UNIVERSITY FOR DEVELOPMENT STUDIES

EFFECTS OF NATIVE TREE PRODUCTS HARVESTING ON THE LIVELIHOODS OF RURAL HOUSEHOLDS IN NORTHERN GHANA

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(MBA, Finance; B. ED. Social Sciences)

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BY

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THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURE AND FOOD ECONOMICS, FACULTY OF AGRICULTURE FOOD AND CONSUMER SCIENCES, UNIVERSITY FOR DEVELOPMENT STUDIES, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY (MPHIL) DEGREE IN AGRICULTURE ECONOMICS

APRIL, 2023

DECLARATION

I hereby declare that this thesis is a product of my own original study, and no part herein has been submitted for another degree in this University or elsewhere, except for duly acknowledged references from other studies.

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Supervisor

I hereby declare that the preparation and presentation of the thesis was supervised in accordance with the guidelines on supervision of thesis laid down by the University for Development Studies.

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ABSTRACT

The study examined the effects of native tree products harvesting on the livelihoods of rural Households in Northern Ghana. Several studies in Ghana on native trees have not looked at quantities of products harvested for sale and for consumption and the factors influencing household harvesting decisions. The main objective of the study was therefore to assess the harvesting of six native tree products and their effects on the livelihoods of rural households in Northern Ghana. Specifically, the study examined the quantities of native tree products harvested for sale and for household consumption, the factors influencing harvesting intensity, and the contribution of native tree products to the livelihood outcomes of rural households. A household survey was conducted to collect data through the use of structured and semi-structured questionnaires, administered on households in Kumbungu District, Kassena Nankana, and Nandom Municipalities. The multistage sampling technique was employed to select 324 household respondents from the three study districts/municipalities. Quantitative and qualitative data analysis were done through Stata statistical tool. The Ordinary least Square (OLS) regression and the livelihood (well-being) indices were used. Household demographic characteristics such as age, size, gender, educational status, and distance to trees, were the independent variables used. Household asset acquisition was assessed to determine household well-being status on the livelihood endowment status pentagon. The study revealed that households predominantly harvest five main native tree parts; fruits, leaves, seeds, bark, and flowers. Majority of these parts harvested are consumed domestically, leaving a smaller percentage for sale in the local markets. Also, of the thirteen parameters estimated, eight jointly formed significance on the harvesting intensity. These are; sex of respondents, access to credit, household size,

remittances, primary occupation, distance to native trees, income, and availability of trees. The study also revealed that, with an index of 0.57 and 0.63 respectively for harvesters and non-harvesters, both respondent categories have the same medium well-being status, implying that harvesting native tree products has not contributed in improving the well-being status of harvesters as compared to non-harvesters. The study also discovered that, with an index of 0.57, most harvesters of native tree products are not wealthy but of medium well-being status. The study recommends to government and other partners in tree development on the need to train and inform households on the values and potentials of native tree products at their disposal to improve their well-being.

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DEDICATION

I dedicate this work to my wife, Rahma and children; Naasirah, Faqiha, Adl, Aaleya, and Muhammad, for their patience during my study period at the University for Development Studies.

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ABBREVIATIONS

AC	Area Council
CAI	Composite Asset Index
CRES	Climate Resistance Ecosystem Services
DFID	Department for International Development
FAO	Food and Agricultural Organisation
FGD	Focus Group Discussion
GSS	Ghana Statistical Service
IDS	Institute of Development Studies
IFT	Indigenous Fruit Tree
KNEM	Kasena Nankana East Municipality
LES	Livelihood Endowment Status
LGA	Local Government Authority
LG	Local Government
MCA	Multiple Correspondents Analysis
NTFP	Non-Timber Forest Product
NTP	Native Tree Products
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares
ORGIS	Organisation for Indigenous Initiative of Sustainability
PCA	Principal Component Analysis
PHC	Population and Housing Census
SFC	Savannah Fruit Company
SHS	Senior High School
SIC	Simple Index Construction

SLF	Sustainable Livelihood Framework
SRL	Sustainable Rural livelihoods
SSA	Sub-Saharan Africa
UK	United Kingdom
UNEP	United Nations Economic Programme
UNDP	United Nations Development Programme
UN	United Nations
WACWISA	West Africa Center for Water Irrigation and Sustainable Agriculture

CHAPTER ONE

INTRODUCTION

1.1 Background

In Africa, majority of rural dwellers harvest, utilize, and market indigenous tree products such as fruits and nuts which are integral to their livelihoods (Akinnifesi *et al*., 2007; Leakey *et al*., 2005; Akinnifesi *et al*., 2007). In periods of food shortage, this can be a safety net (Mithofer and Waibel, 2003; Akinnifesi *et al*., 2006; and Akinnifesi *et al*., 2007). Majority of rural smallholder farm households especially women in developing countries like Ghana, depend on native tree product harvesting and processing for consumption and for sale in their local domestic market as their only source of income for daily subsistence in the diversified livelihood portfolio. As espoused by Leakey *et al*., 2005; and Akinnifesi *et al*., 2007), harvesting fruits from the forest can greatly improve income and create employment for rural people in Africa.

Households in rural areas often engage in varied livelihood strategies in the form of harvesting natural resources such as fishing and hunting as well as the pursuance of other activities like farming, off-farm, and livestock herding (Nawrotzki *et al*., 2012). Chambers and Conway (1991), defined livelihood to comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living. In periods of shocks, households encounter difficulty in creating a balance in their daily consumption to maintain dignified livelihoods. They then resort to several means of diversification from their already stretched sources of livelihoods to several other strategies to overcome such shocks. In such periods natural resources like trees, and land come in handy. Native trees such as baobab

(*Adansonia Digitata*,) Locust Beans (*Parkia biglobosa*, Lannea (*Lannea spp*), Marula (*sclerocarya birrea*), Bombax (*bombax costatum*), and *Ziziphus mauritiana* (jujube) are usually situated in and around households or closer to households, and in farms to provide cover for difficulties during lean periods. Such native trees from the Non-Timber Forest Tree (NTFT) stock, have been found to provide products with varied local and international uses. These products include; leaves, fruits, seeds, nuts, bark, flowers, and pulp. In addition, some of the products, like the seeds, fruits, nuts and pulp, can further be processed into oil, drinks, and medicinal products. Yet the methods deployed by the harvesters are still traditional resulting in damage to products and sometimes the trees. As Korbo *et al*. (2013) reported in Mali, the traditional approaches for harvesting and use of leaves of Adansonia digitata have some challenges on the tree species protection.

According to Lokonon *et al*. (2021) the poor populations' livelihoods in many emerging countries depend on the availability of Non-Timber Forest Products (NTFP). To Angelsen and Wunder (2003), native tree products are sold for cash income to contribute to household food security and for the well-being of individuals. These products provide safety net for vulnerable people in households in times of food shortage. Kamatou *et al*. (2011) found that indigenous trees increase the copping ability of local communities through providing food and income. Neudeck *et al*. (2012) found that in Botswana, those who depend on tree products resources are poor households. According to the FAO (2012) most rural populations in Ghana exploit forest and other native tree products to survive, and women are particularly central in the tree products harvesting for food, shelter, and clothing. Mithofer and Waibel (2008) found that indigenous fruit trees promote the

development of rural livelihoods and also supports the sustainable management of the landscape. Also, Schakleton *et al*. (2007) found in their dry forest review that forest income offers a pathway out of poverty and about 20% of household income comes from the forest in South Africa.

There is empirical evidence that native tree products harvest by rural marginalised groups such as women and youth have an impact on their livelihood improvements. For instance, Whiteman and Lebedys (2006) in their study in Africa, found that informal activities from NTFPs contribute to household income and employment generation. Marshall *et al*. (2005) also found in Kenya that NTFPs can help in the reduction of poverty through provision secure food systems to reduce community and household vulnerabilities to poor crop yield and illness. Studies, as in Babulo *et al*. (2009); and Mamo *et al*. (2007), have projected that about 27% and 40% of household income is attributed to products from the forest. Also, according to Leakey and van Damme (2014) rural households can have multiple sources of income and benefit from nutritious tree food products to improve their household livelihoods and shield them from the shocks of market failures. However, According to Akinnifesi *et al*. (2006), except in periods of famine, some fruits of indigenous trees are usually consumed as snacks and not the main food source for the household. These fruits only become the main food source and therefore the main household diet when there are food shocks in the rural households.

The rural harvesters of these trees usually are not aware of all the products that can be developed from the already known products harvested. For instance, the only edible product information that may be available to the harvesters for locus beans, bombax, lannea, and marula is for condiments, and pulp for locus beans, the flowers

for soup for bombax, eating the fruit for lannea and marula. They are thus resigned to their status quo of what they already know. Studies have proved that seeds or nuts of all six native trees have edible oil in commercial quantities. For instance, Kayode and Kayode (2011) found that the locust bean seed has a 27% oil content. As espoused in Olaoye (2010), as in Simonyan (2012), the entire locust bean tree parts are important. Locust bean gum can be produced from the pod which is used to as a thickening material. It can also be used as a stabilizer in food products like mayonnaise and in the textile industry to thicken textiles (Glasson Grain Ltd, 2006; Simonyan, 2012). The fresh and unripe fruit is used to prepare beverages and the oil from the seed is suitable for consumption (Oyen, 2011).

Rural households in Africa and the developing countries in the world use different products from native tree species. These tree products are consumed usually by rural households for food and for trade (Schumann *et al*., 2012). The poverty reducing role of TFPs has resulted in households cultivating the trees on their farms rather than harvesting them from the forest. Yet, according to Poulton and Poole (2001) the important influence of these native fruit trees to household livelihoods sees little recognition in the national discourse. According to Leakey and Newton (1994) as in Schreckenberg *et al*. (2006), this shows that there is no interest in the tree species that always provide rural people important daily products.

According to the UNDP (2013), trade and livelihood activities are promoted through investments planned to facilitate dryland places to be highly productive and economically varied. traditional livelihood activities and related enterprises can be enhanced through management arrangements and investments designed to enable dryland areas to become more productive and economically diverse. These can

include large-scale public and private initiatives, as well as activities of communities, households and small businesses. To enhance natural resource use and conservation, there is the need to channel investment into tree conservation. A study in Botwana of the food plants potential in rural households' food security, Legwaila *et al*. (2011), found natural woodlands to be essential part of daily lives in rural communities around the country and that varied products such as fruits, pole, roots, fuel wood, leaves, honey, and insects are sought. To Hasalkar and Jadhav (2004), the livelihood opportunities of marginalised groups such as women are limited because of their inability to access credit, land, and other livelihood assets. Thus, exploring tree-based foods are particularly essential to their daily livelihoods.

However, poor resource harvest and usage may pose great risk to the native tree population if not managed efficiently. For instance, Dhillion and Gustad (2004) found that baobab tree and fruit production can be hampered by the level of leaves harvest. The local and international demand for baobab fruit pulp results in the discard of baobab seeds which consequently threatens the regeneration of baobab trees (Cuni-Sanchez, 2010; Fisher *et al*., 2005). According to Peters (1995) as in Murya and Pelser (2018), the harvesting of native tree parts such as leave, fruits, bark, wood, and other parts may pose significant dangers to the species depending on the intensity of harvest. These species may be depleted or go into extinction should appropriate management and sustainability actions are not designed (Murya and Pelser, 2018).

The study Informs government and other policy makers of the need to focus attention on empowering local native tree product harvesters in rural communities through value-added native products for domestic and international markets. The study

contributes to knowledge on native tree products harvesting and how the exploration contributes to household asset acquisition. The distinctive nature of this study is the examination of variables that have seen little or no attention from previous studies and the combination of six native trees in one study.

1.2 Problem Statement

Several of the studies in indigenous trees in Northern Ghana, such as Alhassan (2012), Lovett and Phillips (2018), and Awo and Anaman (2015), have concentrated on the shea tree and its associated economic benefits to the rural households. However, to the best of my knowledge, little studies have been conducted on the harvesting and use as well as for sale of other native tree species such as Baobab (*Adansonia Digitata), Bombax (Bombax Costatum),* Marula *(Sclerocarya birrea), Lannea (Lannea spp),* Jujube *(Ziziphus mauritania),.and* Locust Beans *(Parkia biglobosa*). These few studies have focused on individual tree species not in relation to their harvest effects on rural livelihoods coping strategies of households, but on tree ownership, and land management. For instance, Poudyal (2011) studied tree ownership and management incentives in two multipurpose trees in Northern Ghana. Apuri *et at*. (2018) researched on the adaptation of agroforestry in climate change in the Kassena Nankana West District of Ghana. Whiles Kiptot and Franzel (2011) studied the participation of women in agroforestry in Northern Ghana.

