyag, L., Dwomoh, F., Pappinen, A. and Luukkanen, O. (2009). Dependence on forest resources and tropical deforestation in Ghana. *Environment, Development and Sustainability*, **11(3)**, 471-487.

Arnold, J. M. and Pérez, M. R. (2001). Can non-timber forest products match tropical forest conservation and development objectives?. *Ecological economics*, **39(3)**, 437-447.

Arnold, M. (2004). Introduction. Forest Products, Livelihoods and Conservation. Case studies of Non-Timber Forest Product Systems. Volume 1 - Asia. (eds) Kusters, K. and Belcher, B. Bogor, CIFOR.

Ashaolu, O. F., Momoh, S., Phillip, B. B. and Tijani, I. A. (2011). Microcredit Effect on Agricultural Productivity: A Comparative Analysis of Rural Farmers in Ogun State, Nigeria. *International Journal of Applied Agriculture and Apiculture Research*, **7(1)**, 23-35.

Aswani, S. and Weiant, P. (2004). Scientific evaluation in women's participatory management: monitoring marine invertebrate refugia in the Solomon Islands. *Human Organization*, **63(3)**, 301-319.

Ayodeji, I., Pendlebury, S. and Annegarn, H. (2009). Forest people, two countries and one continent: what empirical connections?. *International Research in Geographical and Environmental Education*, **18(1)**, 45-56.

Babalola, F. D. (2009). Prospects and challenges of production and marketing of Non-Timber Forest Products (NTFPs) by rural farmers in southwest Nigeria. *Academic Journal of Plant Sciences*, **2(4)**, 222-230.

Badamasi, M. M., Yelwa, S. A., AbdulRahim, M. A. and Noma, S. S. (2010). NDVI threshold classification and change detection of vegetation cover at the Falgore Game Reserve in Kano State, Nigeria. *Sokoto Journal of the Social Sciences*, **2(2)**, 174-194.

Baillie, J., Hilton-Taylor, C. and Stuart, S. N. (2004). IUCN red list of threatened species: a global species assessment. IUCN, p. 26.

Baker, F. B. and Kim, S. H. (Eds.). (2004). Item response theory: Parameter estimation techniques. CRC Press, pp. 507.

Balmford, A., Green, J. M., Anderson, M., Beresford, J., Huang, C., Naidoo, R. and Manica, A. (2015). Walk on the wild side: estimating the global magnitude of visits to protected areas. *PLoS Biology*, **13(2)**, e1002074.

Bankole, T.O. (2016). Econometric Analysis of Factors Influencing Collection and Utilization of Medicinal Herbs: The case of Lame Burra Forest Reserve, Nigeria. MSc. Thesis. ATBU Nigeria, p. 103.

Baral, N. and Heinen, J. T. (2007). Resources use, conservation attitudes, management intervention and park-people relations in the Western Terai landscape of Nepal. *Environmental Conservation* **34(1),** 64–72.

Barbier, E. B. (2007). Valuing ecosystem services as productive inputs. *Economic Policy*, **22(49)**, 178-229.

Barbier, E. B., Hacker, S. D., Kennedy, C., Koch, E. W., Stier, A. C. and Silliman, B. R. (2011). The value of estuarine and coastal ecosystem services. *Ecological monographs*, **81(2)**, 169-193.

Barve, N., Kiran, M. C., Vanaraj, G., Aravind, N. A., Rao, D., Shaanker, R. and Poulsen, J. G. (2005). Measuring and mapping threats to a wildlife sanctuary in southern India. *Conservation Biology*, **19(1)**, 122-130.

Belcher, B. and Schreckenberg, K. (2007). Commercialization of non-timber forest products: A reality check. *Development Policy Review*, **25(3)**, 355-377.

Belcher, B. M. and Vantomme, P. (2003). What isn't an NTFP? *The International Forestry Review*, **5**(2), 161-168.

Bello, V. A. (2015). Communities' Willingness to Pay for Protection of Environmental Resources from Oil Spillage in Delta State: A Contingent Valuation Approach. *International Journal of Environment and Pollution Research*, **3(4)**, 67-76.

Benjaminsen, T. A., Kepe, T. and Brathen, S. (2008). Between global interests and local needs: conservation and land reform in Namaqualand, South Africa. *Africa*, **78(02)**, 223-244.

Beyene, F., Bessie, S., Kotu, B. H., Goshu, G. and Mengesha, Y. (2014). Local communities' perceptions of bamboo deforestation in Benishangul Gumuz region, Ethiopia. https://cgspace.cgiar.org/handle/10568/76046 (Retrieved on 8 March 2016)

Bih F, (2008). Assessment Methods for Non-Timber Forest Products in Off-Reserve Forests. Case Study of Goaso District, Ghana. PhD Thesis. Freiburg, Germany: der Albert-Ludwigs-Universität, p. 152.

Bindschadler, R., Vornberger, P., (1998). Changes in the West Antarctic ice sheet since 1963 from declassified satellite photography. *Science* **279**, 689–692

BirdLife International, (2007). BirdLife's online World Bird Database: the site for bird conservation. http://www.birdlife.org. (Retrieved on 7 July 2014)

Bishop, J. and Landell-Mills, N. (2002). Forest environmental services: an overview. In:Bishop, J., Pagiola, S., Landell-Mills, N. (Eds.), Selling Forest Environmental Services: Market-based Mechanisms for Conservation and Development. Earthscan, London.

Bisong, F. E. and Ajake, A. O. (2001). An economic analysis of women's dependence on forest resources in the rainforest communities of South-Eastern Nigeria. *Global Journal of Pure and Applied Sciences*, **7(2)**, 345-350.

Blaikie, P. and Springate-Baginski, O. (2007). Forests People and Power*:* The Political Ecology of Reform in South Asia,(ed.), Earthscan, London, p. 394.

Blumenschein, K., Johannesson, M., Yohoyama, K. K. and Freeman. P. R. (2001). "Hypothetical versus Real Willingness to Pay in the Health Care Sector: Results from a Field Experiment." *Journal of Health Economics*, **20(3)**, 441-457.

Boccaletti, S. and Nardella, M. (2000). Consumer willingness to pay for pesticide-free fresh fruit and vegetables in Italy. *The International Food and Agribusiness Management Review*, **3(3)**, 297-310.

Bodin, Ö., Tengö, M., Norman, A., Lundberg, J. and Elmqvist, T. (2006). The value of small size: loss of forest patches and ecological thresholds in southern Madagascar. *Ecological Applications*, **16(2)**, 440-451.

Boffa, J. M. (2000). West African agroforestry parklands: keys to conservation and sustainable management. UNASYLVA-FAO, pp. 11-17.

Bogale, A. (2011). Valuing natural forest resources: an application of contingent valuation method on Adaba-Dodola Forest Priority Area, Bale Mountains, Ethiopia. *Journal of sustainable forestry*, **30(6)**, 518-542.

Bolt, K., Ruta, G. and Sarraf, M. (2005). Estimating the cost of environmental degradation. A Training Manual in English, French and Arabic. The World Bank Environment Department, pp. 51-56.

Borokini, T. I. and Lawal, I. O. (2014). Traditional medicine practices among the Yoruba people of Nigeria: a historical perspective. *Journal of Medicinal Plants*, **2(6)**, 20-33.

Brummit, N. and Bachman, S. (2010). Plants under pressure—a global assessment: the first report of the IUCN sampled red list index for plants. Royal Botanic Gardens, Kew, UK.

Campese, J. M., Borrini-Feyerabend, D. C., de Cordova, G., Guigner, M., A., Oviedo, G., Colchester, M. and Lassen, B. (2007). Just conservation? What can human rights do for conservation and vice versa. *Policy Matters*, **15**, 6-9.

Campese, J., Sunderland, T., Greiber, T. and Oviedo, G. (Eds.) (2009). Rights-based approaches: Exploring issues and opportunities in conservation. Bogor, Indonesia: CIFOR/IUCN, p. 308.

Casana, J., Cothren, J., 2008. Stereo analysis, DEM extraction and orthorectification of CORONA satellite imagery: archaeological applications from the Near East. Antiquity **82**, 732–749.

Cavendish, W. (2000). Empirical regularities in the poverty-environment relationship of rural households: Evidence from Zimbabwe. *World development*, **28(11)**, 1979-2003.

Cavendish, W. and Campbell, B. M. (2002). Poverty, environmental income and rural inequality: A case study from Zimbabwe. CIFOR, Bogor, Indonesia. http://www.cifor.org/miombo/docs/Environmental_IncomeInequality.pdf (Retrieved on 20 July 2015).

CBD. (1992). The Convention on Biological Diversity. United Nations Environment Programme, Montreal. Available from www.biodiv.org/convention/convention.shtml (Retrieved on 4 July 2014).

CBN (2012). Summary report-national financial inclusion strategy from http://www.cenbank.org (Retrieved on 12 March 2015).

Chan, S. and Sasaki, N. (2014). Assessment of drivers of deforestation and forest degradation in phnom tbeng forest based on socio-economic surveys. *Journal of Environmental Protection*, **5(17)**, 1641-1653.

Chape, S., Spalding, M. and Jenkins, M. (2008). *The world's protected areas: status, values and prospects in the 21st century*. Univ de Castilla La Mancha, p. 365.

Chikamai, B. N. and Kagombe, J. (2002). Country report for Kenya. In: Review and synthesis on the state of knowledge of Boswellia spp. and commercialisation of Frankincense in the drylands of Eastern Africa. KEFRI, Nairobi

Chikamai, B., Tchatat, M., Ieguhong, J. C. and Ndoye, N. (2008). Forest management for non-wood forest products and services in sub-Saharan Africa. *Discovery and Innovation*, **21**, 50–59.

Chukwuone, N. A. and Okorji, C. E. (2008). Willingness to pay for systematic management of community forests for conservation of non-timber forest products in Nigeria's rainforest region. In: Rob B. Dellink and Arjan Ruijs (eds.) Economics of Poverty, Environment and Natural-Resource Use, pp. 117-137.

Ciccarese, L., Mattsson, A. and Pettenella, D. (2012). Ecosystem services from forest restoration: thinking ahead. *New Forests*, **43(5-6)**, 543-560.

Clement, F. and Amezaga, J. M. (2009). Afforestation and forestry land allocation in northern Vietnam: analyzing the gap between policy intentions and outcomes. *Land Use Policy*, **26(2)**, 458-470.

Clevo, W. and Tisdell, C. (2002). OLS and Tobit Analysis: When is Substitution Defensible Operationally? Economic Theory, Applications and Issues. Working Paper No. 15

Cocksedge, W. (2006). Incorporating non-timber forest products into sustainable resource management: An overview for resource managers. Royal Roads University, Victoria, B.C, p. 320.

Corbera, E., Soberanis, C. G. and Brown, K. (2009). Institutional dimensions of Payments for Ecosystem Services: An analysis of Mexico's carbon forestry programme. *Ecological economics*, **68(3)**, 743-761.

Coulibaly-Lingani, P., Tigabu, M., Savadogo, P., Oden, P. C. and Ouadba, J. M. (2009) Determinants of access to forest products in southern Burkina Faso. *Forest Policy Economics*, **11(7)**, 516-524.

Daneji, M. I. and Suleiman, M. S (2011). Accessibility and Utilization of Agricultural Information among Farmers in Wudil Local Government Area, Kano State. Proceedings of the 36th Annual Conference of the Nigerian Society for Animal Production (NSAP) held at Abuja 13th – 16th March, pp. 652-654.

Das, K. C., Singh, K., Bibens, B., Hilten, R., Baker, S. A., Greene, W. D. and Peterson, J. D. (2011). Pyrolysis characteristics of forest residues obtained from different harvesting methods. *Applied Engineering in Agriculture*, **27(1)**, 107.

Davenport, N. A., Shackleton, C. M. and Gambiza, J. (2012). The direct use value of municipal commonage goods and services to urban households in the Eastern Cape, South Africa. *Land Use Policy*, **29(3)**, 548-557.

De Beer, J. H. and McDermott, M. J. (1989). The economic value of non-timber forest products in Southeast Asia: with emphasis on Indonesia, Malaysia and Thailand. *The economic value of non-timber forest products in Southeast Asia: with emphasis on Indonesia, Malaysia and Thailand*, p. 175.

Díaz, S., Demissew, S., Carabias, J., Joly, C., Lonsdale, M., Ash, N. and Bartuska, A. (2015). The IPBES Conceptual Framework—connecting nature and people. *Current Opinion in Environmental Sustainability*, **14**, 1-16.

Diouf, A. and Lambin, E. F. (2001). Monitoring land-cover changes in semi-arid regions: remote sensing data and field observations in the Ferlo, Senegal. *Journal of Arid Environments*, **48(2)**, 129-148.

Docena, H. (2010). Philippines: Deforestation through mining subsidized by CDM project. *WRM's bulletin No., 161*. http://wrm.org.uy/oldsite/bulletin/161/Philippines.html (Retrieved on 3 January 2015)

Dolisca, F. McDaniel, J. and Teeter, L. (2007). Dolisca Frito, McDaniel, Josh, and Teeter, Lawrence 2007. "Farmers' perception towards forest: A case study from Haiti." *Forest Policy and Economics*, **9(6)**, 704-712.

Dunjó, G., Pardini, G. and Gispert, M. (2003). Land use change effects on abandoned terraced soils in a Mediterranean catchment, NE Spain. *Catena*, **52(1)**, 23-37.

Duong, N. H. (2008). The role of non-timber forest products in livelihood strategies and household economics in a remote upland village in the upper ca River basin Nghe the Phuong. *Journal of science and development*, **1**, 88-98.

Egunjobi L. (2003). NTFPs Utilization in the Forest Region. Centre for Urban and Regional Planning, University of Ibadan Press, p. 120.

Eichler, M., and Albanese, P. (2007). What is household work? A critique of assumptions underlying empirical studies of housework and an alternative approach. *The Canadian Journal of Sociology/Cahiers Canadiens de Sociologie*, 227-258.

Ejidike, B. N. and Ajayi, S. R. (2013). Trends in wildlife conservation practices in Nigeria. *International Journal of Biodiversity and Conservation*, **5(4)**, 185-191.

Ellingson, L. and Seidl, A. (2007). Comparative analysis of non-market valuation techniques for the Eduardo Avaroa Reserve, Bolivia. *Ecological Economics*, **60(3)**, 517-525.

Emerton, L. (1997). Livelihood values and conservation in Mount Kenya Forest. In Earthwatch conference on African Rainforests and the Conservation of Biodiversity, Limbe Botanical Gardens, South West Cameroon.

Emodi, N. V. and Boo, K. J. (2015). Sustainable energy development in Nigeria: Current status and policy options. *Renewable and Sustainable Energy Reviews*, **51**, 356-381.

Endamana, D., Angu, K. A., Akwah, G. N., Shepherd, G. and Ntumwel, B. C. (2016). Contribution of non-timber forest products to cash and non-cash income of remote forest communities in Central Africa. *International Forestry Review*, **18(3)**, 280-295.

Erle, E. and Pontius, R. (2007) Land-use and land-cover change. In: Cleveland, C.J. (ed) Encyclopaedia of earth environmental information. Coalition, Washington

Ezebilo, E. E. and Mattsson, L. (2010). Contribution of non-timber forest products to livelihoods of communities in southeast Nigeria. *International Journal of Sustainable Development & World Ecology*, **17(3)**, 231-235.

Falconer, J. and Koppell, C. R. (1990). The major significance of minor forest products: the local use and value of forests in the West African humid forest zone.

http://agris.fao.org/agris-search/search.do?recordID=XF9545073 (Retrieve on 1 March 2016)

Famuyide, O. O., Adebayo, O., Bolaji-Olutunji, K. A., Awe, F., Owoeye, A. Y., Awodele, D. O. and Adeyemo, A. (2013). Assessment and sustainable management of non-timber forest products used as food and medicine among urban dwellers in Oyo State, Nigeria. *Journal of Horticulture and Forestry*, **5(11)**, 186-193.

FAO (1995). Non Wood Forest Products for Rural Income and Sustainable Forestry. Rome: FAO NWFPs. FAO (1995). http://www.fao.org/docrep/v9480e/v9480e04.htm (Retrieved on 3 April 2015)

FAO (1999). State of the World's Forests 1999. Rome, Italy. http://www.fao.org/docrep/W9950E/W9950E00.htm. (Retrieved on 7 July 2014)

FAO (2000). State of the World's Forests 2000. FAO, Rome, Italy. http://www.fao.org/docrep/004/Y1997E/Y1997E00.HTM. (Retrieved on 7 July 2014)

FAO (2001). Global Forest Resources Assessment 2000. FAO Forestry Paper 140. http://www.fao.org/docrep/004/y1997e/y1997e00.htm (Retrieved on 7 July 2014)

FAO (2005). State of the World's Forests 2005. FAO, Rome, Italy. http://www.fao.org/docrep/008/a0400e/a0400e00.htm (Retrieved on 7 July 2014)

FAO (2006). Better forestry, less poverty: a practitioner's guide. FAO Forestry Paper No. 149, Rome

FAO (2007). State of the World's Forests 2007. FAO, Rome, Italy. https://www.cabdirect.org/cabdirect/abstract/20073257548?start=250 (Retrieved on 7 July 2014)

FAO (2009). State of the World's Forests 2009. FAO, Rome, Italy. http://www.fao.org/3/a-i0350e.pdf (Retrieved on 15 July 2016)

FAO (2010). Global Forest Resources Assessment 2010 Country Report Indonesia Forest Resource Assessment (FRA) 2010/095 (Rome: UNFAO)

FAO (2012). State of the World's Forests 2012. Rome, FAO http://www.fao.org/docrep/016/i3010e/i3010e00.pdf (Retrieved on 15 July 2016)

Federal Government of Nigeria (2001). *First National Biodiversity Report, Garki Abuja.*

Fisher, B., Turner, R. K. and Morling, P. (2009). Defining and classifying ecosystem services for decision making. *Ecological economics*, **68(3)**, 643-653.

Fisher, B., Turner, R. K., Burgess, N. D., Swetnam, R. D., Green, J., Green, R. E. and Marshall, A. R. (2011). Measuring, modeling and mapping ecosystem services in the Eastern Arc Mountains of Tanzania. *Progress in Physical Geography*, **35(5)**, 595-611.

Fisher, M., Chaudhury, M. and Mc-Cusker, B. (2010). Do forests help rural households adapt to climate variability? Evidence from Southern Malawi. *World Development*, **38(9)**, 1241-1250.

Fisher, R.J., Maginnis, S., Jackson, W.J., Barrow, E. and Jeanrenaud, S. (2005) Poverty and conservation: landscapes, people and power. IUCN, Gland, Switzerland, p. 149.

FRN (2010) Fourth National Biodiversity Report to the United Nation. Prospect and Constraints in achieving the goals and target of CBD. https://www.cbd.int/doc/world/ng/ng-nr-04-en.pdf (Retrieved on 15 July 2016)

Gajere, E. N., Mohammed, S. O., Eguaroje, E. O., Shaba, H., Ogbole, J. O., Mangut, Y. S. and Kolawole, I. S. (2013). Spatio-temporal analysis of the national parks in Nigeria using geographic information system. *Ife Journal of Science*, **15(1)**, 159-166.

García-Frapolli, E., Ramos-Fernández, G., Galicia, E. and Serrano, A. (2009). The complex reality of biodiversity conservation through Natural Protected Area policy: Three cases from the Yucatan Peninsula, Mexico. *Land Use Policy*, **26(3)**, 715-722.

Gebremariam, G. G., Edriss, A. K., Maganga, A. M. and Terefe, A. T. (2013). Labor as a Payment Vehicle for Valuing Soil Conservation Practices in a Subsistence Economy: Case of Adwa Woreda in Ethiopia. *American Journal of Economics*, **3(6)**, 283-290.

Golam, R., Karki, M. and Sah, R. P. (2008). The role of non-timber forest products in poverty reduction in India: Prospects and problems. *Development in Practice*, **18(6)**, 779-788.

Green, J. M., Larrosa, C., Burgess, N. D., Balmford, A., Johnston, A., Mbilinyi, B. P., Platts, P.J. and Coad, L. (2013). Deforestation in an African biodiversity hotspot: Extent, variation and the effectiveness of protected areas. *Biological Conservation*, **164**, 62-72.

Greene, S. M., Hammett, A. L. and Kant, S. (2000). Non-timber forest products marketing systems and market players in Southwest Virginia: Crafts, medicinal and herbal, and specialty wood products. *Journal of Sustainable Forestry*, **11(3)**, 19-39.