Others such as Donkoh *et al*. (2009), and Dorm-Adzobu *et al*. (1991), concentrated their studies on the adoption of green revolution services and poverty reduction in Ghana, and religious beliefs in environmental protection through indigenous trees in Ghana. Boon and Ahenkan (2008) researched on how non-timber forest products

helps in food security enhancement in Ghana. Whiles Obiri *et al.* (2011) researched on forest dependency assessment in Ghana, Ofori *et al*. (2014) concentrated on the development of agroforestry systems to improve food and nutrition through indigenous trees. Again, Amoako (2012), looked at the locust bean tree tenure and its ability to sustainably manage lands in Northern Ghana. These studies done on rural poor in Ghana have mainly focused on tree conservation and the participation of the rural vulnerable in maintaining a green ecosystem, but have not looked at the harvesting of native trees as sources of response to livelihood shocks. Besides, these studies have not considered the impact of the native trees' products harvesting on the diversified livelihood portfolios of households in Northern Ghana. Again, these studies have not considered quantities of native tree products harvested and whether the harvested quantities are consumed domestically or sold for income. Those studies have not also looked at the factors influencing intensity of native tree products harvesting.

In Northern Ghana, rural households, especially women and the youth, in their quest to have dignified livelihoods, resort to the harvesting of native trees and their products to enable them live with some level of dignity. However, their actions and inactions in the harvesting process leaves long lasting damage to the native trees. Analysing the factors influencing the harvesting and utilisation of non-timber forest products in rural Nigeria, Opalua *et al*. (2011) found women to be more likely to harvest non-timber forest products than men. Also, they found that respondents were less likely to collect NTFP with an increase in distance to the sources of products. Again, Ndayambage, *et al*. (2012) in their study of the determinants of household farm tree planting, found in Rwanda that poorer households are more likely to

harvest NTFP. Tassou (2017) found in her analysis of the determinants of households to collect NTFP in Uganda that those likely to harvest non-timber forest products are the younger household heads as compared to older household heads. Issaka (2018), found in his analysis of the role of NTFP in building resilience against climate change, that NTFPs contribute significantly to livelihood in Northern Ghana as well as account for up to 30% of household income. In an investigation to find ways of addressing food security and malnutrition in Northern Ghana, Sadik (2020) found that there was general acceptability for the product as majority (90%) of the respondents liked the shortbread biscuit prepared from locust beans pulp for its taste, texture, colour and appearance. Several studies in Africa (Schumann *et al*., 2012; Venter & Witkowski 2011; Gebauer and Luedeling 2013; Fischer, *et al*.,) have found that harvesting can result in harmful effects on native tree species. Helm and Witkowski (2013) found in the Kruger National Park, South Africa, that marula tree population was declining at a fast rate as a result of increased harvesting rate.

Native trees and their associated products, which are supposed to be avenues for improved livelihoods of the rural marginalised households, may well not be serving their purpose, or may even have negative consequences if tree conservation strategies, with regard to appropriate harvesting methods are not brought to bear on the rural harvesters. This study sought evidence in Ghana about improvement in household livelihoods through native tree products harvesting.

This study therefore fills the research gap by examining the various native tree products harvesting possibilities for improving the well-being of rural households. It will also examine the harvested quantities of native tree products that are consumed in the households and those sold for income. The distinctive nature of this

study is the inclusion of variables which have seen little or no attention from previous studies in Ghana, such as the livelihood outcomes derived from harvesting native tree products by households, and the quantities sold and consumed.

1.3 Research Questions

1.3.1 Specific Research Questions

The following specific questions were formulated to guide the study:

1. What quantities of native tree products are harvested by rural households in Northern Ghana? Are these quantities harvested for sale or for household consumption?
2. What are the factors influencing native tree product harvest intensity among households in Northern Ghana?
3. What is the contribution of native tree products harvest on the livelihood outcomes of rural households in Northern Ghana?

1.4 Research Objectives

1.4.1 Specific Research Objectives

The specific objectives formulated for the study are:

1. To examine the quantities of native tree products harvested for sale and for household consumption by rural households in Northern Ghana.
2. To examine the factors influencing native tree product harvesting intensity among rural households in Northern Ghana.
3. To assess the contribution of native tree products harvesting on the livelihood outcomes of rural households in Northern Ghana.

1.5 Justification of the Study

The findings of the study have contributed to knowledge in livelihood resilience of rural households in Ghana. It helped bridge the literature gap by unearthing the livelihood strategies of rural households through native tree product harvesting as explained in the problem statement. Specifically, the study is relevant as it:

1. Assist harvesters of native tree products to plan their harvesting to take advantage of marketing opportunities to improve their household incomes.
2. Help households who harvest native tree products to consume to also venture into harvesting for sale to increase household income.
3. Informs government and other policy makers of the need to focus attention on empowering local native tree product harvesters in rural communities through value-added native products for domestic and international markets;
4. Bring to light the challenges facing women and youth in households in their pursuit of diversified livelihood portfolio through value-added native tree products;
5. Help policy makers in tree policy formulation on the native trees and their products to ensure all year-round utilisation and trade in the native tree products;
6. Benefit the Government of Ghana, agricultural products marketers, investors, creditors and other stakeholders in native tree products as it makes contributions to policy that will help clarify roles in ensuring the conservation of native trees to protect rural livelihoods.

1.6 Scope of the Study

The study covered Kumbungu District, Nandom Municipality and Kasena-Nankana Municipality in the Northern, Upper West and Upper East Regions of Ghana respectively. It focused on both rural and urban communities of the study Districts/Municipalities to draw on the native tree products exploration experiences of women and the youth. It assessed livelihood resilience strategies in the context of native tree products exploration among women and the youth over a one-year period.

1.7 Organisation of the Study

The study was organized into five chapters. Chapter one provides a background to the study, the problem statement, research questions, the objectives of the study, the significance of the study, and the organisation of the study.

Chapter two presents the literature review. It proceeds to provide empirical frameworks for the study, the concept of livelihoods, livelihood assets, livelihood strategies, livelihood outcomes, women empowerment, and youth empowerment. It also reviewed literature on the native tree species under study: Baobab, Locust beans, Bombax, Lannea, Marula, and Jujube. The chapter concludes with reviews on the quantity of native tree products harvested and whether the products are consumed or for sale. Chapter three of the study presents the research methodology. This is outlined as; study design, sampling method, instruments, data collection procedure and data analysis. Chapter four of the study presents the results from the analysis of primary data obtained through the research instruments employed.

Chapter five of the study contains the summary of the results, conclusions and recommendations by the researcher.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents theoretical literature on recognized data on household native tree products harvesting, and household livelihoods. Also, it provides relevant empirical literature on the native tree product harvesting practices of rural households and the contribution to the livelihood resilience of households. It contains review of literature on livelihoods strategies, livelihood outcomes of households, women and youth empowerment and native tree product harvesting among rural households. It proceeds with literature on factors influencing native tree products harvesting intensities, and native tree products and their contribution to the livelihood outcomes of households in Northern Ghana. The chapter concludes by presenting the theoretical and conceptual frameworks supporting the study.

2.2 Livelihoods

According to Long (1998) as in Haan and Zoomers (2003), the individual and group struggle aimed at making a living, meeting their household consumption and other necessities, taking advantage of opportunities and making choices between value positions are expressions of livelihood. Chambers and Conway (1991) defined livelihood as that comprising of the capabilities, assets, (stores, resources, claims and access) and activities required to make a living. In explaining the Sustainable Livelihoods Framework (SLF), Ellis (1998) defined livelihoods as the activities, assets, and access that determine the living gained by an individual or household. He then defined rural livelihood diversification as the process which households construct a diverse portfolio of activities and social support capabilities for survival

to improve their standards of living. To Murray (2001) livelihoods encompasses the abilities, assets and events needed for a proper wellbeing.

2.2.1 Livelihood Assets

The DFID sustainable livelihoods guidance sheets depict the assets pentagon within the SLF. The pentagon is used to explain the livelihood assets of the rural poor people. Fouracre (2001), grouped the capital assets as; human capital, natural capital, social capital, physical capital and financial capital.

Human Assets

The Human capital assets, according to Scoones (1998) is the inherent worth which helps the individual to pursue strategies to improve their food security situation. These inherent values empower people to take advantage of other assets (DFID, 1999). Rural household's human livelihood assets usually comprise the quantity and quality of people in the household which differs in household demographics such as skills set, health, and size (DFID, 1999).

Natural Assets

The natural assets are the possessions emanating from the natural flow of resources including water resources, biodiversity, wildlife, and land. It also includes services from the environmental which are essential to the livelihoods of households. To the extent that rural household derive their livelihoods from agriculture and related enterprises, natural assets are important to their daily survival (DFID, 1999).

Social Capital

The DFID (1999), sees social assets as the resources from the society which individuals and households rely upon to facilitate their improved well-being status through varied livelihood strategies. These according to Carney *et al*., (1999), include; belonging to a group, having networks, building trust relations and having access to broader institutions.

Physical Assets

The physical assets, according to DFID (1999), includes the elementary resource stocks needed to build household livelihood strategies. These stocks may be private or public resource stocks. To Scoones (1998), physical assets must be able to provide the means for poor households to achieve their livelihood outcomes as it impacts on both their human and financial assets.

Financial Assets

According to the DFID (1999), the financial assets are the are monetary possessions employed by individuals and households to realise their livelihood outcomes. They are the most liquid assets available to the individual and household that are conveniently disposed of for cash. They include; cash, savings, credit, and remittances which helps households to achieve their livelihood outcomes (Carney, 1998).

2.2.2 Livelihood Strategies

Whereas resources are essential to accomplish objectives, livelihood strategies are the means through which individuals and households deploy these resources to use. Individuals and households commit to particular strategy contingent upon their portfolio of resources or assets, and the opportunities that are envisaged. These

actors are into manufacturing, consumption, and activities concerning their livelihood diversification into farming, non-farm, or off-farm to satisfy their approaches to livelihood shocks (Ellis, 2000). According to Oxfarm Novib (2010), the strategies needed to achieving a sustained livelihood are:

- The construction and caring for assets;
- Imploring national leaders and the individuals and non-governmental institutions to perform dutifully.; and
- creating prospects for the underprivileged.

2.2.3 Livelihood Outcomes

Livelihood outcomes are consequences of the livelihood approaches. These livelihood outcomes are multifaceted and are outcomes of a collective effects of resources and livelihood approaches in the sustainable livelihood framework (DFID, 1999; Farrington *et al*., (1999). Bebbington (1999) detailed that the livelihood strategies individuals and households implement leads to attaining their livelihood outcomes. These livelihood outcomes lead to fluctuations in their welfare and Such outcomes result in fluctuations in their welfare and physical constructions of their households.

2.2.4 Sustainable Livelihoods

When livelihood is sustainable, then it can withstand stress and shocks as well as maintain the capabilities and resources in the presents and the future and not deflating normal resource base (DFID, 1999). Sustainable livelihoods is an integral part of livelihood policies helping to solve developmental and asset management issues aimed at simultaneously eradicating poverty (UNDP, 1997). Within the

Framework (SLF), according to Ellis (1998), livelihoods are the activities, the assets, and the access that jointly determine the living gained by an individual or household. He then defined livelihood diversification as the process by which households construct a diverse portfolio of activities and social support capabilities for survival in order to improve their living standards.

Various organisations and institutions have developed workable solutions based on the sustainable livelihood concept. The Department for International development (DFID) of the United Kingdom (UK), OXFAM, OXFAM NOVIB, CARE, UNDP and the Institute of Development Studies (IDS) have all presented comprehensive works on understanding and addressing food security of marginalised groups in Northern Ghana. The UNDP for instance, in 2006, established the Sustainable Rural Livelihoods (SRL) Project in the then Northern, Upper East, and Upper West regions of Ghana. The project was in partnership with Africa 2000 Network, a Tamale based Non-Governmental Organisation to work in some districts in the selected regions to foster sustainable livelihoods for the rural individuals and households.

The sustainable livelihoods framework offers a wide and systematic understanding of the factors restricting or enhancing livelihood opportunities and explains how they relate to each other (DFID 1999). Sustainable livelihood approach also focuses on livelihood assets such as natural capital, social capital, human capital, physical capital and financial capital that are useful for local communities' livelihoods (Rakodi and Tony 2002). According to DFID (1999), the framework provides the main issues that influence the livelihoods of people and their interrelations. From the preparation for innovative expansion actions to evaluating their role to sustaining livelihoods. The framework particularly:

- offers specifications of vital issues and draws linkages to them;
- provides reflections to essential influences and procedures; and
- stresses on several relations among the multiple factors which affect livelihoods.

According to Ellis (1998), resources as in income, assets, social relations and opportunities are consequences of livelihood diversification. Again, Societal features like networking, gender, associations, and communal holdings, are significant. To Alinovi *et al* (2010), the SLF depicts the different context of sustainable livelihoods and how the different livelihood strategies help in achieve the livelihood outcomes.

Bennett (2010) postulates that the incidence of interchangeable livelihood resources that are capable of being used to realise the strategies of livelihood to attained the livelihood outcomes of individuals and households. To him, access to capital resources is facilitated through the transformation factors believed to contributory mechanisms to individual and household vulnerability. These factors include institutions such as civil organisations, government, and non-governmental organisations; and procedures such as the policies, laws, and culture.