Greene, W. (2005). Reconsidering heterogeneity in panel data estimators of the stochastic frontier model. *Journal of Econometrics*, **126(2)**, 269-303.

Griffiths, T. and Hirvelä, V. V. (2008). India: Illegal aluminum refinery in Tribal lands in Orissa. WRM's bulletin No. 126, January 2008.

Grimes, A., Loomis, S., Jahnige, P., Burnham, M., Onthank, K., Alarcón, R. and Bennett, B. (1994). Valuing the rain forest: the economic value of nontimber forest products in Ecuador. *Ambio*, **23 (7)**, 405-410.

Gujarati, D. (2004**).** Basic Econometrics. United States Military Academy, West Point, p. 1024.

Gujarati, D. N. (2007). Basic Econometrics. Tata McGraw Hill Publishing Company Limited, New Delhi, pp. 451-452.

Gunatilake, H. M. (1998). The role of rural development in protecting tropical rainforests: evidence from Sri Lanka. *Journal of Environmental management*, **53(3)**, 273-292.

Gunatilake, H., Yang, J. C., Pattanayak, S. and Van den Berg, C. (2006). Willingness-to-pay and design of water supply and sanitation projects: a case study. https://think-asia.org/bitstream/handle/11540/2279/tn19willingnesspaywatersupply.pdf?sequence=1 (Retrieved on 7 July 2014)

Guruswamy, L. D. (1999). The Convention on Biological Diversity: exposing the flawed foundations. *Environmental conservation*, **26(02)**, 79-82.

Haj Tahir, M. E., Kääb, A. and Xu, C. Y. (2010). Identification and mapping of soil erosion areas in the Blue Nile, Eastern Sudan using multispectral ASTER and MODIS satellite data and the SRTM elevation model. *Hydrology and Earth System Sciences*, **14(7)**, 1167-1178.

Halstead, J. M., Lindsay, B. E. and Brown, C. M. (1991). Use of the Tobit model in contingent valuation: experimental evidence from the Pemigewasset Wilderness Area. *Journal of Environmental Management*, **33(1)**, 79-89.

Hanemann, W. M. (1984). Discrete/continuous models of consumer demand. *Econometrica: Journal of the Econometric Society*, **52(3)**, 541-561.

Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A., Tyukavina, A., Thau, D., Stehman, S. V., Goetz, S. J., Loveland, T. R. and Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. *Science*, **342(6160)**, 850-853.

Hardin, G. (1968). Abortion. Or Compulsory Pregnancy? *Journal of Marriage and the Family*, 246-251.

Hayter, A.J. (1986). The maximum familywise error rate of Fisher's least significant difference test. *Journal of the American Statistical Association*, **81**, 1001-1004.

Hegde, R. and Enters, T. (2000). Forest products and household economy: a case study from Mudumalai Wildlife Sanctuary, Southern India. *Environmental Conservation*, **27(3)**, 250–259.

Hein, L., Van Koppen, K., De Groot, R. S. and Van Ierland, E. C. (2006). Spatial scales, stakeholders and the valuation of ecosystem services. *Ecological economics*, **57(2)**, 209-228.

Heistermann, M., Müller, C. and Ronneberger, K. (2006). Land in sight? Achievements, deficits and potentials of continental to global scale land-use modeling. *Agriculture, Ecosystems & Environment*, **114(2)**, 141-158.

Hooker, S. K., Cañadas, A., Hyrenbach, K. D., Corrigan, C., Polovina, J. J. and Reeves, R. R. (2011). Making protected area networks effective for marine top predators. *Endangered Species Research*, **13(3)**, 203-218.

Hoskins, M. (1990). The contribution of forestry to food security. *Unasylva*, **41(1)**, 3-13.

Huxham, M., Emerton, L., Kairo, J., Munyi, F., Abdirizak, H., Muriuki, T. and Briers, R. A. (2015). Applying Climate Compatible Development and economic valuation to coastal management: A case study of Kenya's mangrove forests. *Journal of environmental management*, **157**, 168-181.

Islam, M. A., Rai, R. and Quli, S. M. S. (2015). Forest Resources Use for Building Livelihood Resilience in Ethnic Communities of Jharkhand. *Trends in Biosciences*, **8(5)**, 1256-1264.

IUCN (2004). *Collaborative Management Working Group (CMWG) and Theme Indigenous and Local Communities, Equity and Protected Areas (TILCEPA).* Governance of natural resources - the key to a just world that values and conserves nature? CENESTA, Tehran, Iran.

IUCN (2010). *Biodiversity Management Systems: Proposal for the Integrated Management of Biodiversity at Holcim Sites. Gland Switzerland: IUCN.* http://cmsdata.iucn.org/biodiversity_management_system. (Retrieved on 13 August 2014)

Jimoh, S. O., Amusa, T. O. and Azeez, I. O. (2013). Population distribution and threats to sustainable management of selected non-timber forest products in tropical lowland rainforests of south western Nigeria. *Journal of forestry research*, **24(1)**, 75-82.

Jimoh, S.O. and Azeez, I.O. (2002). Prospects of community participation in the management of shasha forest reserve, Osun State, Nigeria, in: J.E. Abu, P.I. Oni, L. Popoola, (Eds.), in: Proceedings of the 28th Annual Conference of Forestry Association of Nigeria, Akure, 2002. Forestry and Challenges of Sustainable Livelihood, pp. 208-216.

Jimoh, S.O. and Haruna, E.A. (2007). Contributions of non-timber forest products to household food security and income around Onigambari forest reserve, Oyo State, *Nigeria. Journal of Environmental Extension*, **6**, 28−33.

Kaale, B. K., Ndilanha, A. E., Songela, F. and Abdi, H. (2000). *Fuel Wood and Charcoal Uses with Possible Alternative Energy Sources in Ikwiriri Township and Mbuju Mvuleni Village, Rufiji District.* REMP Technical Report No. 4. Dar es Salaam, Tanzania. 86p.

Kabubo-Mariara, J. and Gachoki, C. (2008). Forest Dependence and Household Welfare: Empirical Evidence from Kenya. CEEPA Discussion Paper No. p. 43.

Karira, W. J., Mburu, J. I. and Guthiga, P. M. (2013). Empirical Analysis of the Environmental Benefits of Compliance with GLOBALGAP Standards among Smallholder Farmers in Eastern and Central Kenya: An Environmental Valuation Approach. In *Invited paper presented at the 4th International Conference of the African Association of Agricultural Economists*, p. 19.

Katila, P., Galloway, G., Alfaro, R. I., Kanninen, M., Lobovikov, M. and Varjo, J. (2010). Forests and society-responding to global drivers of change. Vienna: IUFRO, p. 509.

Keenan, R. J., Reams, G. A., Achard, F., de Freitas, J. V., Grainger, A. and Lindquist, E. (2015). Dynamics of global forest area: results from the FAO Global Forest Resources Assessment 2015. *Forest Ecology and Management*, **352**, 9-20.

Kengen, S. (1997). Forest valuation for decision-making. Lessons of experience and proposals for improvement. Rome: Food and Agriculture Organization of the U.N. http://www.fao.org/3/a-w3641e.pdf (Retrieved on 3 April 2014)

Kessy, J. F., Nsokko, E., Kaswamila, A. and Kimaro, F. (2016). Analysis of Drivers and Agents of Deforestation and Forest Degradation in Masito Forests, Kigoma, Tanzania. *International Journal of Asian Social Science*, **6(2)**, 93-107.

Khosravi, M. and Sabouhi, M. (2011). Estimating conservation value of tamarisk in Fahliyan river bank using by contingent valuation method. *Journal of Environmental Science* **4**, 73–82

Kideghesho, J. R., Nyahongo, J. W., Hassan, S. N., Tarimo, T. C. and Mbije, N. E. (2006). Factors and ecological impacts of wildlife habitat destruction in the Serengeti ecosystem in northern Tanzania. *African Journal of Environmental Assessment and Management*, **11**, 17-32.

Kilonzo, M. (2009). Valuation of Non-timber forest products used by communities around Nyanganje forest reserve, Morogoro, T anzania. Unpublished Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, p. 85.

Kio, P. R. O. and Abu, J. E. (1992). Land allocation: the Nigerian experience. In *Forests, a Growing Concern: Proceedings of the XIXth International Forestry Students*, p. 56.

KNARDA (2006). Mission, vision and achievements of the special mass food production programme, Kano State. Kano state Ministry of agriculture and rural development publication No. 31, pp. 2-10.

KNARDA (2015). Farmers Pastoralists Conflicts in Kano State and Future of Falgore Game Reserve. Kano State. Kano state Ministry of agriculture and rural development monthly Bulletin No. 51, pp. 21-30.

Koenig, J., Altman, J. and Griffiths, A.D., (2011). Artists as harvesters: natural resource use by indigenous wood carvers in Central Arnhem Land, Australia. *Human Ecology* **39**, 407–419.

Kothari, C. R. and Garg, G. (2014). Research Methodology. Methods and Techniques. New Age International Publishers. New Delhi-110002.

Koutsoyiannis, D., & Foufoula-Georgiou, E. (1993). A scaling model of a storm hyetograph. *Water Resources Research*, **29(7)**, 2345-2361.

Koziell, I. and Saunders J. (2001). Living off Biodiversity: Exploring Livelihoods and Biodiversity. IIED, London, p. 275.

Kusters, K., Achdiawan, R., Belcher, B. and Ruiz Pérez, M. (2006). Balancing development and conservation? An assessment of livelihood and environmental outcomes of nontimber forest product trade in Asia, Africa, and Latin America. *Ecology and Society*, **11(2)**, 22.

Lambin, E. F., Goyvaerts, K. and Petit, C. (2003). Remotely-sensed indicators of burning efficiency of savannah and forest fires. *International Journal of Remote Sensing*, **24(15)**, 3105-3118.

Laurin, G. V., Liesenberg, V., Chen, Q., Guerriero, L., Del Frate, F., Bartolini, A. and Valentini, R. (2013). Optical and SAR sensor synergies for forest and land cover mapping in a tropical site in West Africa. *International Journal of Applied Earth Observation and Geoinformation*, **21**, 7-16.

Lawes, M. J., Macfarlane, D. M., & Eeley, H. A. (2004). Forest landscape pattern in the KwaZulu–Natal midlands, South Africa: 50 years of change or stasis?. *Austral Ecology*, **29(6)**, 613-623.