The adoption of the SLF as the central point of reference, is therefore to demonstrate how natural assets, as in the case of the study focus can contribute to the wellbeing improvement of marginalised groups. The intensive harvest of native tree products by households, women and the youth can help them cope with livelihood shocks.

2.2.5 Women Empowerment

Within the context of empowerment, rural women are universally acknowledged to be the main target of several development interventions that impact on livelihoods. This is largely because rural women are more able to manage small interventions to improve their household wellbeing than their male counterparts The growing needs for rural women to contribute to the livelihood needs of the family often leaves them without choice than to engage in small businesses to raise the needed income.

Most women in rural areas have now become bread winners, working to providing the daily household food needs in support of their children wellbeing in terms of their education and health. Against this back drop, Oxfam (2017), conceived women empowerment as the process of transforming the lives of women from limited power relations to situations of equal power with their male counterparts. To Oxfam, the economic, social, personal, and political empowerment of women is interconnected; women's economic, social, personal and political empowerment is interconnected; Narayan (2002), viewed empowerment as improving a marginalised groups' assets base and abilities to engage in, negotiate with, influence, control, and hold institutions responsible which have an impact on their lives. To him, empowerment entails improving a person's or group inclusion and involvement, information accessibility, accountability, and domestic organisation capacity.

To Kabeer (1999), empowering a person involves strengthening his or her capacity in making strategic decisions especially in situations where the person is deprived of these capabilities. To him, the ability to execute strategic decision comprises the resources (ability to participate in negotiation and decision making) and achieving

(wellbeing indicators). Lakshmi & Sivasree (2012), view empowerment as increasing women economic, political and legal strength so as to promote equal rights by all persons and make them confident. To them power is central to empowerment of women and bothers on confidence, self-esteem, and awareness which can be enhanced through participation in decision making.

2.2.6 Youth Empowerment

Youth empowerment according to Vavrus and Fletcher, (2006) is the acquisition of skills, authority, and agency to make decisions to implement change in their lives and others through an attitudinal, structural, and cultural process. A basic hindrance to youth empowerment, according to the United Nations (2018), is the inaccessibility of the youth to resources because of low quality education, and unemployment. Youth empowerment is a tool to achieve youth involvement in decision making attain higher well-being (Morton and Montgomery, 2013).

The aim of youth empowerment is to improve the quality of lives through youth participation in Youth empowerment programs aimed at improving the quality of life and is achieved through participation in youth empowerment programs including: developed internship, financial, marketing, legal, advisory programs and other assistance, and creating an equal engaging field for jobs, markets, and capital to facilitate their well-being (Ledford *et al*., 2013; Zimmerman, 1990).

2.3 Native Tree Species

Africa has many well-adapted native trees. yet much of the continent's landmass is rapidly losing its native trees as population (both humans and animals), as well as investments in farming and mining are increasing (Negash, 2021). The importance of native tree species in the livelihoods of rural communities has been evidenced since decades (Larwanou, *et al*., 2010; Fandohan., 2010; Eude, *et al*., 2016). The emphasis has been on these species, not only for their role in sustaining rural livelihoods, but also for their ability to meet the challenge of on-farm biodiversity conservation (Nyoka *et al*., 2014; Haarmeyer *et al*., 2013; Eude *et al* 2016).

Indigenous trees are important components of the agricultural landscape in West Africa, especially in the semi-arid 'agroforestry parklands', where scattered trees are present in crop fields. Most farmers reportedly retain trees in cultivated fields for their valuable products and the service role they play in the soil. However, the pressure on land to meet the food demands of the ever-growing population has resulted in decreasing numbers of indigenous trees (Boffa 1999; Poudyal 2011). Such tree species as: Baobab (*Adansonia digitata*); Bombax (*Bombax costatum*); Marula (*Sclerocarya birrea*); Lannea (*Lannea spp*); Jujube (*Ziziphus mauritiana*); and Locust bean (*Parkia biglobosa*), are essential to the daily livelihoods of the both rural and urban marginalised groups. According to Dossa *et al*., (2015), these resources from the forest ecosystems are subject to various forms of harvesting and to the vagaries of the weather.

2.3.1 Baobab *(Adansonia Digitata)*

Baobab (*Adansonia digitata L.*) is valued in Africa for food, fiber and medicine. Where baobab products are sold in informal markets, they form an important source of income for the thousands of rural people (Sidibe and Williams, 2002). The baobab tree is a massive long-lived tree whose leaves, fruit pulp and seeds are comestible. Every part of the baobab is used; roots, bark, wood, leaves, flowers, gum, fruits and seeds (Wickens and Lowe 2008, Buchmann *et al*., 2010).

The baobab tree is deciduous, majestic tree up to 25m high, tick, angular, wide spreading branches and stout trunk (Wickens and Lowe 2008). The tree is one of the most important indigenous fruit trees in Sub-Saharan Africa (SSA), providing direct and indirect contribution to food security and livelihoods (Franzel *et al*. 2008). More than 300 products containing baobab have been identified on the European market (Gebauer *et al*., 2014).

According to Kamatou *et al*., 2011), baobab has antimicrobial, antiviral agent, antioxidant and anti-inflammatory features used for treating numerous diseases. It contains antimicrobial, antiviral, antioxidant, and anti-inflammatory features, and the leaves, roots, seeds, and bark are medicinal, and used to treat diseases like; malaria, hypertension, tumors, asthma, cough and other respiratory infections. (Assogbadjo, 2006; Buchmann *et al*., 2010).

Recognised for its nutritional contents, the baobab fruit is known throughout Africa and beyond (Tembo, 2016). containing pulp and seeds, the pulp can be consumed raw or cooked as food and the seed is processed into oil (Muthai *et al*., 2017). The powdered pulp can be used as wine, consumed as milk, porridge and water. The fruit

also contains some appreciably high levels of vitamin C, potassium, and magnesium (Stadlmayr *et al*., 2013). In Northern Ghana, the fresh baobab leaves (Tuukari, as is called in Dagbanli) serve as vegetable for preparing soup. The fresh leaves are also dried, and pounded into powder (Kuuka as known in Dagbanli) and used to prepare soup. As noted by Chadare *et al*., (2009), young leaves can be processed into dried leaves powder for cooking soup.

2.3.2 Baobab Product Harvest

In West Africa, baobabs bear leaves from April till November (Codjia *et al*., 2001; Sidibe & Williams, 2002; Dhillion and Gustad, 2004; Assogbadjo *et al*., 2005a; Diop *et al*., 2005; Assogbadjo, *et al*., 2006). The baobab leaves harvested, dried, and stored for use during periods of food shortages usually during the dry season. The drying and processing process, however leads to a significant reduction in the vitamin A content of the leaves (Sidibe, *et al*., 1998b; Sidibe and Williams, 2002).

After flowering in June and July, baobab fruit first ripen in December or January and harvested until April (Sidibe & Williams, 2002; Dhillion and Gustad, 2004; Assogbadjo *et al*., 2005a; Diop *et al*., 2005; Assogbadjo, *et al*., 2006).

2.3.3 Bombax (Bombax Costatum)

As a result of its poor regeneration, *Bombax costatum* is a one of the threatened species in Africa (Ouedraogo *et al*., 2006; Assogba *et al*., 2018). This is because of the intensive harvesting of its flowers for food in households and for trade (Belem et al., 2008; Assogbadjo *et al*., 2018). The species is mainly consumed as a vegetable and also as medicine, as well as for timber. Assessments of bombax ethnobotanical properties in Benin and Burkina Faso listed eight uses for the species. Food and

medicinal uses emerged the highly referred and culturally important. (Belem *et al*., 2008; Assogbadjo *et al*., 2017).

Bombax costatum is a native tree species famously called the "red-flowerd silk-cotton tree", red kapok tree, and the Gambian "silk-cotton tree" (Akoegninou *et al*., 2006). Native, and spread across the West Savanna ecological area from Chad to Mauritania, *Bombax costatum* (Orwa *et al*., 2009; Ouedraogo and Thiombiano, 2012; Assogba *et al.*, 2018), is also abundant in northern parts of Ghana where rural people depend on its products for their food and medicinal needs.

Growing between10 and 25m high, *Bombax costatum* performs well in relatively wet conditions (Ouedraogo and Thiombiano, 2012), but rarely grows over 6m in the Sahel (Orwa *et al*., 2009). Young Bombax trees have crown structure and storied, while older ones are irregular and sturdy with a thick grey-brown bark and sharp-pointed spines on the stem (Orwa et al., 2009.; Assogbadjo *et al*., 2017).

In Ghana, especially in Northern Ghana where the tree is abundant, even though the medicinal uses of the species is recognized, the only known use of 'Vabga', the local name in Dagbanli for *Bombax costatum*, for food is the flowers (Pum as in Dagbanli). 'Vabpum' as is known in Dagbanli is the flowers of Bombax. The fresh and dried red flowers are used to prepare soup, enjoyed with goat meat. In terms of the medicinal uses, bombax is known in the Northern Region of Ghana, especially among the Dagbong ethic group to possess some spiritual influences and is thus used in treating spiritual ailments. It is believed that one, upon sighting a parasitic plant on a bombax tree would not be able to see it again if he or she turns away for a brief moment. Thus, a parasitic plant on bombax is so essential in traditional medicine

treatment of spiritual sicknesses and if sighted should immediately be harvested, else it will vanish before one could harvest it.

2.3.4 Locust Beans (*Parkia Biglobosa)*

The locust bean tree (*Parkia biglobosa*) African locust bean tree (*Parkia Biglobosa*) is persistent native tree species (Akande *et al*., 2010; Simonyan, 2012). It is a deciduous tree which grows in height to between7m to 20m. It grows large and wide branches spreading down low. With a grey-brownish bark, it has a longitudinal gaps green leaf when flowering and reddish-brown during fruiting stage (Leaky, and Tomich, 1999). It is distributed extensively in West Africa and still among the known native trees in Northern Ghana (Orwa *et al*., 2009; Zakari *et al*., 2015). The locust bean tree is usually not planted but seen in clusters in the West Africa savannah regions (Hopkins, 1983).

Parkia biglobosa is an essential tree in the livelihoods of individuals and households in Northern Ghana. Providing food, medicine, and wood, the tree is vital in soil improvement and environmental protection (Peiler, 1994; Boffa, 1999; Amoako, 2012). Several studies have proved the benefits of locust beans for rural households and individuals and that the tree species should be a subject of conservation and regeneration in Africa. (Sabitti and Cobbina, 1992). Known for its fruit's food value, the growth of the African locust bean tree is from the nature. The fruit is the greatest and the most valuable part of the locust bean tree consisting of a bunch of pods (Koura *et al*., 2011).

The nutritional and dietary value of the locust bean seed is extensively used. These seeds have high protein, lipids, lysine when fermented, and vitamin B2 contents.

The locust bean has about 60% unsaturated fat, and if fermented, are applied in soups and stew as condiments and spices (Owalarafe *et al*., 2011). The condiment from the fermented locust beans is the most vital food security source in times of shocks such as shortage of food, and drought. Rural households consider it as an important socioeconomic and cultural product part of the tree (Koura, 2014).

The condiment from locust beans seeds ('Kpalgu' as it is known in Dabganli), is used to spice soups prepared from other native tree leaves such as 'Kuuka' (dried baobab leaves powder soup), tuukari maha (fresh baobab leaves soup), and vabpum soup (Bombax flowers soup). These soups are consumed daily in households as safety nets against households' consumption shocks and vulnerabilities. As in Azokpota, *et al*., (2020); and Roukaya, *et al*., (2020), the condiment is called soumbara in Cote d'Ivoire, soumbala in Burkina Faso and mali, dawadawa in Niger and Nigeria, and netu in Benin and Senegal. It is also known as Dawadawa in Ghana even though various ethnic groups have their own names for the condiment. In most West African countries, ''soumbala'' is widely consumed by the rural and urban population. It is widely acknowledged that dawadawa condiment has the ability to regulate hypertension leading to the desire for its use by both rural and urban households (Azokpota, *et al*., 2011; Yerobessor, *et al*., 2020).

2.3.5 Locust Bean Product Harvest

The techniques for harvesting locust beans are generally similar everywhere among harvesters in Africa. This is done with the use of light hooked pole where the harvester climbs the tree and leans against a bigger branch to stretch out the hooked pole to harvest the bunches of pods (Akande *et al*., 2010). A tree of Parkia boglobosa

produces approximately 25-52kg of pods 6-14kg of beans may be harvested (Odunfa, 1982).

2.3.6 *Lannea SPP* (*Lannea Macrocarpa)*

Lannea Macrocarpa belongs to the family of Anacardiacea comprising approximately 40 species limited to Africa. Frequently referred to as African grape, *Lannea macrocarpa* is broadly dispersed in sub-Saharan Africa from Senegal to Cameroon. The tree reaches about 15m in height and 70cm in diameter (Marque and Jansen 2005). To Sinsin and Kampmann (2010), the trees grow in western Sahel and does well in the sand.

Lannea macrocarpa is a locally significant tree species related to plants in agroforestry parklands and protected in home gardens in Northern Benin (Sinsin and Kampmann, 2010; Eude, et al., 2016). The fruits of Lannea can be freshly consumed of processed into drinks. The bark is applied to dye cotton fabrics, and in medicine (Market and Jansen, 2005; Eude, *et al*., 2016). Lannea seeds contain edible oil that can also be used for cosmetics production (Bazongo *et al*., 2014; Eude, *et al*., 2016). It can also be used to produce biodiesel with physiochemical properties similar to that derived from jatropha curcas (Yunus *et al*., 2013; Eude, *et al*., 2016).

2.3.7 Marula (*Sclerocarya Birrea)*

Emerging from the Greek *scleroses,* which means hard and *karyon* which means nut (Shone, 1979), marula (*Sclerocarya birrea*) is a member of the Anacardiaceae family which is an indigenously wild fruit tree (Mojeremane and Tshwenyane 2004). Marula, according to Xaba (2011), is a precious medium-sized native fruit tree that reaches 17m high, having a round and spreading crown. It grows naturally in the

eastern and Southern African countries (Orwa, *et al*., 2009). The species perform well in low altitude. With a rough bark, giving it a mottled appearance, the leaves are arranged spirally (Palgrave, 2002).

Marula is widespread in Africa, growing in variety of vegetations including; open woodland, deciduous and semi-deciduous savannah and forest (Helm and Witkowski, 2012; Gouwakinnou *et al*., (2009). It produces better in altitudes around 1,800m above sea level and where forests are not so endemic because the tree is sensitive to cold environments. (Ngorima, 2006; Elijah *et al*., 2015). Marula tree desires temperatures between 10℃ to 40℃ (Coezee *et al*., 1979). The tree species is drought resistant growing in humid to sub-humid areas with a rainfall of 1,500ml (Hamidou *et al*., 2014). Fruits from marula are plum-sized, thick yellow peel and Female trees bear fruits that are plum-sized fruits with thick yellow peel and a white glowing aromatic sweet-sour fruit which can be eaten raw (Hiwilepo, 2013; Maroyi, 2013).

Marula utilisation is a main income generating venture for individuals and households producing a wide range of products like juice, oil, soda, and butter. (Leakey, 2005). As a climacteric fruit, Marula fruit ripens on the ground after abscission (Emongor and Tautsagae, 2016). To Hall *et al*., (2000), the marula fruit is a specialized stone made up of 2-5 carpel, and 96 separate stigmas. The fruit is freshly eaten, and can also be processed into juice, alcoholic beverages, dry fruits, and jam (Mizrahi & Nerd, 1996). The fruit is acidic, bitter but when fully ripe, has a pleasant flavour (Hewlepo, 2013). Animals like; elephants, monkeys, cattle, baboons, and porcupines also consume the vitamin C rich marula fruit (Helm & Witkowski, 2013; Pegg, 2014).

2.3.8 Marula Tree Product Harvest

Marula harvesting is significant in the livelihoods of rural households and close supervision is needed to ensure the regeneration of the tree species. Rural households and farmers collect tree parts of marula such as fruits, and seeds for household consumption (Leakey, 2005). According to the Swaziland Indigenous Products (2012), women are usually the sole collectors of marula products. They pick up the fallen ripped fruit from the ground.

2.3.9 Jujube (*Ziziphus Mauritiana)*

Ziziphus Mauritiana is a hardy native tree species which copes with high temperature and dry conditions. Quality jujube fruit is ideal in dry, hot and sunny environments even though some amount of rainfall is needed to support production. Jujube is native to both tropical and subtropical zones of Africa and more prevalent in annual rainfall between 300-500. The tree can endure environmental conditions such as; drought, salinity, and waterlog areas (Orwa *et al*., 2009).

Jujube is preserved in farmlands in sub-Sahara Africa for its nutritious fruits and planted as fences to protect crops (Bonkoungou *et al*., 1999). Jujube is a timeless shrub growing up to a height of 15m, with a 40cm truck, and loose branches. The bark is grey, and at severed climatic conditions, it only grows to about 3-4m tall (Orwa *et al*., 2009). Jujube contains 81-83% moisture, vitamin A, B complex and C. It also contains about 22% sugars; galactose, fructose, glucose, organic acids, fatty acids, amino acids, minerals, linoleic acid, and polynols (Wojdylo *et al*., 2016).

2.4 Native Tree Product Harvest

Rural individuals and households especially women in sub-Saharan Africa have been encouraged to engage in harvesting native tree products for trade to generate income (UNEP and IISD, 2004; Ladefoged *et al*., 2009; Myerson, 2015). However, natural products harvesting contribution to the livelihoods leads negative effects on the environment. For instance, the development of markets for Non-Timber Forest Products may result in the over exploitation of the native trees which consequently will lead to the extinction of the species (Neumann and Hirsch, 2000).

Amoako (2012), found varied ownership systems of *Parkia Biglobosa* in the study of sustainable land management and tree tenure in the Northern Region of Ghana. Her study discovered differences in tenure systems in the Dagbong, Gonja and Mamprugu kingdoms with consequences for *Parkia biglobosa* trees' growth and for land management sustainability. The Dagbon and Gonja tenure systems have a regulatory system where ownership of the tree species if vested in a traditional chief called the Dohi (*Parkia biglobosa* trees) Naa (Chief) with responsibility to protect the trees from destruction. In contrast, ownership in the Mamprugu traditional areas has an open access system where trees are not protected from destruction.

2.5 Quantities Harvested for sale and for Household Consumption

Sogodogo *et al*., (2021), found in their study of farmers' perception of the impact of exploiting baobab leaves on its preservation and on livelihoods of local communities in Mali that baobab leaves appear to be the most NTFP product of high value to farmers in Mali. De Caluwe (2011), in his study of market chain analysis of baobab

and tamarin products in Mali and Benin that majority of baobab fruits harvested in Mali are for home consumption.

Wild fruits harvested from native trees are usually done through different methods these include picking fruits from the ground after fruit abscission, picking fruits after climbing the tree, throwing things to dislodge the fruits, shaking stems or branches, and hitting stems and branches (Kadzere *et al*., 2002). To Ham and Akinnifesi (2006), these outmoded techniques of harvesting damage the fruits and cause so much damage to the trees, cause fruit bruises, and reduces the shelve live of fruits.

According to Akande *et al*., (2010), as in Simonyan (2012), harvesting techniques of locust beans is generally same using light hooked pole. After climbing the tree, the farmer stretches the hooked pole to reach every bunch. In developing and experiment of eccentric type vibratory harvester for forest fruits in China, Wang *et al*., (2012) discovered that beating tree branches and collecting the falling fruits manually have been and is still in some areas, the traditional harvesting method.

To Kadzere *et al*., (2002) the ripening patterns of native tree fruits need to be studied to understand and determine the application of techniques of harvesting unripe fruits for post-harvest ripening. To Maroyi (2013), marula fruits may be harvested by anyone in South-Central Zimbabwe, even though women are usually involved in the harvesting as they are those who process the fruits to produce juice, and a general rule for all wild fruits allows the fruit to fall first and then harvested. In the Limpopo Province in South Africa, as reported in Tapiwa (2019), Shackleton and Shackleton (2005) reported that a very stringent policy guiding the harvesting and handling of marula tree species and that it is only fallen fruits that are harvested. To ensure

sustainability, it is only fruits that fall to the ground that are harvested and any fruit harvested from the tree would be rejected.

2.6 Factors Influencing Native Tree Product Harvesting Intensity

Mwema, *et al*., (2013), found in Kenya that a kilometer increase in the distance to the market would decrease the likelihood of a household to participate in harvesting native tree fruits. This, according to them is due to the additional expenditure and time required to transport the fruits. Again, Saha and Sunddriyal (2012) found in their study of utilisation of NTFP in humid tropics that living closer to the market is more likely to influence a household to collect NTFP. In a study of farmer perception of the impact of *Adansonia digitata* leaves exploitation in Mali, Sogodogo, *et al*, (2021), found that age, education of household head, and sex are major influencers of harvesting baobab leaves. Their findings rather did not find marital status to influence baobab leaves harvesting.

Suleiman *et al*. (2017), found in Nigeria that people living closer to forest reserves are more likely to collect forest products for their livelihoods. Again, Ndayambaje *et al*., (2012), found a strong impact of tree product sales on the availability of trees on farms. To them, as living in an agroecological region increases the probability of selling NTFPs by 40%.

Mwema *et al*., (2013), discovered in Kenya that marital status of household head was significant in influencing household decision to engage in harvesting indigenous fruit for trade. They found that a divorced household head was more likely to engage in native tree fruit harvest than that of married household head. This is corroborated by Murye (2017), that marital status influence respondents' decision to take part in

harvesting marula products. He found that separated, divorced and widowed respondents are more likely to harvest marula products to supplement their household income.

Mwema, *et al*., (2013), revealed sex of household head to be a significant determinant in harvesting indigenous fruits for trade. Also, Ntiwane (2015) found in Kenya that harvesting of marula fruits are usually done rural women. Murye (2017), in his analysis of ecological and socio-economic sustainability of marula harvesting in the Lubombo Region, Swaziland found a statistically significant relationship between gender and harvesting marula products. He discovered that women were more inclined to harvest marula for household income generation than their male counterparts. Suleiman *et al*., (2017) found in Nigeria that main occupation of a household head significantly influences his decision to participate in the collection and utilisation of NTFPs. To them household heads who are engaged in formal employment are more likely to engage in NTFP harvesting.

Adikhari, *et al*., (2014), found household size to significantly affect household decision to harvest NTFPs in their analysis of household features and forest dependency in Nepal. Also, Suleiman *et al*., (2017), found household size to significantly influence the collection of NTFPs in Nigeria. Again, Mujawamariya and Karimov (2014) found larger households to rely on the harvest forest resources for their food requirements. This is supported by the findings of Murye (2017), who found a statistically significant relationship between household size and harvesting of marula products for household income. He found that larger households are more inclined to harvesting the marula products to supplement their income than smaller households. Omotesho *et al*., (2013) found in their study of awareness and usage of

baobab in rural Nigeria that consumers who are aware of baobab products and their benefits were more likely to use the products.

Analyzing the economics of harvesting and marketing selected indigenous fruits in Kenya, Mwema *et al*., (2013), found that, higher and middle-income earners were less likely to engage in indigenous fruits trade. His findings were supported by Murye (2017), in his analysis of environmental and socio-economic sustainability of marula harvesting in the Lubombo Region, Swaziland. Analyzing the importance of socioeconomic factors in the collection of Non-Timber Forest Products (NTFPs) in Kenya, Mujawamariya and Karimov (2014), found a higher dependency on forest resources for those living closer to the forest. Also, Suleiman *et al*., (2017) found that the further a household from forest reserve, the less likely the household would engage in harvesting forest products. Murye (2017) found age to be a statistically significant indicator for harvesting marula products for income generation in Swaziland. His study found that older household heads are more likely to engage in marula products harvesting than younger household heads.

2.7 Native Tree Product Harvesting Contribution to Livelihood Outcomes

Kehlenbeck *et al*., (2013), in their study of the variety of indigenous fruit trees and their influence on nutrition and livelihoods in sub-Saharan Africa discovered that the production of native trees contributes to livelihood improvement of households. This was corroborated by Tanimonure, *et al*., (2021) study of underutilizes indigenous tree products for households' nutritional variety in Southwest Nigeria. In this vein as regards livelihood outcomes, Uberhuage *et al*., (2012), found in Bolivia that wealthier households were the most harvesters of NTFPs in their study

of forest income dependency in lowlands. Similarly, Kibria *et al*., (2016) found in their study of the relations between livelihood capitals and access of local communities to the forest provisioning services of the Sundarbans Mangrove Forest in Bangladesh that households with larger financial capital tend to harvest higher volumes of NTFPs.

The contribution of these harvested native tree products to the daily wellbeing of people has been well documented in Africa. For instance, Venter and Witkowski (2013) discovered in South Africa that income from baobab fruit sale can assist households to reduce poverty. Also, they concluded that several products from the baobab tree serve as buffer in periods of shocks for people in the arid and semi-arid areas because of its capacity to produce fruits when other plants are not able to produce. According to UNDP and UNEP (2009) as in Murye and Pelser (2018), the boundary that exist between household poverty, rural livelihoods and marula harvesting in Swaziland reflects the reliance of impoverished rural populations on natural capital demonstrating the complex relationship between people and the ecosystem in which they live. Murye and Pelser (2018) found in their study on commercial harvesting of Marula in Swaziland that a greater percentage of rural individual and households relied on marula products harvesting for their livelihoods in addition to subsistence crop and animal production

Farayola *et al*., (2012) found in Nigeria that locust beans harvest serves as food buffer during lean periods while reliable income accrues to farmers and women involved in collection, processing, and marketing of product. To Simonyan (2012), harvesters must either buy the locust beans or acquire the harvesting rights from the owner.