Leibenstein, H. (1957). The theory of underdevelopment in backward economies. *Journal of Political Economy*, **65**: 91–103.

Leisher, C., Sanjayan, M., Blockhus, J., Larsen, N., & Kontoleon, A. (2012). Does conserving biodiversity work to reduce poverty? A state of knowledge review. *Biodiversity conservation and poverty alleviation: Exploring the evidence for a link*, pp. 143-159.

Lepers, E., Lambin, E. F., Janetos, A. C., DeFries, R., Achard, F., Ramankutty, N. and Scholes, R. J. (2005). A synthesis of information on rapid land-cover change for the period 1981–2000. *BioScience*, **55(2)**, 115-124.

Lescuyer, G. (1996). Monetary valuation of the non-timber forest products (NTFPs): Does it contribute to determine a sustainable management of those resources. In 6th International Conference of the Association for the Study of the Common Property (IASCP), Berkeley, pp. 5-8.

Lette, H. and De Boo, H. (2002). Economic valuation of forests and nature: a support tool for effective decision making (No. 6). International Agricultural Centre, p. 69.

Liu, Y., Fu, B., Lü, Y., Wang, Z. and Gao, G. (2012). Hydrological responses and soil erosion potential of abandoned cropland in the Loess Plateau, China. *Geomorphology*, **138(1)**, 404-414.

Loaiza, T., Nehren, U. and Gerold, G. (2015). REDD+ and incentives: An analysis of income generation in forest-dependent communities of the Yasuní Biosphere Reserve, Ecuador. *Applied Geography*, **62**, 225-236.

Lu, D., Moran, E. and Batistella, M. (2003). Linear mixture model applied to Amazonian vegetation classification. *Remote sensing of environment*, **87(4)**, 456-469.

Luenberger, D. G. (1979). Introduction to dynamic systems theory, models, and applications. New York: Wiley Publishers.

Lulekal, E., Kelbessa, E., Bekele, T. and Yineger, H. (2008). An ethnobotanical study of medicinal plants in Mana Angetu District, Southeastern Ethiopia. *Journal of ethnobiology and Ethnomedicine*, **4(1)**, 4-10.

Lykke, A. M., Kristensen, M. K. and Ganaba, S. (2004). Valuation of local use and dynamics of 56 woody species in the Sahel. *Biodiversity & Conservation*, **13(10)**, 1961-1990.

Maddala, G. S. (1983). Limited Dependent and Qualitative Variables in Econometrics, Cambridge University Press, Cambridge, p. 403.

Madumere, A. J. (2000). Environmental programme as indispensable tool for enriching public environmental education in Nigeria. In: Akale, M.A.G., (Ed.), Proceeding of 41st Annual Conference of Science and Teaching Association, pp. 188-190.

Mahapatra, A. K. and Tewari, D. D. (2005). Importance of non-timber forest products in the economic valuation of dry deciduous forests of India. *Forest Policy and Economics*, **7(3)**, 455-467.

Malleson, R., Asaha, S., Egot, M., Kshatriya, M., Marshall, E., Obeng-Okrah, K. and Sunderland, T. (2014). Non-timber forest products income from forest landscapes of Cameroon, Ghana and Nigeria–an incidental or integral contribution to sustaining rural livelihoods? *International Forestry Review*, **16(3)**, 261-277.

Margoluis, R., Stem, C., Salafsky, N. and Brown, M. (2009). Design alternatives for evaluating the impact of conservation projects. *New directions for evaluation*, **2009(122)**, 85-96.

Margoluis, R., Tem, S. C., Salafsky, N. and Brown, M. (2008). Using conceptual models as a planning and evaluation tool in conservation. *Evaluation and Program Planning*, **32**, 138–147

Masozera, M. K. and Alavalapati, J. R. R. (2004). Forest dependency and its implication for protected areas management: A case study from Nyungwe Forest Reserve, Rwanda. *Scand. Journal of Forest Resource* **19(4)**, 85–92.

Mayes, M. T., Mustard, J. F. and Melillo, J. M. (2015). Forest cover change in Miombo Woodlands: modeling land cover of African dry tropical forests with linear spectral mixture analysis. *Remote Sensing of Environment*, **165**, 203-215.

May-Tobin, C. (2011). Wood for fuel. In: Boucher, D., Elias, P., Lininger, K., May-Tobin, C., Roquemore, S., Saxon, E. (Eds.), The Root of the Problem: What's Driving Tropical Deforestation Today? Union of Concerned Scientists, USA, pp. 79–87.

Mbau, J. S. (2013). An analysis of human-wildlife conflicts in tsavo west-amboseli agro-ecosystem using an integrated geospatial approach: a case study of taveta district (Doctoral dissertation, University of Nairobi), pp. 207.

Mbuvi, D., and Boon, E. (2009). The livelihood potential of non-wood forest products: The case of Mbooni Division in Makueni District, Kenya. *Environment, Development and sustainability*, **11(5)**, 989-1004.

MEA (2005). Ecosystems and human well-being: synthesis. Island, Washington, *DC*.http://www.millenniumassessment.org/documents/document.356.aspx.pdf (Retrieved on 8 July 2014)

Meduna, A. J., Ogunjinmi, A. A. and Onadeko, S. A. (2009). Biodiversity Conservation Problems and their Implications on Ecotourism in Kainji Lake National Park, Nigeria. *Journal of Sustainable Development in Africa* **(10)4**, 59-73.

Meijaard, E., Abram, N. K., Wells, J. A., Pellier, A. S. and Ancrenaz, M. (2013). People's perceptions about the importance of forests on Borneo. *Plos One* **8(9)**, 73008.

Melillo, J. M., Steudler, P. A., Aber, J. D., Newkirk, K., Lux, H., Bowles, F. P., Catricala, C. Magill, A., Ahrens, T. and Morrisseau, S. (2002). Soil warming and carbon-cycle feedbacks to the climate system. *Science*, **298(5601)**, 2173-2176.

Mengistu, D. A. and Salami, A. T. (2007). Application of remote sensing and GIS inland use/land cover mapping and change detection in a part of south western Nigeria. *African Journal of Environmental Science and Technology*, **1(5)**, 99-109.

Meyfroidt, P. and Lambin, E. F. (2008). The causes of the reforestation in Vietnam. *Land use policy*, ***25*(2)**, 182-197.

Mhapa, P. I. (2011). "Trade of non-timber forest products and its contribution to the livelihood in Njombe District, Tanzania." PhD dissertation., Sokoine University of Agriculture (SUA), p. 112.

Mohammed, S. O., Gajere, E. N., Eguaroje, E. O., Shaba, H., Ogbole, J. O., Mangut, Y. S. and Kolawole, I. S. (2010). Spatio-temporal analysis of the national parks in Nigeria using geographic information system. *Ife Journal of Science*, **15(1)**, 159-166.

Molaei, M. and Kavoosi, K. M. (2011). Estimating the preservation value of Lilium ledebourii using single bounded dichotomous choice contingent valuation method. *Journal of Agricultural Economics and Development***, 25**,322–329.

Mongaka, H., Simon, G., Emarton, E. and Karanja, F. (2001). Economic Aspect of Community Involvement in Sustainable Forest Management in Eastern and Southern Africa Report. Forest and social in perspectives conservation report No. 8. IUCN Eastern Africa. p. 157.

Montgomery, M. R. (2008). The urban transformation of the developing world. *Science*, **319(5864)**, 761-764.

Muchapodwa, E. (2003). The Economics of Community-Based Wildlife Conservation in Zimbabwe. Ph.D Thesis, Department of Economics. Göteborg University Sweden and University of Zimbabwe Harare.

Mulenga, B. P., Richardson, R. B., Mapemba, L. D. and Tembo, G. (2011).The contribution of non-timber forest products to rural household income in Zambia. A paper (No. 109887) to presented to the Department of Agricultural, Food, and Resource Economics. Michigan State University.

Musa, S.A., Mustapha, A. and Suleiman, A. (2012). Socio-Economic Characteristics of Rice Value Chain Actors in Kano State, Nigeria, in: Jibrin, J. M., Hussaini, M. A., and Auwalu, B. M (Eds.), Agricultural transformation in deregulated economy: prospects and challenges. *Proceedings of the 46th annual conference of the agricultural society of Nigeria*, pp. 191-196.

Mustapha, A. (2012). Economic Analysis of Rice Value Chain in Kano State, Nigeria: PhD. Thesis BUK Nigeria p. 280.

Mwita, E., Menz, G., Misana, S., Becker, M., Kisanga, D. and Boehme, B. (2013). Mapping small wetlands of Kenya and Tanzania using remote sensing techniques. *International Journal of Applied Earth Observation and Geoinformation*, **21**, 173-183.

Nasi, R. and Frost, P. (2009). Sustainable forest management in the tropics: is everything in order but the patient still dying? *Ecology and Society*, **14(2)**.

Ndoye, O., Pérez, M. R. and Eyebe, A. (2016). The markets of non-timber forest products in the humid forest zone of Cameroon. London, UK: Overseas Development Institute, p. 25.

Nepstad, D., Carvalho, G., Barros, A. C., Alencar, A., Capobianco, J. P., Bishop, J. and Prins, E. (2001). Road paving, fire regime feedbacks, and the future of Amazon forests. *Forest ecology and management*, **154(3)**, 395-407.

Nepstad, D., McGrath, D., Stickler, C., Alencar, A., Azevedo, A., Swette, B. and Armijo, E. (2014). Slowing Amazon deforestation through public policy and interventions in beef and soy supply chains. *Science*, **344(6188)**, 1118-1123.

Newton, P., Miller, D. C., Byenkya, M. A. A. and Agrawal, A. (2016). Who are forest-dependent people? A taxonomy to aid livelihood and land use decision-making in forested regions. *Land Use Policy*, **57**, 388-395.

Ngalim, O.Y. (2011). Revenue components and conflicts in the use of natural resources in the peripheral zone Northeast of Korup National Park. Unpublished Master's thesis, Department of Forestry, The University of Dschang, Cameroon. P. 93.

Nouhoheflin, T., Coulibaly, O., Andy, J., Cherry, A. H. and Patrice, Y. (2004). 'Consumers. In Perception and Willingness to Pay for Organic Vegetable in Benin and Ghana. Shaping the Future of African Agriculture for Development: The Role of Social Scientists''. Proceedings of the Inaugural Symposium (Vol. 6), p. 67.

Nweze, N. J. and Igbokwe, E. M. (2000) Non timber forest products in the rural economies of southeastern Nigeria. *Journal of Non-timber Forest Products*, **7(3/4)**, 145–155.

Ogunsawa, O. Y. and Ajala, O. O. (2002). Firewood crises in Lagos- implication on the suburban and rural ecosysyem management. In: JE Abu, PO Oni, L Popoola (eds). Proceeding of the 28th annual conference of Forestry Association of Nigeria at Akure, Ondo State. Nov. 4th – 8th. pp. 257-264.

Ojea, E., Loureiro, M.L., Alló, M. and Barrio, M., (2016). Ecosystem services and REDD: estimating the benefits of non-carbon services in worldwide forests. *World Development*. **78**, 246–261.

Ojo, J. A. (2007). Financial Sector Maladaptation, Resource Curse and Nigeria's Development Dilemma. *Public Lecture Series*, **9**, 2-79.

Ojo, L.O. (2004). The fate of a tropical rainforest in Nigeria: Abeokuta Sector of Omo Forest Reserve. *Global Nest*: *the International Journal*, **6(2)**, 116−130.

Ojo, O. J. and Akande, S. O. (2003). Facies relationships and depositional environments of the Upper Cretaceous Lokoja Formation in the Bida Basin, Nigeria. *Journal of Mining and Geology*, **39(1),** 20-37.

Okafor, J. C., Omorodion, F. I. and Amaza, P. S. (1994). Non-Timber Forest Products, Nigeria. Unpublished report prepared for the Tropical forests Action plan, FORMECU, Federal Department of forestry (FDF), Abuja, Nigeria, p. 189.

Olofin, E. A. (2000). 'Environmental Hazards and Sustainable Development in Northern Nigeria' in Issues in Land Administration and Development in Northern Nigeria,

Falola, J. A; Ahmed, K; Liman, M. A; Maiwada, A. (Eds.) Department of Geography, Bayero University, Kano, Nigeria pp 207-220.

Oluwalana, S. A. and Momoh, S. (2015). Economic Valuation of Medicinal Plants Used for Traditional Treatment of Diabetes in Benue State, Nigeria. *International Journal of Forestry and Horticulture*, **1(2)**, 1-31.

Onojeghuo, A. O. and Blackburn, G. A. (2011). Forest transition in an ecologically important region: patterns and causes for landscape dynamics in the Niger Delta. *Ecological Indicators*, **11(5)**, 1437-1446.

Onuche, P. (2011). Non-Timber Forest Products: A Pathway for Rural Poverty Reduction in Nigeria. *International Journal of Economic Development Research and Investment*, **2(2)**, 28-37.

Ormsby, A. and Kaplin, B. A. (2005). A framework for understanding community resident perceptions of Masoala National Park, Madagascar. *Environmental Conservation*, **32(02)**, 156-164.

Osborne, J. W. (2003). Effect sizes and the disattenuation of correlation and regression coefficients: lessons from educational psychology. *Practical Assessment, Research & Evaluation*, **8(11)**, 1-5.

Osemeobo, G. J. (1991). Effects of common property resource utilization on wildlife conservation in Nigeria. *GeoJournal*, **23(3)**, 241-248.

Oseni, J. O. (2007). Ensuring peaceful coexistence between man and animal in protected areas in Nigeria. *Available on line at http://peaceparks2007. whsites. net/papers/osenii peaceful.(*Accessed on May 2015*)*.

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge: Cambridge University Press, Cambridge.

Overmars, K. P. and Verburg, P. H. (2005). Analysis of land use drivers at the watershed and household level: Linking two paradigms at the Philippine forest fringe. *International Journal of Geographical information science*, **19(2)**, 125-152.

Pascual, U., Muradian, R., Brander, L., Gómez-Baggethun, E., Martín-López, B., Verma, M. and Farley, J. (2010). The economics of valuing ecosystem services and biodiversity p. 368.

Paumgarten, F. (2005). The role of non-timber forest products as safety-nets: a review of evidence with a focus on South Africa. *Geo Journal*, **64(3)**, 189-197.

Pearce, D. W. (2001). The economic value of forest ecosystems. *Ecosystem health*, **7(4)**, 284-296.

Pearce, D. W. and Turner, R. K. (1990). *Economics of natural resources and the environment*. JHU Press p. 378.

Pearce, D. W., Markandya, A. and Barbier, E. (1989). *Blueprint for a green economy* (Vol. 1). Earthscan, p. 13.

Peluso, N. L. (1995). Whose woods are these? Counter-mapping forest territories in Kalimantan, Indonesia. *Antipode*, **27(4)**, 383-406.

Pérez, C., Jones, E. M., Kristjanson, P., Cramer, L., Thornton, P. K., Förch, W. and Barahona, C. (2015). How resilient are farming households and communities to a changing climate in Africa? A gender-based perspective. *Global Environmental Change*, **34**, 95-107.

Peters, C. M. (1994). Sustainable harvest of non-timber plant resources in tropical moist forest: an ecological primer. https://www.researchgate.net/profile/C_Peters/publication/238066719_Sustainable_Harvest_of_Non-timber_Plant_Resources_in_Tropical_Moist_Forest_An_Ecological_Primer/links/00b7d539df5f538a1f000000/Sustainable-Harvest-of-Non-timber-Plant-Resources-in-Tropical-Moist-Forest-An-Ecological-Primer.pdf (Retrieved on 11 May 2015)

Peters, C. M., Gentry, A. H. and Mendelsohn, R. (1989). Valuation of a tropical forest in Peruvian Amazonia. *Nature*, **339**, 655-657.

Pettorelli, N., Chauvenet, A. L., Duffy, J. P., Cornforth, W. A., Meillere, A. and Baillie, J. E. (2012). Tracking the effect of climate change on ecosystem functioning using protected areas: Africa as a case study. *Ecological Indicators*, **20**, 269-276.

Pimentel, D., McNair, M., Buck, L., Pimentel, M. and Kamil, J. (1997), 'The value of forests to world food security', *Human Ecology*, **25(1)**, 91-120.

Polasky, S., Nelson, E., Camm, J., Csuti, B., Fackler, P., Lonsdorf, E. and Haight, R. (2008). Where to put things? Spatial land management to sustain biodiversity and economic returns. *Biological conservation*, **141(6)**, 1505-1524.

Pontius Jr, R. G. and Malizia, N. R. (2004). Effect of category aggregation on map comparison. In *International Conference on Geographic Information Science*. Springer Berlin Heidelberg, 251-268Pp.

Pontius, R. G., Boersma, W., Castella, J. C., Clarke, K., de Nijs, T., Dietzel, C. and Koomen, E. (2008). Comparing the input, output, and validation maps for several models of land change. *The Annals of Regional Science*, **42(1)**, 11-37.

Potter, C., Klooster, S., Huete, A. and Genovese, V. (2007). Terrestrial carbon sinks for the United States predicted from MODIS satellite data and ecosystem modelling. *Earth Interactions*, **11(13)**, 1-21.

Pretty, J. and Smith, D. (2004). Social capital in biodiversity conservation and management. *Conservation Biology*, **18(3)**, 631-638.

Radeloff, V. C., Nelson, E., Plantinga, A. J., Lewis, D. J., Helmers, D., Lawler, J. J. and Lonsdorf, E. (2012). Economic-based projections of future land use in the conterminous United States under alternative policy scenarios. *Ecological Applications*, **22(3)**, 1036-1049.

Ransome-Kuti, O. (1991). Introductory Remarks." In Children's Vaccine Initiative. Report of the First Meeting of the Consultative Group, Geneva (December 16-17). *WHO*, ***106*(91)**, 15-16.

Redo, D., Bass, J. J. and Millington, A. C. (2009). Forest dynamics and the importance of place in western Honduras. *Applied Geography*, **29(1)**, 91-110.

Reynisdottir, M., Song, H. and Agrusa, J. (2008). Willingness to pay entrance fees to natural attractions: An Icelandic case study. *Tourism Management*, **29(6)**, 1076-1083.

Rigina, O., (2003). Detection of boreal forest decline with high-resolution panchromatic satellite imagery. *International Journal of Remote Sensing***, 24**, 1895–1912.

Robertson, J. and Lawes, M. J. (2005). User perceptions of conservation and participatory management of iGxalingenwa forest, South Africa. *Environmental Conservation*, **32(01)**, 64-75.

Rodrigues, R. R., Gandolfi, S., Nave, A. G., Aronson, J., Barreto, T. E., Vidal, C. Y. and Brancalion, P.H.S. (2011). Large-scale ecological restoration of high diversity tropical forests in SE Brazil. *Forest Ecology Management*, **261**, 1605–1613.

Rodríguez-Vicente, V. and Marey-Pérez, M. F. (2009). Land-use and land-base patterns in non-industrial private forests: Factors affecting forest management in Northern Spain. *Forest Policy and Economics*, **11(7)**, 475-490.

Sakai, S., Choy, Y. K., Kishimoto-Yamada, K., Takano, K. T., Ichikawa, M., Samejima, H. and Nakashizuka, T. (2016). Social and ecological factors associated with the use of non-timber forest products by people in rural Borneo. *Biological Conservation*, **204**, 340-349.

Sands, P. and Peel, J. (2012). Principles of international environmental law. Cambridge University Press, p. 30.

Satake, A. and Rudel, T. K. (2007). Modeling the forest transition: forest scarcity and ecosystem service hypotheses. *Ecological Applications*, **17(7)**, 2024-2036.

Schaafsma, M, Morse-Jones, S., Posen, P., Swetnam, R. D., Balmford, A., Bateman, I. J. and Geofrey, V. (2014). The importance of local forest benefits: Economic valuation of Non-Timber Forest Products in the Eastern Arc Mountains in Tanzania. *Global Environmental Change*, **24**, 295-305.

Schumann, K., Wittig, R., Thiombiano, A., Becker, U. and Hahn, K. (2011). Impact of land-use type and harvesting on population structure of a non-timber forest product-providing tree in a semi-arid savanna, West Africa. *Biological conservation*, **144(9)**, 2369-2376.

Seller, C., Stoll, J. R. and Chavas, J. P. (1985). Validation of empirical measures of welfare change: a comparison of nonmarket techniques. *Land economics*, **61(2)**, 156-175.