2.8 Review of Empirical Literature

Analysing the factors contributing to the consumption expenditure of rural farm households in South Africa, Manyaja *et al*., (2018), found after using Poisson regression that access to credit, marital status, single crop cultivation, farm income, and credit access decrease household consumption expenditure significantly. also, in using the instrumental variable approach to examine the welfare effect of livelihood diversification among rural households in Ghana, Mahama & Nkegbe (2021), found education, marital status of household head, livelihood diversification, sex, urban residential status, sex, and religion had a significant and positive effect on welfare of households.

Using the Heckman selection model, Sebatta *et al*., (2014), analysed the factors influencing smallholder farmers' decision to participate in potato market in the Eastern part of Uganda. Khonje *et al*., (2018), found that farmers participation and adoption of agricultural technologies significantly increase their income and yield than those who did not adopt. Again, they found that farmers participation and adoption of multiple agricultural technologies was influence by education, rainfall, gender, land tenure, distance from home to farm and access to market information. Omotayo and Aremu (2020), Evaluated the factors influencing indigenous plants inclusion in household food security using binary logistic regression in South Africa and found that gender of household head, educational status of household head and religious denomination of the household head had positive and significant influence on the probability of a household being food secure. Analyzing household food security and strategies for coping using the Ordinary Least Square (OLS) regression in rural Ethiopia, Tefera & Tefera (2014) found age of household head, gender of

household head, and education to be significant, positive, and essential to improve household food security.

This study used the OLS regression to analyse the factors that influence harvesting intensity of native tree products by rural households in the tree study areas. The study however did not use the conventional income and consumption measurements of livelihoods to measure the contribution of native tree products harvesting on rural households' livelihoods. Instead, the study employed the Livelihood Endowment Status (LES) of households to determine their livelihood status in terms of their assets acquisition. This methodology was used by Lackow (2006), in his analysis of the impact of microfinance on the livelihoods of rural households in Uganda.

2.9 Theoretical Framework of the Study

The theoretical framework for this study is the utility maximisation theory. A households' choice to participate in the harvesting of native tree products depends on the benefits he or she derives from the choice of tree and the tree product. Such individual will choose to harvest the tree or tree product that maximizes his/her utility. According to McFadden (1974), households' decision-making process can be explained by the utility maximisation theory with a base from the random utility theory. To Clifton & Handy (2001), utility maximisation suggest that households assess every opportunity coming their way with complete knowledge of all substitutes and choose the opportunity that maximizes their utility.

In essence, decision maker, ***n*** faces a choice set among, ***j*** alternatives. The decision maker obtains a certain level of utility or profit or satisfaction ***(U)*** from each alternative selected. The utility that decision maker ***n,*** obtains from alternative ***j*** is

given by ***Unj***. The utility is known to the decision maker but not the researcher. The decision maker chooses the alternative that produces the highest utility. Hence, given a choice set to a household as to choose to harvest the products of a particular native tree from among a number of native trees, the household **n**, will act based on the utility it will derive from a native tree product. The household will choose the tree product that will maximise his/her desired utility.

In the random utility approach, as in Gujarati (2003), an individual chooses between alternative outcomes based on expected utility, by assuming that a decision maker derives the highest utility from any alternative chosen. The utility has both systematic (***Vim***) and random (e***im***) components. It is assumed that the individual will choose the alternative or outcome that maximizes the expected utility derived from that choice. Consider an individual, ***i***, who chooses among alternatives ***m*** in the choice set. The utility function is given by;

$$Uim = Vim + eim$$

It is assumed that the systematic component (*Vim*) is a linear function of some variables, including personal or individual specific characteristics. Thus;

$$Vim = \chi im bim$$

As Rungie et al., 2012) posited, the utility an individual or household derives from a choice set depends on its features, which is (χim) and those of the alternative choices. The variable, *b*im is unobservable, leading to the following relation;

$$Uim = \chi imbim + eim$$

In the above setup, it is assumed that individual ***i,*** chooses choice ***m*** if

$$Uim > U\,ij \text{ and } j \neq m$$

The power of the random utility model is its flexibility to accommodate more than two choices as well. The probability that an individual chooses alternative ***1*** is just the probability that the utility from alternative ***1*** is larger than the utility from alternative ***2***. Thus,

$$Pr\ (y_i=1) = Pr\ (U_{i1} > U_{i2})$$

$$= Pr\ (V_{i1} + e_{i1} > V_{i2} + e_{i2})$$

$$= Pr\ (e_{i2} - e_{i1} < V_{i1} - Vi_2)$$

2.9.1 Conceptual Framework

Figure 2.1 depicts the conceptual framework of the effects of harvesting native tree products harvesting on the livelihoods of rural households. It shows the linkages in household struggles to cope with seasonal variations in their livelihood entitlements and explains the household characteristics that are likely to influence the decisions of the household in the type of strategies to employ.

The livelihood strategies employed explain the household assets acquired as a result of the exploration of natural resources at the disposal of households. These livelihood assets acquired from native trees explored leads to the attainment of the desired livelihood outcomes such as increased income, improved well-being, reduced vulnerabilities, and food security.

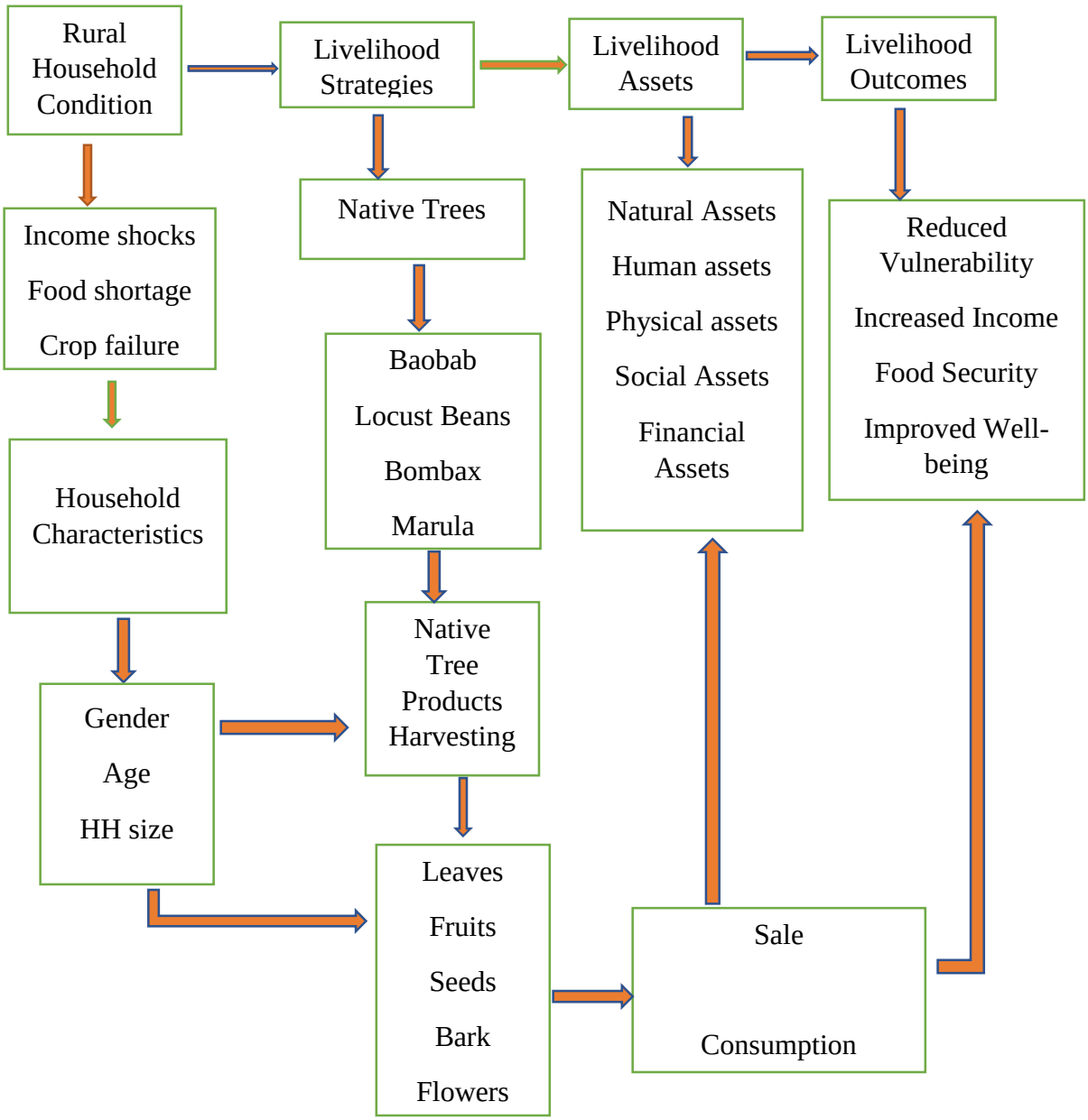

Figure 2.1: Conceptual Framework of the Study

Source: Researcher's Construct (2022)

In this study household demographic features like age, sex, marital status, income, distance to market and trees, occupation, access to credit and size influence the desire to engage in harvesting native tree products. A household chooses to harvest products that adds some value to its well-being through sale or consumption of the products. The choice of harvesting to consume or to sell contributes to realising the

acquisition of various livelihood assets as the human assets, natural assets, social asserts, financial assets, and physical assets. Ultimately, households will realise their livelihood outcomes, such as reduced vulnerabilities, increased in incomes, food security, and improved well-being of households.

2.9.2 Summary of Literature Reviewed

The chapter reviewed literature on livelihoods and sustainable livelihoods framework, native tree species, and the theoretical framework of the study. Literature that centered on the individual tree species, their harvesting practices, the quantities of the tree products harvested; whether for household consumption or for sale, the factors that influence the harvesting of the tree products, and the influence of the native tree harvesting on the livelihood outcomes of the rural households.

These studies reviewed applied different methods in attaining their objectives. The linear probability models of logit and probit, as well as binary logistic regression were widely used to measure factors influencing household choice in participating in project interventions. Others used the propensity score matching to analyse household decision between participation or not in project, or other interventions. However, all literature reviewed concentrated on the income and consumption measures of measuring household well-being and livelihood attainment without really measuring the livelihood endowment status of households. This study therefore shifted from the traditional income and consumption measures of household livelihood to measuring the livelihood endowment status of households in order to addressed these shortfalls from the literature.

The literature revealed that majority of respondents harvest most native tree products for household consumption. It also found that men harvest most native tree products, and that distance to the trees is a major influencer to intensive harvesting of the native tree products. The review also discovered that native tree product harvesting contributes significantly to increasing household income.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research procedure for realising the objectives of the study. It starts with description of the study area, the research design, the population of the study, sample and sampling procedure, research instruments, data collection and analysis procedures.

3.2 The Study Area

Data for this study was sourced from one district and two Municipalities of Northern Ghana. These are, the Kumbungu District in the Northern Region; the Kassena Nankana Municipality in the Upper East Region; and the Nandom Municipality in the Upper West Region. Northern Ghana comprises five regional boundaries of Ghana. They are the Northern Region, Upper East Region, Upper West Region, Savannah Region and North East Region. These regions according to the 2021 Population and Housing Census (PHC) collectively contain 5,825,879 inhabitants, representing about 19% of Ghana's population. The Northern Region which is the largest of the five regions has a population of 2,310,939 followed by the Upper East Region with a population of 1,301,226. The Upper West, North East and Savannah Regions have populations of 901,502, 658,946, and 653,266 respectively.

Three regions of Northern Ghana according to the 2021 PHC have the lowest proportion of urbanized population. The Upper East region has the lowest proportion of urbanized population of 25.4%, with the Upper West, and Savannah regions having 26.4% and 29.6% respectively. The North East region has an urbanized

population proportion of 32.6%, while the Northern Region has the highest proportion among the five regions with an urban population proportion of 47.4%. The implication of this is that the five regions are more rural than urbanized as the average proportion of urbanized population is 32.28%.

The Northern Region, from the report of the 2021 PHC, has a total household of 437,934 with an average household size of 5.2 people, with a total household population of 2,275,197 people, and a non-household population of 35,742 people. The report puts the total households of the Upper East Region at 264,404 households, with an average household size of 4.8 people with a total household population 1,272,072 people and a non-household population of 29,154 people. The Upper West Region according to the report, has a total household of 190,193 households, with an average household size of 4.6 people, a total household population of 875,474 people and a non-household population of 26,028 people. The map of Ghana showing Northern Ghana and the study areas is as in figure 3.1 below.

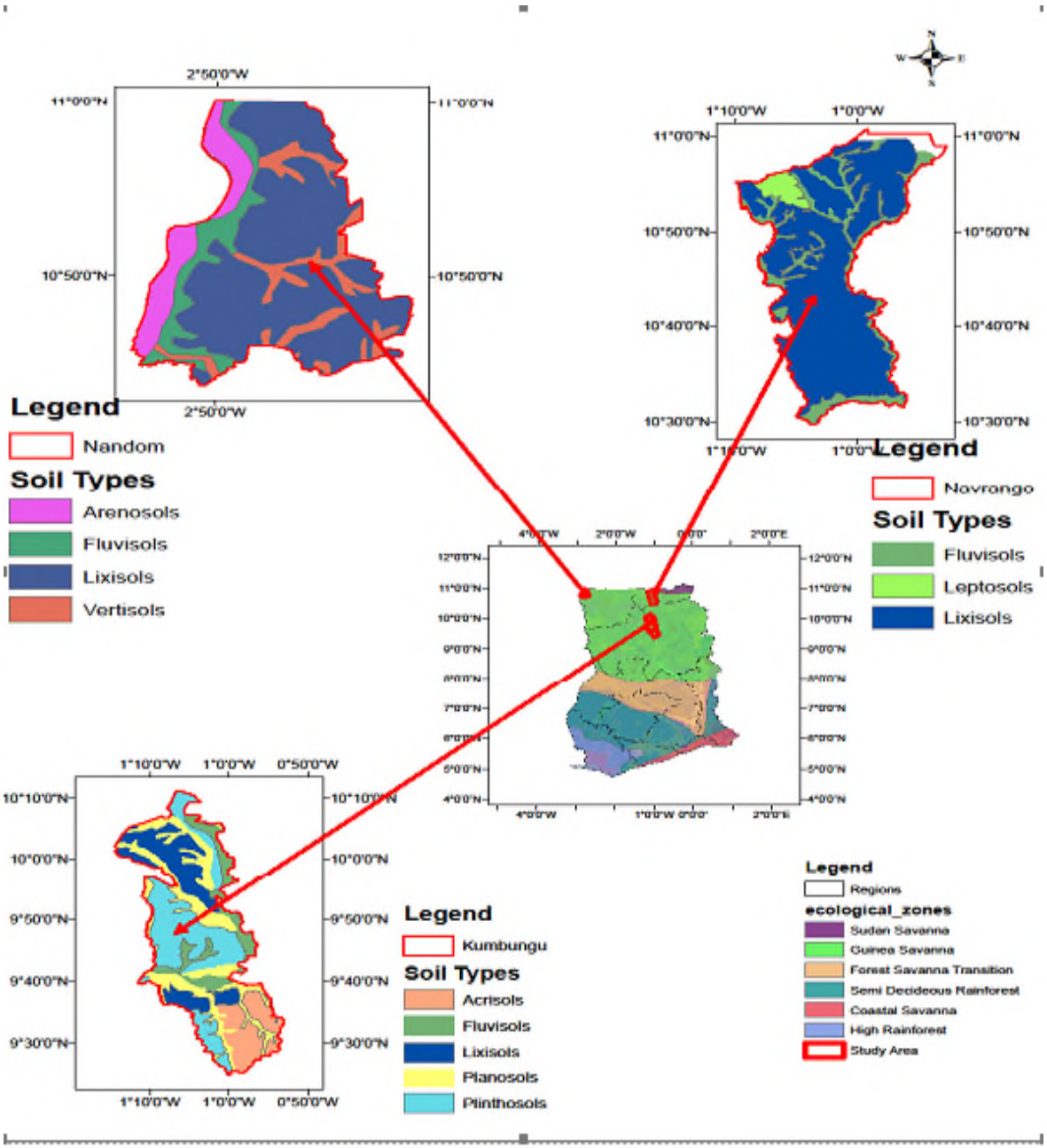

Fig. 3.1: Map Showing the Study Areas

Source: Researcher's Construct (2022) with extract from Ghana map.

3.2.1 The Kumbungu District

The district was created in 2011 from the Tolon/Kumbungu district through L. I. 2062 and inaugurated in June 2012 naming Kumbungu as the capital. Sharing

boundaries with Mamprugu/Moagduri, Tolon, and North Gonja districts to the west, Sagnarigu district to the south and Savelugu Municipality to the east, the district has a land mass of 1,599sqkm. It is one of the smallest districts in Northern Region (GSS, 2014). The 2021 Population and Housing Census estimates the district's population density at 71.5 persons per squared kilometer.

The district as in the other districts of the North, has two seasons; rainy season and dry season. The rainy season starts in May and last up to October, with July to September being the peak of the rains, recording up to 1000mm of rains annually, leading to flooding. The dry season starts in the latter part of October and goes up to end of April (GSS, 2014).

Having a Guinea Savannah vegetation combined with short drought resistant tree and grassland, the soil is sandy loam except in low land areas with alluvial deposits. The main economic tree species being integral to the livelihoods of the people are the shea, locust beans, and mango (GSS, 2014).

The Kumbungu district has 115 communities in 24 electoral areas, with one town council and area councils. These are; Gupanerigu, Gbulung, Zangbalung, Dalun, and Voggu Area Councils, and the Kumbungu town council as the administrative capital (Kumbungu District, 2021). According to the 2021 PHC, the total population of the Kumbungu District is 110,586. This comprises an urban population of 27,694 representing 25.04%, and a rural population of 82,892, representing 74.96%. Total male population is 55,291, representing 49.99%, whiles female population is 55,295,

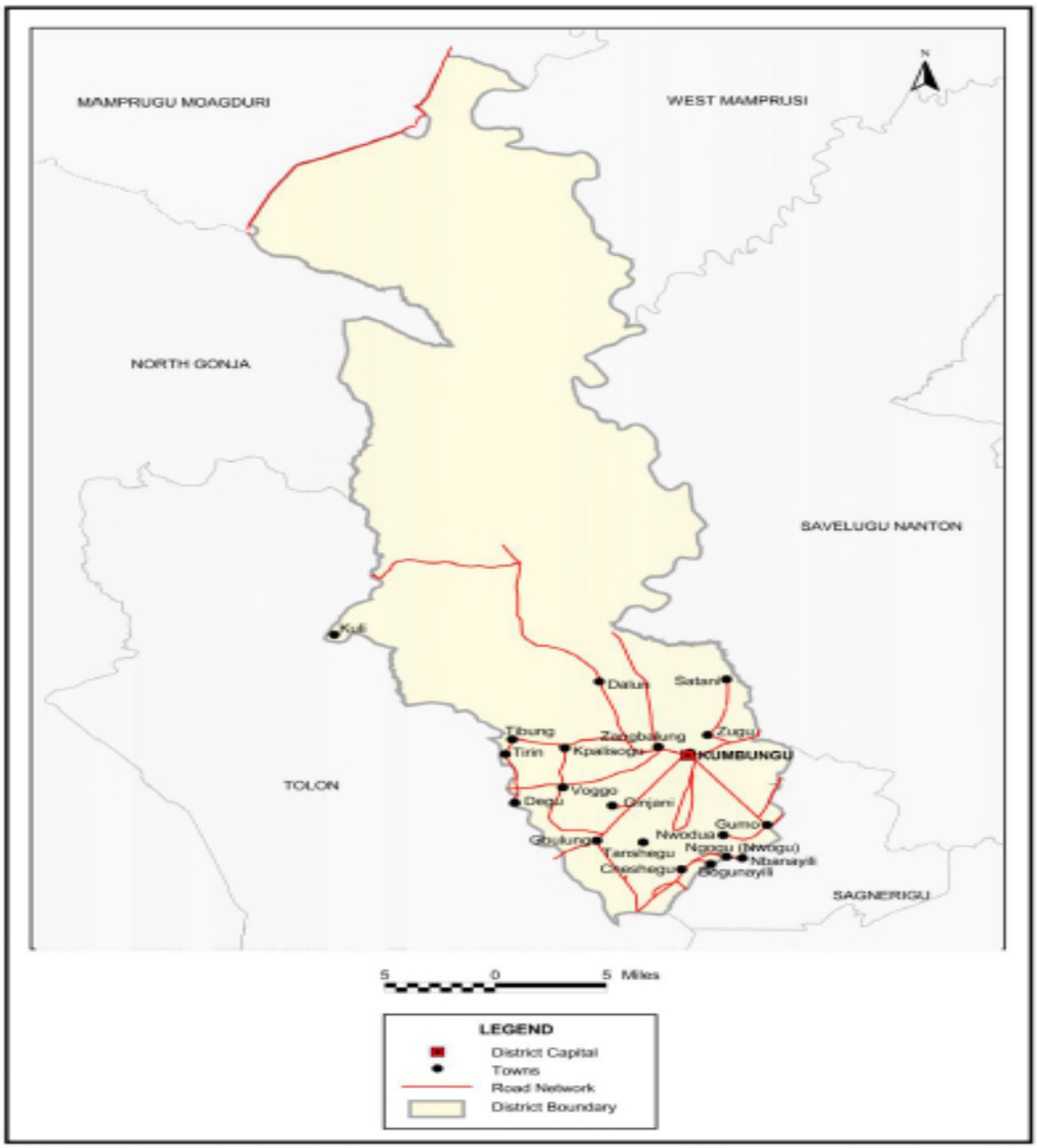

Figure 3.2: Kumbungu District Map

Source: GSS, 2014

representing 50.01%. This shows that male and female population in the district are almost the same, with female just more than men by four (4) inhabitants.

The 2021 PHC puts the number of households in the Kumbungu District at 17,766, representing 4.06% of the total household population in the Northern Region. The district has a household population of 109,486 households and a non-household population of 1,100 inhabitants and an average household size of 6.2 people.

3.2.2 The Kassena-Nankana Municipality

Elevated from the Kassena Nankana District to the Kassena Nankana Municipality by LI 2106 in 2011, the municipality is having Navrongo as its capital politically and administratively (GSS, 2014). The 2021 population and housing census estimates the total land cover of the municipality to be 865Km² and a population density of 66.8 inhabitants per square kilometer.

The municipality has 6 urban/Area Councils. These are; Navrongo urban council Manayoro Area Council, Kologo Area Council, Naaga Area Council, Pungu Area Council and Doba Area Council. The Municipality is sub-divided into 6 Urban/Area Councils namely; Navrongo Urban Council, Manyoro Area Council, Kologo Area Council, Naaga Area Council, Pungu Area Council and Doba Area Council. Comprising 35 electoral areas, the municipality has 99 communities in one constituency (KNMA, 2014).

The municipality shares borders with Kassena Nankana West district and Burkina Faso to the north, Kassena Nankana and Bolgatanga Municipality to the east, Builsa district and West Mamprusi to the west and south respectively (GSS, 2014). The West Mamprusi District, south of the KNEM is now in the North East Region as a result of the creation of two new regions out of the Northern Region in 2018 (GSS, 2014).

The climatic condition of the KNM known to have dry and wet seasons, influenced by the North east trade winds and the south-westerly. The winds are usually characterized by dry and dusty without any rains from the Sahara Desert. Temperatures usually rises up to about 42℃ during the day and as low as 18℃ between February and March. The rains, which is the tropical maritime occurs between May and October with an average rainfall of 950mm (GSS, 2014). The Municipality is within the guinea savannah woodlands, covered by the Sahel and Sudan-savannah vegetation made up of savannah grassland. Major trees in the municipality are the locust bean, baobab, shea, and mango (GSS, 2014). Figure 3.3 presents the map of the municipality.

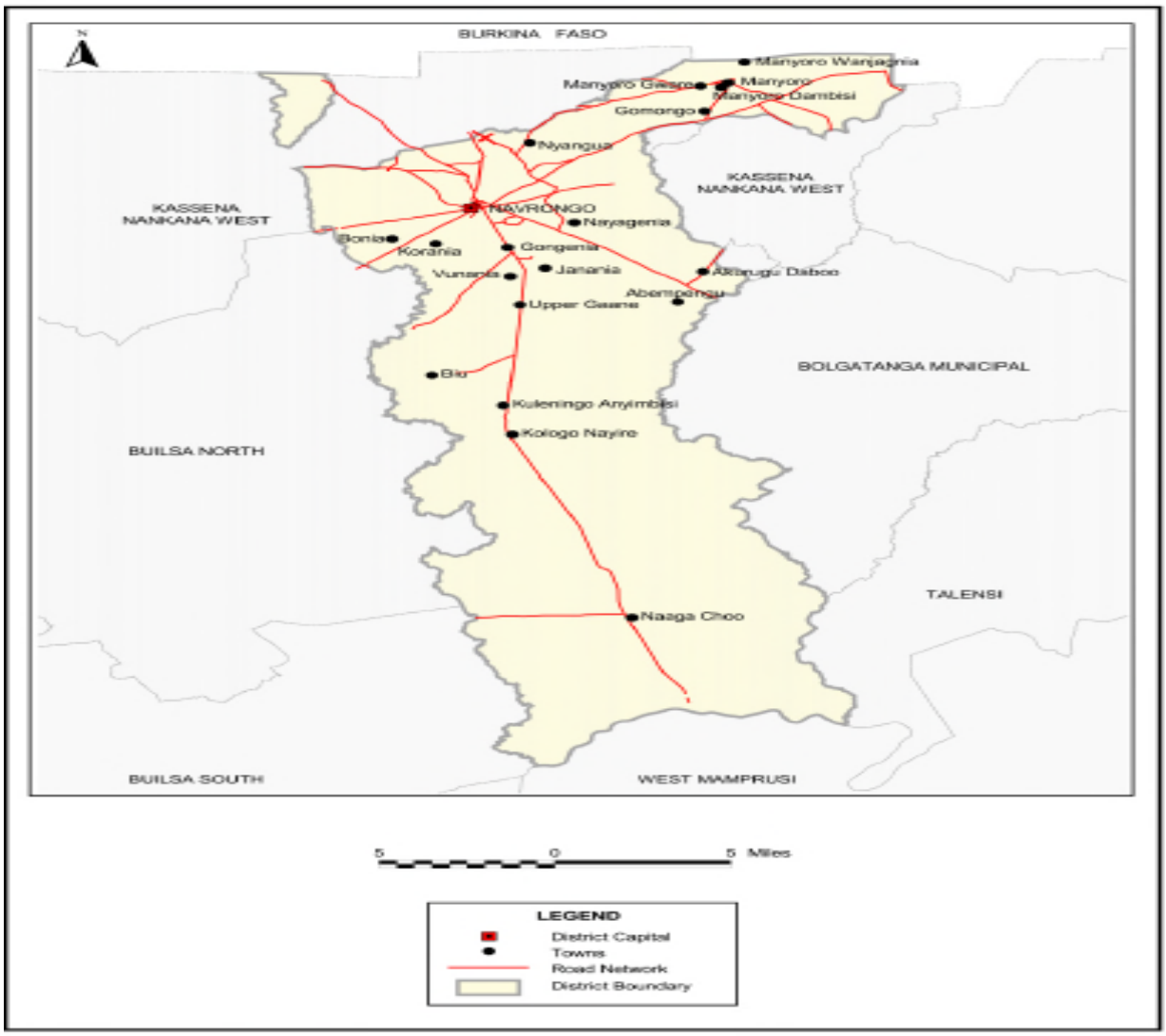

Figure 3.3: Map of Kassena Nankana Municipality

Source: Ghana Statistical Service (2014)