Selten, R., & Stoecker, R. (1986). End behavior in sequences of finite Prisoner's Dilemma supergames A learning theory approach. *Journal of Economic Behavior & Organization*, **7(1)**, 47-70.

Sesabo J. K., Lang, H. and Tol, R. S. J. (2006). Perceived Attitude and Marine Protected Areas (MPAs) establishment: Why households' characteristics matters in Coastal resources conservation initiatives in Tanzania. https://www.researchgate.net/publication/24130214 (Retrieved on 9 May 2014).

Shackleton, C. and Shackleton, S. (2004). The importance of non-timber forest products in rural livelihood security and as safety nets: a review of evidence from South Africa. *South African Journal of Science*, **100(11-12)**, 658-664.

Shackleton, C. M., Shackleton, S. E., Buiten, E. and Bird, N. (2007). The importance of dry woodlands and forests in rural livelihoods and poverty alleviation in South Africa, *Forest Policy and Economics*, **9(5)**, 558-77.

Shackleton, R., Shackleton, C., Shackleton, S. and Gambiza, J. (2013). Deagrarianisation and forest revegetation in a biodiversity hotspot on the Wild Coast, South Africa. *PloS one*, **8(10)**, e76939.

Shackleton, S., Delang, C. O. and Angelsen, A. (2011). From subsistence to safety nets and cash income: exploring the diverse values of non-timber forest products for livelihoods and poverty alleviation. In: *Non-timber forest products in the global context*. Springer Berlin Heidelberg, pp. 55-81.

Shalaby, A. A., Ali, R. R. and Gad, A. (2012). Urban sprawl impact assessment on the agricultural land in Egypt using remote sensing and GIS: a case study, Qalubiya Governorate. *Journal of Land Use Science*, **7(3)**, 261-273.

Shanley, P., Pierce, A. R., Laird, S. A., López Binnqüist, C. and Guariguata, M. R. (2015). From Lifelines to Livelihoods: Non-timber Forest Products into the Twenty-First Century. *Tropical Forestry Handbook. Berlin Heidelberg: Springer-Verlag*, pp. 1-50.

Sheil, D. and Wunder, S. (2002). The value of tropical forest to local communities: complications, caveats, and cautions. *Conservation Ecology*, **6(2)**, 9.

Shibia, M. G. (2010). Determinants of attitudes and perceptions on resource use and management of Marsabit National Reserve, Kenya. Journal of Human Ecology **30(1)**, 55–62.

Shiva, M. P. and Verma, S. K. (2002). Approaches to sustainable forest management and biodiversity conservation: With pivotal role of non-timber forest products. http://agris.fao.org/agris-search/search.do?recordID=XF2015021699 (Retrieved on 6 February 2015)

Sonwa, D. J., Okafor, J. C., Buyungu, P. M., Weise, S. F., Tchatat, M., Adesina, A. A. and Endamana, D. (2002). Dacryodes edulis, a neglected non-timber forest species for the agroforestry systems of West and Central Africa. *Forests, Trees and Livelihoods*, **12(1-2)**, 41-55.

Stainback, G. A., Masozera, M., Mukuralinda, A. and Dwivedi, P. (2012). Smallholder agroforestry in Rwanda: a SWOT-AHP analysis. *Small-scale Forestry*, **11(3)**, 285-300.

Steele, M. Z., Shackleton, C. M., Shaanker, R. U., Ganeshaiah, K. N. and Radloff, S. (2015). The influence of livelihood dependency, local ecological knowledge and market proximity on the ecological impacts of harvesting non-timber forest products. *Forest Policy and Economics*, **50**, 285-291.

Strazzera, E., Genius, M., Scarpa, R. and Hutchinson, G. (2003). The effect of protest votes on the estimates of WTP for use values of recreational sites. *Environmental and resource economics*, **25(4)**, 461-476.

Sunderlin, W. D., Angelsen, A., Belcher, B., Burgers, P., Nasi, R., Santoso, L. and Wunder, S. (2005). Livelihoods, forests, and conservation in developing countries: an overview. *World development*, **33(9)**, 1383-1402.

Sundriyal, M., Sundriyal, R. C. and Sharma, E. (2004). Dietary use of wild plant resources in the Sikkim Himalaya, India. *Economic Botany*, **58(4)**, 626-638.

Tao, Z., Yan, H. and Zhan, J. (2012). Economic valuation of forest ecosystem services in Heshui watershed using contingent valuation method. *Procedia Environmental Sciences*, **13**, 2445-2450.

Taruvinga, A. and Mushunje, A. (2010). Socio-economic factors that influence households` participation in wetland cultivation: a binary logistic regression of wetland cultivators and non-cultivators Paper presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa, September 2010. pp. 19-23.

Te Velde, D. W., Rushton, J., Schreckenberg, K., Marshall, E., Edouard, F., Newton, A. and Arancibia, E. (2006). Entrepreneurship in value chains of non-timber forest products. *Forest Policy and Economics*, **8(7)**, 725-741.

Tewolde, M. G. and Cabral, P. (2011). Urban sprawl analysis and modeling in Asmara, Eritrea. *Remote Sensing*, **3(10)**, 2148-2165.

Timko, J. A., Waeber, P. O. and Kozak, R. A. (2010). The socio-economic contribution of non-timber forest products to rural livelihoods in Sub-Saharan Africa: knowledge gaps and new directions. *International forestry review*, **12(3)**, 284-294.

Tong, X., Brandt, M., Hiernaux, P., Herrmann, S. M., Tian, F., Prishchepov, A. V. and Fensholt, R. (2017). Revisiting the coupling between NDVI trends and cropland changes in the Sahel drylands: A case study in western Niger. *Remote Sensing of Environment*, **191**, 286-296.

Tsegaye, D., Moe, S. R., Vedeld, P. and Aynekulu, E. (2010). Land-use/cover dynamics in Northern Afar rangelands, Ethiopia. *Agriculture, ecosystems & environment*, **139(1)**, 174-180.

Tudunwada, I. Y. (2012).Vegetation change detection due to anthropogenic activities in Falgore Game Reserve, Kano, Nigeria, using GIS and Remote Sensing The International Conference Geotunis 6th Session 26th – 30th March 2012, p. 11.

Turner, R. K., Morse-Jones, S. and Fisher, B. (2010). Ecosystem valuation. *Annals of the New York Academy of Sciences*, **1185(1)**, 79-101.

UNFCCC, (2007). Report on the Second Workshop on Reducing Emissions from Deforestation in Developing Countries, Cairns, Australia, 7 to 9 March 2007 (FCCC/SBSTA/2007/3, UNFCCC, Bonn, Germany, 2007); http://unfccc.int/resource/docs/2007/sbsta/eng/03.pdf. (Retrieved on 9 May 2014)

UNPP (2004). Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2002 Revision and World

Urbanization Prospects: The 2001 Revision. http://esa.un.org/unpp. (Retrieved on 11 May 2015)

Uprety, Y., Boon, E. K., Poudel, R. C., Shrestha, K. K., Rajbhandary, S., Ahenkan, A. and Tiwari, N. N. (2010). Non-timber forest products in Bardiya district of Nepal: Indigenous use, trade and conservation. *Journal of Human Ecology*, **30(3)**, 143-158.

USAID/Nigeria. (2008). Nigeria Biodiversity and Tropical forestry assessment: Maximizing Agricultural Revenue in Key Enterprises (Markets). Chemonics International Inc 461p.

USGS (2015). Land-use and land cover maps archives. (http://glovis.usgs.gov/index.shtml) (Retrieved on 8 April 2016)

Usman, B. A. and Adefalu, L. L. (2010). Nigerian forestry, wildlife and protected areas: Status report. *Biodiversity*, **11 (3-4)**, 54-62.

Uusiku, N. P., Oelofse, A., Duodu, K. G., Bester, M. J. and Faber, M. (2010). Nutritional value of leafy vegetables of sub-Saharan Africa and their potential contribution to human health: A review. *Journal of Food Composition and Analysis*, **23(6)**, 499-509.

Van Andel, T. R. (2000). Non-timber forest products of the North-West District of Guyana. Utrecht University, p. 284.

Van den Ban, A.W. and Hawkins, H.S., (1996). Agricultural Extension, second ed. Blackwell Science Ltd., Cambridge, Massachusetts p. 182.

Van Kooten, C. G. and Bulte E. H. (2000). The Economics of Nature: Managing Biological Assets, Blackwell Publishers, Massachusetts, Massachusetts: Blackwell Publishers, Massachusetts p. 512.

Vedeld, P., Angelsen, A. and Sjaastad, E. (2004). Counting on the environment: forest incomes and the rural poor. In: Paper No. 98. The World Bank Environment Department, Washington, DC, p. 959.

Vedeld, P., Angelsen, A., Bojö, J., Sjaastad, E. and Berg, G. K. (2007). Forest environmental incomes and the rural poor. *Forest Policy and Economics*, **9(7)**, 869-879.

Verburg, P. H. and Overmars, K. P. (2009). Combining top-down and bottom-up dynamics in land use modeling: exploring the future of abandoned farmlands in Europe with the Dyna-CLUE model. *Landscape Ecology*, **24(9)**, 1167.

Wasonga, V. O. (2009). Linkages between land-use, land degradation and poverty in semiarid rangelands of Kenya: The case of Baringo district. Doctoral dissertation, University of Nairobi.

Wattage, P. and Mardle, S. (2008). Total economic value of wetland conservation in Sri Lanka identifying use and non-use values. *Wetlands ecology and management*, **16(5)**, 359-369.

WCS (2010)**.** "Nigeria". World Conservation Society (WCS).www.wsc.org>where we work>Africa. (Accessed 12.10.2015)

Weinberger, K. and Msuya, J. M. (2004). Indigenous vegetables in Tanzania: significance and prospects (Vol. 600). AVRDC-World Vegetable Center.

Wekesa, C., Makenzi, P. M., Chikamai, B. N., Lelon, J. K., Luvanda, A. M. and Muga M. O. (2010). "Gum Arabic yield in different varieties." *African Journal of Plant Science*, **3(11)**, 263-276.

Whitehead, J. C. (2005). Combining willingness to pay and behavior data with limited information. *Resource and Energy Economics*, **27(2)**, 143-155.