The Municipality, according to the 2021 PHC by the Ghana Statistical Service, is estimated to have 99,895 inhabitants, comprising of an urban population of 28,736 representing 28.77%, and a rural population of 71,159, representing 71.23%. This shows that the Municipality is largely rural. Male population constitutes 48,658, representing 48.71%, while female population constitutes 51,237, representing 51.29%. The Municipality has a total household of 23,176, with an average

household size of 4.1. Total household population in the Municipality is 94,066 and a non-household population of 5,829 people.

3.2.3 Nandom Municipality

Established by LI 2102 in 2012 with Nandom as its capital, having been taken out of the Lawra district, the Municipality is one of the 11 districts of the Upper West Region of Ghana (GSS,2014). It was elevated to a municipal status on 27th January, 2020.

The municipality is bordered to east and south by Lambussie and Lawra respectively. To north and west, the Municipality is bounded by Burkina Faso. the municipality has a land area of 404.6 square km. representing about 3.1% of the upper west Region's land area. The municipality has 84communities with 86% dwelling in rural areas. It has one town council, three Area Councils, and twenty-two-unit committees. With a population density of 114 per square km, the municipality is the most densely populated district in the Upper West Region. (GSS, 2014). However, the 2021 population and housing census estimated the population density in the municipality to be 132.8 inhabitants per square kilometer.

Falling within the Guinea Savannah zone, the municipality has a vegetation consisting of short grasses with scattered fire-resistant trees such as shea, acacia, and baobab. The vegetation is very congenial for livestock production, which contributes significantly to household incomes in the municipality. The prolonged dry season has a significant influence on the vegetation when the grasses dry up leading to bush burning. (GSS, 2014). Figure 3.3 shows the map of the Nandom Municipality. The

vegetation cover is usually depleted by human activities such as tree felling for wood and charcoal. This ultimately leads to soil infertility (GSS, 2014).

Figure 3.4: Map of Nandom Municipality

Source: Ghana Statistical Service, (2014)

The municipality has a mean monthly temperature of between 21°C and 32°C rising to about 40°C. The lowest temperature is usually 12°C around December at the peak

of the harmattan. The municipality like every district in the Region has one rainy season limiting crop production to between May and October when the rains are certain. (GSS, 2014).

The Municipality according to the 2021 PHC, has a total population of 51,328, comprising an urban population of 6,754 people representing 13.16%, and a rural population of 44,574 people representing 86.84%. This clearly puts the place as a rural Local Government (LG) area. The 2021 PHC also reports the total households in the Nandom Municipality to be 9,864 with an average household of size of 5.0 people. Total household population is reported at 49,498 people, and a non-household population of 1,830 people.

3.3 Research Design

The study is a cross sectional and employed a mixed method comprising quantitative and qualitative methods to collect primary data through a household survey in the selected communities. The household survey was conducted with funding from the Climate Change Resilient Ecosystem Services (CRES) Project, and the West Africa Center for Water, Irrigation and Sustainable Agriculture (WACWISA) on the various native trees and their contribution to the livelihoods of households in the three study areas between July and September 2022. Numerical data was generated to explain the relationship between variables. Data was also collected through interviews and focus group discussions. Respondents were grouped into women groups, men groups and youth groups. Interview guide was prepared to guide the focus group discussions. The discussions were held separately and on different dates.

3.4 Population

Based on the WACWISA-CRES project objectives, the population for the study comprised all households'; men, women and youth in the Kumbung, Navrongo, and Nandom in the Northern, Upper East and Upper West Regions of Northern Ghana respectively. Respondents were drawn from rural communities comprising household heads, women and youth in households.

3.5 Sample and Sampling Technique

The sample frame for the study are households in the Kumbungu District, Nandom Municipality, and Kassena Nankana Municipality of the Northern, Upper West and Upper East Regions of Ghana respectively. This comprises a study of all household members; household heads, women and youth in households.

The multi-stage sampling technique was used to obtain 324 household respondents through the Cochran (1963) formula for sample size determination for the study. Using the total populations of the study areas, this number comprises a minimum of 152 households in Kumbungu District, 137 in Kassena Nankana Municipality, and 72 households in the Nandom Municipality.

A total of 14 communities were purposively selected by the CRES Project for the study as presented in table 3.1. This is because of the presence of the native tree species in these communities. Each community was grouped into five zones and the households were randomly selected from each zone to constitute the study sample for the community, using the simple random sampling technique. The simple random sampling allows all respondents to have equal chance of being selected for the study. As seen from the computations, approximately 361 respondents were

selected for the study, however, at the end of data cleaning, 324 questionnaires were remained and was used for the analysis.

Table 3.1: Sampled Communities

District	Number of HH	Population	Communities Sampled	Percentage	Sample Size
Kumbungu	17,766	110,586	Gbulung	42.24	36
			Jizaa-Gundaa		30
			Jakpahi		30
			Tonjing		28
			Kpalga		28
			Total		**152**
KNEM	23,176	99,895	Chiana	38.16	32
			Pindaa		32
			Kologo		25
			Naaga		24
			Katui		24
			Total		**137**
Nandom	9,864	51,328	Zimoupare (Golo-Yir)	19.6	24
			Zimoupare (Boo)		17
			Kussela		16
			Gengekpe		15
			Total		**72**
Total	**50,806**	**261,809**	**14**	**100**	**361**

Source: Researcher's Field Work (2022), with Populations from GSS (2021)

$$nf = \frac{z^2 \times p \times q}{d^2}$$

Where:

nf = desired sample size when estimated population is greater than 10,000.

P = proportion in population estimated to engage in native tree product harvest.

d = level of statistical significance

q = 1 – p

As the standard deviation of the sample is not known, the study adopted Fisher *et al.*, (1983) recommendation to use a p-value of 50% when the standard deviation of the sample is not known. Hence the expected level of statistical significance is 5% with a z-statistics of 1.90. In computing, the sample size from Cochran (1963) is as below:

$$nf = \frac{1.90^2 \times 0.5 \times 0.5}{0.05^2}$$

$$= 361$$

3.6 Data Collection

This study was funded by the West Africa Center for Water, Irrigation and Sustainable Agriculture (WACWISA) of the University for Development Studies, through the Climate Change Resilience of Ecosystem Services (CRES). Primary data was collected for the study through structured questionnaire for household respondents. The instruments also included an interview guide for focus group discussions for women, men, and youth groups. Data collection duration covered a period of three months, from July to September 2022.

Data was collected in the three study areas on household demographics, the availability of native tree species in the study areas, the quantities of native tree products harvested, whether for sale or for household consumption, the groups of respondents involved in harvesting native tree products whether men, women, or youth., the factors that influence the harvesting intensity of native tree products, and the contribution of native tree products to the livelihood outcomes of households. The factors influencing harvesting intensity included in the study are; distance to native tree species, gender, age of household head, availability of native tree species,

access to native tree species, ownership of native tree species, household size, education of household head, distance to market, income level of household, food security situation of the household, and the marital status of household head.

The community entry process for data collection involved a coordinated facilitation by officers from Savannah Fruit Company (SFC) and the Organisation for Indigenous Initiatives and Sustainability (ORGIIS) as well as some representatives of the electoral areas concerned. These officers also assisted in the community entry process. Both communities with large and small population were selected. The Largest community selected in the Kumungu District was Gbulung. Smaller communities selected were: Jizaa-Gundaa, Kpalga, Jakpahi and Tonjing. These communities were selected because of the availability of the native tree species. With the exception of the Gbulung community which has some semblance of urban life, most of the selected communities are largely rural. Chiana was the largest community selected for the study in the KNM. Smaller communities selected are; Kologo, Pindaa, Naaga and Katui. Four Communities were selected in the Nandom Municipality. These are; Zimoupare (Golo-Yir), Zimoupare (Boo), Kusella and Gengekpe.

In addition to the questionnaires, focus group discussions were held between the researchers and women groups, men groups and youth groups. Focus Group Discussion (FGD) checklist was prepared for this purpose. These meetings were necessitated by the need to clarify some basic project objectives that were not clearly addressed during the household survey. The groupings were done such that women and youth who are usually afraid to speak out in the presents of their husbands and fathers, as in Northern culture, could express themselves in their peer groupings.

The discussions mostly lasted for 2 and half hours and patronized by at least thirty-five participants per session in each district.

3.7 Data Analysis

Quantitative data obtained through the use of questionnaires for respondents was analysed by the use of Stata statistical stool. Variables that were measured include household demographic characteristics influencing native tree products harvesting including, age of household head, gender, distance of household to native trees and education. Household welfare was measured as dependent variables. This helped determine relationships between NTP and contribution to livelihood resilience of households.

Analyzing the first objective involves the use of descriptive statistics. This involves the use of the Stata statistical tool to extract frequency tables, that helps to give impression of the quantity of native tree products harvested on one hand and the quantities consumed in the household and those sold. The second objective, which is to examine the factors influencing native tree product harvesting among rural households, was analysed using the Ordinary Least Square (OLS) regression. The OLS was used because the dependent variable, Native Tree Product Harvesting (NTPH) was measured as a continuous variable and agrees with all assumptions of the Gauss-Markov assumptions as follows:

i. the assumption of the error term. The error term should be normally distributed. Hence, $E(e_i) = 0$ and $E(e_i)\ \sigma_i = 1$

ii. the assumption of the model. Before the model is said to be fit, the R^2 or the adjusted R^2 should be equal or greater than 50 or 0.5. That is, $R^2 \geq 0.5$.

iii. the assumption of the independent variable. The independent variables are linearly correlated with the dependent variable. That is, $E(x_i, x_j) \neq 0$.

The theoretical model of factors influencing harvesting intensity is specified below:

$$Y_i = \beta_0 + \beta_i \chi_i + \varepsilon_i$$

Where:

Y_i = quantity of native tree products (fruits and seeds) harvested measured in kilograms

β_0 and β_1 are parameters to be estimated and $\mathscr{E}_i$ is the error term.

The empirical model is specified below:

$$Y_{Quantity\ Harvested} = \beta_1 sex + \beta_2 Age + \beta_3 Accr + \beta_4 Eduhh + \beta_5 HHSize + \beta_6 \chi_6 AwarNTP + \beta_7 Marst + \beta_8 PimOcp + \beta_9 DistMark + \beta_{10} DistNT + \beta_{11} IncHH + \beta_{12} NTAvail + \beta_{13} GrpMem + \mathcal{E}_i$$

Where:

x_1 = Sex of respondents (male or Female)

x_2= age of respondents (number of years)

x_3= access to credit (whether or not)

x_4= educational status of respondents (number of years in school)

x_5= household size (number in household)

x_6= awareness of native tree products from native trees (yes or no)

x_7= marital status of respondents (whether married or not)

x_8= primary occupation (1 = farming, 0 = other occupations)

x_9 = Distance to the market (Km)

x_{10} = distance of respondents to native tree (Km)

x_{11} = income of respondents (in GH₵)

x_{12} = availability of native tree species (Yes or no)

x_{13} = membership of a group (whether belonging or not)

$\mathscr{E}_i$ = error term

The third objective was analysed with the use of the Simple Index Construction (SIC). This was used to measure household asset portfolio indices among harvesters and non-harvesters.

3.7.1 Hypothesized Variables Influencing Harvesting Intensity of Native Tree Products

Table 3.2 below presents variables that are expected to influence households' decisions to engage in intensive harvesting of native tree products.