WHO (2002). Traditional medicine strategy 2002–2005. – Retrieved from WHO website, www.who.int/medicines/library/trm/trm_strat_eng.pdf (Accessed 12.10.2015)

WHO (2009). Nutrition and Health Geneva: World Health Organization, (http://www.emro.who.int/nutrition/ind ex*).* Html accessed on 15 December 2014.

Wiggins, S., Marfo, K. and Anchirinah, V. (2004). Protecting the forest or the people? Environmental policies and livelihoods in the forest margins of Southern Ghana. *World Development*, **32(11)**, 1939-1955.

Williams, M. (2002). **Deforesting the Earth**: From Prehistory to Global Crisis. University of Chicago Press.

Wong, J. L. (2000). The biometrics of non-timber forest product resource assessment: a review of current methodology. DFID.

World Bank (2007). A Guide to Value Chain Concepts and Applications https://openknowledge.worldbank.org/bitstream/handle/10986/2401/524610PUB0AFR0101Official0Use0Only1.pdf?sequence (Retrieved on 9 May 2014)

World Bank (2009). Sustaining Forests: A Development Strategy siteresources.worldbank.org/.../Resources/completeforestsourcebookapril2008.pdf (Retrieved on 3 March 2015)

World Bank (2004). Sustaining forests. A development strategy. World Bank, Washington DC, United States of America. p. 80.

World Bank (2006). Country environmental analysis. Report No. 36985-GH. Environmentally and Socially Sustainable Development Department, World Bank, Washington DC, United States of America. p. 227

Wunder, S. (1999). Promoting forest conservation through ecotourism income? (No. CIFOR Occasional Paper no. 21). CIFOR, Bogor, Indonesia, p. 24.

Wunder, S., Angelsen, A. and Belcher, B. (2014). Forests, livelihoods, and conservation: broadening the empirical base. *World Development*, **64**, 1-11.

Yamane, T. (1967). **Statistics: An Introductory Analysis**. 2nd Ed., New York: Harper and Row.

Yang, Y., Jefferson, F. and Yang, X. (2007). Forest transition, its causes and environmental consequences: empirical evidence from Yunnan of Southwest China. *Tropical Ecology*, **48(2)**, 13-7.

Yelwa, S. A. (2008). Broad scale Vegetation Change Assessment across Nigeria from Coarse Spatial and High Temporal Resolution, A VHRR Data, Gottingen, Germany: Cuvillier Verlag, p. 350.

Youn, Y. C., Choi, J., de Jong, W., Liu, J., Park, M. S., Camacho, L. D. and Wanneng, P. (2017). Conditions of forest transition in Asian countries. *Forest Policy and Economics*, **76**, 14-24.

Zaku, S. G., Tukur, A. A., Kabir, A and Jimento, I. G. (2013). Wood fuel consumption in Nigeria and the energy ladder: A review of fuel wood use in Kaduna State. *Journal of Petroleum Technology and Alternative Fuels*, **4(5)**, 85-89.

Zidana, A., Kaunda, E., Phiri, A., Khalil-Edriss, A., Matiya, G. and Jamu, D. (2007). Factors Influencing Cultivation of the Lilongwe and Linthipe River Banks in Malawi: A Case Study of Sal ima District. *Journal of Applied Sciences*, **7(21)**, 3334-3337.

APPENDICES

Appendix 1: Household survey questionnaire for Non-timber Forest Products Valuation in Falgore Game Reserve (FGR) in Kano Nigeria

General Information

1. Date of interview……../……/……
2. Questionnaire number……
3. Name of the enumerator……Phone No:
4. Name of respondents (optional)…….. Phone No:
5. State ……. Local Government ……community ……

Socio-economic Information of the Respondents

6. Sex of the respondent a) Male [ ] b) Female [ ]
7. Age of the respondent [ ] in years
8. Marital status of the respondents : a) Married [ ] b) Single [ ] c) Divorced [ ] d) Widow [ ]
9. Educational status of the respondent: a) Informal education [ ] b) Primary [ ] c) Secondary [ ] d) Tertiary [ ]
10. a) Household size of the respondent…….

    b) Household composition

Age class	Male	Female	Total
Aged (Above 50 yrs)			
Adult (14-50yrs)			
Child (7-13yrs)			
Child (<7yrs)			

11. What is your main occupation? a) Farming [ ] b) Trading [ ] c) Formal employment [ ] d) Craft and artisans [ ] e) Forest resources extraction [ ] f) Others specify……
12. What is your secondary occupation? a) Farming [ ] b) Trading [ ] c) Government salary job [ ] d) Craft and artisans [ ] e) Forest resources extraction [ ] f) Others specify……
13. How much do you earn from the following sources of income per month?

S/No	Income Source	Amount in ₦
1	Self-employment (trading, tailoring, carpentry, crafts, bricklaying, blacksmithing, etc.)	
2	Salary and wages	
3	Sales of Agricultural crop produce	
4	Sales of Livestock	

5	Remittances (money sent by children and relatives)	
6	Money earned from interest on capital lent out and rent on building or dividend on shares, etc.	

14. Is there any member(s) of your household who is earning income? a) Yes [ ] b) No [ ]
15. If yes, state their income in ₦ in the table below

Name	Daily	Weekly	Monthly

16. Does your household keep livestock? a) Yes [ ] b) No [ ]
17. If yes kindly indicate how many livestock your household have and their grazing site

S/No	Livestock Type	Number	Grazing site
	Cattle		
	Sheep		
	Goat		
	Donkey		

18. What is the of your farm size …… in hectare

Social and institutional factors of the respondents

19. Are you an indigene of this community? a) Yes [ ] b) No [ ]
20. If no for how long have you lived in this community……in years
21. Do you have contact with extension agent? a) Yes [ ] b) No [ ]
22. If yes how often? a) Daily [ ] b) Weekly [ ] c) Fortnightly [ ] d) Monthly [ ] e) Yearly [ ]
23. Are you a member of any social organization? a) Yes [ ] b) No [ ]
24. If yes, name the organization you belongs to……
25. What is the distance between your homestead and clinic or hospital……..in km
26. What is the distance between your homestead and nearest market……..in km
27. What is the distance between your homestead and main road……..…..in km
28. What is the distance between your homestead and public schools…….in km

Non-timber Forest Products Information

29. Do you use NTFPs in your household? a) yes [ ] b) No [ ]
30. If yes what are the different types of NTFPs do you use and for what purpose?

NTFPs	Household consumption	Sale at local market
Fuel wood		
Gum Arabic		
Fruits nuts		
Fodder		
Honey		
Medicinal plant		
Others		

31. State the main source of your NTFPs? a) FGR [ ] b) Own farm c) Market d) Others specify……
32. If you collect NTFPs from FGR, how do you get access to the forest? a) paying of fees [ ] b) Seeking of permission [ ] c) Free collection [ ]
33. For how long have you been using the said method in question 32 in years [ ]
34. Are you happy with the procedure you are using to access NTPS in FGR? a) yes [ ] b) No [ ]
35. Are NTFPs important for your livelihood? a) yes [ ] b) No [ ]
36. If yes, in which of the following way(s) do NTFPs from FGR positively affect your livelihoods? a) Income generation [ ] b) Employment [ ] c) Household food provision [ ] d) Fodder for livestock [ ] e) Spiritual and cultural services f) Environmental services [ ] g) Fruit nuts [ ] h) Fuelwood [ ]
37. Who is mainly responsible for the collection/extraction of NTFPs in your household?

NTFPs	Men	Women	Boys	Girls
Fuel wood				
Gum Arabic				
Fruits nuts				
Fodder				
Honey				
Medicinal plant				
Others				

38. What is the trend of NTFPs in terms of quantity and quality in FGR for the last three decades?

Period	Quantity of NTFPs			Quality of NTFPs		
	Increasing	Constant	decreasing	Increasing	Constant	decreasing
1985						
1995						
2005						
2015						

39. Please provide information about the quantity of NTFPs consumed at household and sold at the market in the last month.

NTFPs	Quantity consumed	Value in ₦	Quantity sold	Value in ₦
Fuel wood				
Gum Arabic				
Fruits nuts				
Fodder				
Honey				
Medicinal plant				
Others				

Perceived drivers of forest degradation

40. How would you rate the condition of FGR in the last three decades and the main causes of degradation? Use the key below.

Period	Very degraded	Degraded	Undecided	Slightly degraded	Not degraded	Causes of degradation in order of importance
1985						
1995						
2005						
2015						

a. Poor grazing management, b) Forest fire, c) Expansion of crop cultivation
d) Excessive and unregulated fuelwood collection e) Illegal hunting of game animals
f) Harvesting of medicinal plant g) Others……..

41. In order of priority name three most important causes of forest degradation in your Falgore game reserve

a)……..

b)……...

c)……...

42. Who do you think is/are responsible for forest resource degradation in FGR?
    a. Political leaders (rent seekers) [ ]
    b. Local elite (elite capture) [ ]
    c. Illegal resources exploiters [ ]
    d. Outsiders [ ]
    e. Forest department staff [ ]
    f. General public [ ]
    g. Fulani herdsmen [ ]
    h. Climate change [ ]
    i. Others……

Perception and attitude of local people toward protected Area forest resources conservation

S/No	questions	SD	DA	UD	A	SA
43	Do you agree that establishment of FGR is necessary to sustain the forest resource in your area?					
44	Do you believe that it is the responsibility of the local people to protect the surrounding forest?					
45	Do you agree that the protected area system adequately recognized indigenous people's right to access and use of resources?					
46	Do you think there is need for local people participation in forest resource management of FGR?					
47	If invited by the authority of FGR would you be willing to participate in forest conservation?					
48	Do you agree that free collection of forest resources has reduced the vegetation cover of FGR over the past three decades?					
49	Is your household affected by the changes in forest resources?					

SD = Strongly disagree, DA = Disagree agree, UD = Undecided, A = Agree, SA = strongly agree

50. In what ways does this change affect your household? a) increase food insecurity [ ] b) Low income [ ] c) Unemployment [ ] d) change in microclimate [ ] e) Culture erosion [ ] f) energy problem [ ]

S/No	questions	SD	DA	UD	A	SA
51	Do you think there is any need for resource extraction fees and or seeking permission before utilizing the available NTFPs of FGR?					
52	Do you believe that restriction of access to resources in the reserve is pre-requisite for sustainable conservation of FGR?					

53. Are you aware of the resource collection permits given to local people? a) Yes [ ] b) No [ ]

S/No	**Questions**	SD	DA	UD	A	SA
54	Do you agree that resource collection permits is offered in a timely manner?					
55	Do you believe that this license is offered without discrimination?					

Attitude toward Protected Area conservation

	Questions	VS	SS	NS
56	To what extend are you satisfied with the resources access right provided to your community by FGR administration?			
57	Are you satisfied with capacity of game rangers to ensure physical protection of the reserve against anthropogenic adverse influences?			
58	To what extent are you satisfied with the process of public participation/engagement in decision making process regarding the reserve?			
59	To what extent are you satisfied with the participation of the local people in the forest conservation activities of FGR?			
60	To what extent are you satisfied with level of application of penalties on illegal resources exploiters?			
61	To what extent are you satisfied with the public access to information regarding management decision between FGR administration and your community?			
62	To what extent are you satisfied with the condition of forest resources under protected area system PA system?			

VS= Very satisfied, SS= somewhat satisfied, NS= Not satisfied

Appendix 2: Questionnaire for contingent valuation method (CVM)

Introduction

In this section, I would like to ask you how much you will be willing to pay for the collection of various NTFPs in Falgore game reserve (FGR) in order to determine how much various NTFP are worth to you in Naira as well as, your desire for the protection of FGR against deforestation and subsequent degradation. Below is the background information of the FGR under the current management system and also a strategy which would strengthen the condition of NTFPs in the reserve as well as, the associated benefits for present and future generation.

Background information on Falgore game reserve

Falgore game reserve (FGR) is one of the protected areas in Kano and an important source of livelihood for forest dependent communities. It has an estimated land area of 92,000ha equivalent to 1000 square kilometre. It provides different benefits to the population; for example fish for food, trees for timber, fuel wood, wild fruits, gum Arabic, and recreation in addition to being used for research. The government, through the Federal and State forest laws prohibits all kinds of activity within FGR without legal authorization. However, despite the existence of these laws, illegal resource exploitation is still going on in the reserve leading to an unprecedented rate of resource degradation particularly the non-timber forest products. It is therefore doubtful whether the reserve will be able to continue supplying benefits to people in the future.

Assuming Kano State Ministry of Agriculture and Natural Resources wishes to strengthen the conservation of NTFPs through imposition of forest resource collection fees for who wish to collect NTFPs for subsistence needs. The new policy (NTFP collection permit) is aimed at minimizing illegal exploitation of NTFPs from FGR. However, this permit would only be given to households which are willing to pay for it and which are already living in and around the reserve. Will you be willing to pay certain amount of money to obtain licence for NTFPs collection?

Before you agree on a particular amount of money to pay for the collection of NTFPs, please ask yourself: "Am I willing to pay this amount of money for the protection of FGR every month noting that protection would foster sustainable management? Or should I forfeit the benefits I am currently deriving from the reserve or further should the status-quo be maintained, which may eventually lead to further deterioration of the available resources". Please do not agree

that you are willing to pay a certain amount if you cannot afford it on a regular basis (monthly), or if you feel you have other important things you need to do with the money or if you are not ready to pay such amount of money. I am asking for your sincere response, thank you.

1. Are you willing to pay certain amount of money to buy license for the collection NTFPs and protection of falgore game reserve? a) Yes [ ] b) No [ ]
2. If No go to question 11
3. If yes would you be willing to pay……in Naira every month for collection of fuel wood? If yes, what if the amount is increased to ₦…….. would you be willing to pay this amount? (If yes, continue to increase the amount up to where you get no) (₦0, ₦250, ₦500, ₦750, ₦1,000, ₦1,500, ₦2,000, ₦2,500 ₦3,000, ₦3,500, ₦4,000 etc)
4. Would you be willing to pay……in Naira every month for collection of honey? If yes, what if the amount is increased to ₦…….. would you be willing to pay this amount? (If yes, continue to increase the amount up to where you get no) (₦0, ₦250, ₦500, ₦750, ₦1,000, ₦1,500, ₦2,000, ₦2,500 ₦3,000, ₦3,500, ₦4,000 etc)
5. Would you be willing to pay……in Naira every month for collection of gum arabic? If yes, what if the amount is increased to ₦…….. would you be willing to pay this amount? (If yes, continue to increase the amount up to where you get no) (₦0, ₦250, ₦500, ₦750, ₦1,000, ₦1,500, ₦2,000, ₦2,500 ₦3,000, ₦3,500, ₦4,000 etc)
6. Would you be willing to pay…… in Naira to graze a head of cattle every month? If yes, what if the amount is increased to ₦…….. would you be willing to pay this amount? (If yes, continue to increase the amount up to where you get no) (₦0, ₦250, ₦500, ₦750, ₦1,000, ₦1,500, ₦2,000, ₦2,500 ₦3,000, ₦3,500, ₦4,000 etc)
7. Would you be willing to pay…… in Naira to collect medicinal plants every month? If yes, what if the amount is increased to ₦…….. would you be willing to pay this amount? (If yes, continue to increase the amount up to where you get no) (₦0, ₦250, ₦500, ₦750, ₦1,000, ₦1,500, ₦2,000, ₦2,500 ₦3,000, ₦3,500, ₦4,000 etc)
8. Would you be willing to pay…… in Naira every month for collection of fruits nut/leafy vegetables? If yes, what if the amount is increased to ₦…….. would you be willing to pay this amount? (If yes, continue to increase the amount up to where you get no) (₦0, ₦250, ₦500, ₦750, ₦1,000, ₦1,500, ₦2,000, ₦2,500 ₦3,000, ₦3,500, ₦4,000 etc)
9. How sure are you of your answer to the previous questions above? a)Very sure b) Sure c) Not sure

Follow-up questions:

10. What were the main factors you considered for your answer? a) Personal benefits [ ] b) Income constraint [ ] c) Protection of illegal exploitation [ ]e) Future generations [ ]f) others specify…….
11. If you said no in question one (1) above, which of the reasons below best explains your answer? a) Because the forest has no value to me [ ] b) Because my household income is too small to allow for any contribution [ ] c) it is difficult for me to specify a monetary value for the forest resources [ ] d) Because I don't trust government (corruption) [ ] e) Because I feel that these resources belongs to us (forest communities)

Appendix 3: Focus Group Discussion guide

Date

Time:

Village Name

Local Government Area

Number of participants

Forest Products identification and mode of utilization

1. What are the different forest products available in this community?
2. What are the different forest products you use?

   a. …… b ……..

   c ……. d……..

   e…….. f…….
3. Does these NTFPs harvesting and selling important for the economy/livelihoods support of this community?
4. What are the importance of NTFPs to the local people?

   (a) Source of Income (b) aesthetic/recreation, (c) Medicinal plants (d) Culture (e) Food f) Others
5. Main source of NTFPs in this community? a) Own farm b) FGR c) Market d) others specify……
6. How does your community usually access NTFPs from FGR? a). illegal collection b) paying of fees c) Seeking of permission
7. If the main source is FGR please state extent of accessibility of the resources in terms of timeliness a) Timely b) Not timely

   Seasonality a) Seasonal b) Not seasonal

   Average distance from this community to FGR …….(km)
8. Are there rules guiding the extraction pattern of NTFPs?
9. If yes who enact the rules a) Government b) Community c) User groups d) Others specify
10. If yes do you think these rules are clear and simple to be understood by local people?
11. What percentage of your population depends on NTFPs as their main source of livelihoods?
12. Is the dependency ratio increasing, decreasing or remain constant? And why?

13. Who is mainly responsible for the collection/extraction of NTFPs?

NTFPs	Men	Women	Boys	Girls	Majority	Reason

14. Do you have local/community based group responsible for maintaining/managing the NTFPs?
15. If yes how is the group formed?
16. Is the group independent of FGR Administration?
17. If no how do the administration of FGR engage the group in conservation/management issues? Example a) Enforcement of law b) Extraction pattern c) Management decision e) Benefit sharing
18. In your own opinion do you think NTFPs protection rules of FGR are enforced? a) If yes, what is the effect of enforcement protection rules in relation to NTFPs availability in the reserved? a) Increasing b) Decreasing c) Constant
19. If no why? a) Reduction in quality and quantity of NTFPs b) Poor enforcement of rules c) lack of fair treatment among users etc
20. Do you play any role in terms of policies/legislation decision in relation to management and conservation of NTFPs? If yes state your contribution?
21. Do you think a ban on collection of NTFPs is the best way to conserve NTFPs?
22. If no suggest the best possible ways to achieved conservation goal?
23. What is the trend of human population density in the last three decades? And how it relate to NTFPs availability in the reserve?
24. What is the trend of wildlife density in the last three decades?
25. What is the trend and density of NTFPs in the last three decades?

NTFPs	Increasing	Decreasing	Constant

26. How does the change in quantity and quality of NTFPs affect the livelihoods of this community?

27. Do you experienced any conflict in relation to NTFPs extraction in this community? a) Yes b) No
28. If yes what is the nature of the conflict example a) forest users conflict b) Government/users conflict c) Others
29. How do you resolve the conflicts?

27. What are the major causes of forest resources degradation in this community?
……
……
……
……
…….....
28. Other issues that respondents found important
……
……
……
……
……

Appendix 4: Key informant interview guide

i. Name and affiliation?
ii. In your opinion, what is the situation of forest resources in FGR?
iii. How is governance organized? Involvement, participation, accountability, equity etc.
iv. Are there institutions supporting the conservation of forest resources beside government?
v. Is there local organization that directly involve in conservation activities?
vi. Are there state policies or laws regulating use and access to resources used in FGR?
vii. Are the rules clear to locals and other resource users?
viii. What are the main NTFPs utilized by forest dependent communities?
ix. Does other people from distance communities and towns extract NTFPs from FGR?
x. Is there organized marketing system for NTFPs in the communities?
xi. How conservation information communicated to resource users?
xii. Are there any programs design to enlighten the resource users/capacity building on NTFPs extraction?
xiii. How can you rate the level of resource degradation in the reserve?
xiv. Which resources are more degraded?
xv. Why?
xvi. What can be done
xvii. How do you see the level of protection rules enforcement in the reserve?
xviii. What can be done to improve the level of protection of the reserve?
xix. Is it possible to imposed user license fees?
xx. What constraints and challenges are there in forest resource conservation in FGR?