Table 3.2: Hypothesized variables to influence harvesting Intensity

Variable	Description (measurement unit)	Expected Sign
Quantity Harvested (Qty)	Kilograms (Kg)	
Sex	Dummy (1= male, 0 = female)	-
Age of respondent	Number of years	-
Access to credit	Dummy (1= yes, 0= no)	+
Educational level	Number of years in formal education	-
Household size	Number of people in a household	+
Awareness	Number of products the respondent is aware of (1= yes, 0 = otherwise)	+
Marital status	dummy (1 = married, 0 = unmarried)	+
Primary occupation	Dummy (1= farming 0= others)	+

Distance to market	Distance in km	+
Distance to native trees	Distance in km	+
Income of households	Ghana Cedis (GHS)	+
Native tree availability	1 = yes, 0 = otherwise	+
Group membership	1 = yes, 0 = otherwise	+

Source: Researcher's Field Work (2022)

3.7.2 Description of variables used in the OLS Model

Quantity Harvested

The quantity harvested, which is the dependent variable was measured in kilograms (kg). For the purpose of uniformity in product measurement, only quantities of fruits and seeds of native trees harvested were aggregated for running the model.

Sex of Respondents

Sex is conceived in the model as a dummy variable showing the gender of household respondents, with a value of 1 for male and 0 for female. The gender roles in Northern Ghana are such that women are particularly engaged in harvesting indigenous tree products for household consumption and for sale for better living. Therefore, in this study, female headed households are considered to be more likely to engage in harvesting native tree products for consumption and for sale.

Age of Respondents

In measuring age, the number of years of household head was used. Older household heads are expected to be less involved in harvesting native tree products that younger household heads. Younger household heads are considered to be energetic to go through intensive harvesting from both close and distant trees and from the bushes.

Access to Credit

Household head's access to credit was hypothesized to have a positive influence on harvesting native tree products. As households without native tree would have to by harvesting rights before they could harvest, having access to credit facilities would increase their participation in harvesting the tree products for sale and for consumption.

Educational Level

Household head's educational attainment has the tendency to affect his or her decision to engage in the exploration of natural resources for a living. The economic activities undertaken by households are direct consequences of their level of education. According to Newton et al., (2016), households are able to understand the negative externalities and the uses of natural resources as a result of their level of education. In this study, it is expected that the higher the level of household's educational attainment, the less native tree products they will harvest. This is because a much-educated individual would rather seek higher employment opportunities than harvesting native tree products for their livelihoods.

Primary Occupation

Farming is predominantly the main occupation of households in rural Northern Ghana. Exploring native tree products in rural Northern Ghana is mostly limited to farming households although other households engaged in other occupations also participate in harvesting on subsistence levels. In this study, primary occupation is a dummy variable, with farming having a value of 1 and other occupations as 0. Farming households are expected to be the most harvesters of native tree products

as compared to other occupations. Thus, farming households are more likely to harvest native tree products than those in other occupations such as trading, artisanal works, and waged employment.

Distance to Native Trees

The distance of households to the native trees is expected to influence household head's decision to harvest native tree products. This is measured in Kilometers and the households are less likely to engage in harvesting native tree products with a longer distance to the trees. As Mujawamariya and Karimov (2014) found that households closer to forest depend more on forest resources than those households which are far, it implies that, household heads whose homes are closer to native trees are more likely to harvest more native tree products than their counterparts living farther from the trees.

Distance to Market

Measured as a continuous variable, and in kilometers, distance to the market is expected to influence household head's ability to participate in harvesting native tree products either positively or negatively. The number of kilometers a household head will cover to get to market to sell the product will affect his or her decision to engage in harvesting the tree product. A shorter distance to the market will imply that a respondent is more likely to harvest a native tree product for sale in the market than a longer distance.

Household Size

Household size was conceived to have a positive effect of a households' decision to harvest native tree products. Larger households with more hands and more food requirements, are more likely to harvest native tree products than small households with fewer hands and less food requirements.

Group Membership

A household head belonging to a group in the society is more exposed to information about the benefits of native tree products. This influences the household head's decision to participate in harvesting native tree products for consumption and for sale. This study hypothesized that belonging to a social group in the community has a tendency to influence the harvesting of native tree products.

Income of Households

This study hypothesized that households with higher income are less likely to participate in harvesting native tree products for sale or for consumption than households with lower income. Thus, the expectation of the study was that being rural communities with lower incomes, household heads would harvest more native tree products for sale to supplement their incomes and for household consumption.

Awareness of Native Tree Products and Benefits

Awareness of the products and their benefits, value and uses was hypothesized to have a positive influence on the harvesting intensity of the tree products by households. A one unit increase in the awareness of the benefits of native tree

products was expected to lead to an increase in the intensity of harvesting native tree products by households.

Marital Status

Married household heads are more likely to engage in harvesting native tree products for sale and for consumption. Married households with responsibilities to feed more people would engage in harvesting native tree products for household consumption and for sale to supplement their incomes. The study therefore hypothesized that marital status of household head would have a positive influence on their decision to participate in harvesting native tree products for sale or for consumption.

Native Tree Availability

The availability of the native trees in the communities will influence a household decision to participate in harvesting the products for their livelihoods. Households may be willing to harvest a tree product for either consumption or for sale but for the unavailability of the tree they are unable to harvest the products. This study therefore hypothesized that the availability of the native trees in the communities would have a positive influence in a household head's decision to participate in harvesting native tree products for sale or for consumption.

3.7.3 Measurement of Household Asset Portfolio

This study sought to measure household asset endowments different from the known monetary measures of livelihood outcomes. Livelihood outcomes such as income and consumption expenditure of households have been used extensively in literature, and according to Moser and Felton (2007), these monetary approaches have proved to be incapable of capturing the multiple dimensions and variables used to measure

livelihood assets of households due to recall bias, seasonality and data collection burden. Thus, the approach adopted by this study is to estimate the household assets portfolios through Composite Asset Index (CAI). According to the OECD (2008), the Composite Asset Index is a quantitative score of, a numerical value, used to measure variables of different constructs. It is a composite indicator of wellbeing. To Moser and Felton (2007), this approach provides a complete picture of long-term household wellbeing and living standard than the income snapshot. According to OECD (2008), CA indices are proxy measures of long-term household economic status and food security, as well as the multidimensional concepts which cannot be captured by a single indicator. In computing the asset indices, the study considered a number of multivariate techniques including Principal Component Analysis (PCA), the Multiple Correspondence Analysis, and Factor Analysis.

According to World Food Programme (2012), the PCA creates a continuous variable which explains the underlying relationship and can be used as a proxy for household wealth. The PCA is a multivariate data analysis technique used to reduce the dimensions and number of variables in interrelated datasets into a new ordered set of fewer less correlated variables which retain most of the variations in all of the original variables (Jolliffe, 2002). According to Filmer and Scott, 2008), both PCA and Factor analysis are based on different mathematical formulations but lead to similar results. The PCA is essentially designed to analyse a set of quantitative variables measured in the same units (Booysen *et al*., 2008). According to Booysen et al., (2008), the MCA is believed to be more appropriate to use when variables in the model are categorical.

This study used the Simple Index Construction to measure household livelihood (well-being) status. This is because there is no variability in assets holding among households in all the three districts. Almost all households in the three districts had the same basic household asset type. This is following the work of Lakow (2006), Hulme et al., (2001) and Jalan & Ravallon (2000). According to Moser and Felton (2007), the simple index construction is to simply sum up the number of assets owned by households and assign weight to each asset. Hence, this method would assign equivalent worth to all assets. This is specified below:

W= 1 for each asset (w)

$SIC = \sum w_{1,2}.....n$

Where, $w_{1,2}...n$ = weight of asset 1, 2,…n

3.7.4 Computation of Livelihood Asset Index

The following procedure was adopted to derive the Livelihood Endowment Status of the households. This was based on Simple Index Construction (SIC), relying on the survey of the household on their asset ownership, and based on the previous work of Lakow (2006).

i. Asset sub-categories were assigned weights from 0 – 1, 0 means no asset, and 1 means presence of asset sub-category,

ii. Calculating an index for each asset sub-category,

iii. Asset sub-category normalization to secure comparability between individual asset categories,

iv. Averaging all individual asset subcategories to ascertain the Asset Portfolio Index (API),

v. Assigning weights to calculate the Livelihood status of the households as presented in table 4 below.

Lakow (2006) coming after Hulme (2003) and Jalan & Ravallon (2000), used a four-point cluster approach to identify respondents within the various well-being status categories as in table 3.3 below:

Table 3.3: Household Livelihood Ranking

Rank 1	A rank of 0.76-1score. Those ranked in this range have high well-being status and having a secure well-being.
Rank 2	A score of 0.51-0.75. Those in this range have medium well-being ranking and are categorized as being norm in well-being.
Rank 3	A score of 0.26-0.50. These are considered to be low in well-being ranking.
Rank 4	A score of 0.00-0.25. Those in this rage are having the lowest well-being ranking.

Source: Lakow (2006)

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

Based on the methodologies adopted in chapter three, this chapter presents the data analysis and presentation of results of the study. The results are presented through frequency tables, and graphs to explain how the study objectives are achieved.

4.2 Respondents Demographic Information

Data was collected from 324 household respondents, of which Household heads constituted 91.98%. Majority of respondents fell within the age bracket of 36-60 years, representing 79.32%. Those usually considered as youth, falling within the age brackets of 18-20 years (5) and 21-35 (40) constituted 13.89% of respondents. Those over 60 years were 6.79% of respondents. Majority of household heads in the three-study area are male. This represents 86.42% of the respondents. Female household heads were 13.58% of the total respondents. Again, most household heads, that is 71.6% of respondents in the three study areas are farmers on subsistence level. Most respondents were not educated, whiles 27.16% and 10.8% had basic education and Senior High School respectively. The remaining 1.54% had tertiary education. In all, about 71.90% of respondents reported to be harvesting native tree products, while the remaining 28.10% respondents reported not harvesting native tree products. however, even though this 28.10% reported not harvesting, they reported to be utilizing native tree products as part of their daily livelihood strategies. Table 4.1 presents a detail analysis of the demographic characteristics of respondents.

Table 4.1: Demographic Characteristics of Respondents

	Study Districts						
	Kumbungu		KNEM(Navrongo)		Nandom		
Variable	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Total
e in years							
20	5	3.68	-	-	-	-	5
35	14	10.29	16	13.01	10	15.38	40
60	10	74.26	103	83.74	53	81.54	257
-	16	11.76	4	3.25	2	3.08	22
:al	136	100.00	123	100.00	65	100.00	324
:							
le	125	91.91	106	86.18	49	75.38	280
nale	11	8.09	17	13.82	16	24.62	44
:al	136	100.00	123	100.00	65	100.00	324
ucational Level							
n-formal	87	63.97	66	53.66	43	66.15	196
sic	34	25.00	40	27.59	14	21.45	88
S	14	10.29	15	10.34	6	9.23	35
tiary	1	0.74	2	1.38	2	3.08	5
Total	136	100.00	123	100.00	65	100.00	324
Household Dependency							

≤ 2	3	1.96	6	5.45	6	9.84	15
5	5	3.27	13	11.82	10	16.39	28
10	56	36.60	71	64.55	32	52.46	159
)	89	58.17	20	18.18	13	21.31	122
:al	153	100.00	110	100.00	61	100.00	324
ırital Status							
rried	122	98.39	115	88.46	54	77.14	291
gle	2	1.61	3	2.31	3	4.29	8
orced	-	-	8	6.15	5	7.14	13
dowed	-	-	4	3.08	8	11.43	12
:al	124	100.00	130	100.00	70	100.00	324
cupation							
ming	102	75.56	91	71.65	39	62.90	232
ty trade	20	14.81	24	18.90	17	27.42	61
isan	10	7.41	8	6.30	5	8.06	23
v./Salaried worker	3	2.22	4	3.15	1	1.61	8
:al	135	100.00	127	100.00	62	100.00	324
ligion							
Islam	133	97.79	3	2.44	2	3.08	138
Christianity	1	0.74	120	97.56	62	95.38	183

Traditional	2	1.47	-	-	1	1.54	3
:al	136	100.00	123	100.00	65	100.00	324

rce: Study Survey (2022)

4.3 Native Tree Availability

Table 4.2 shows the native tree species that are available in the three study areas. From the table, it can be seen that apart from jujube which respondents in the sampled communities reported unavailable, the remaining five species were all reported to be available. It was also reported that marula species in the sampled Kumbungu District were few due to destructions. Baobab, locust beans, bombax and lannea tree species were all reported to have declined drastically over the years due to many factors of which the following were specifically mentioned:

i. Bad farming practices, such as the application of destructive chemicals, cutting trees due to their impact on soil fertility and consequent effect on crop yield;
ii. Bush burning;
iii. Tractor plough removing young tree which grow to add to the tree stock;
iv. Poor harvesting practices

Table 4.2: Respondents' Indications of the Availability of Native Tree Species

	Kumbung		Navrongo		Nandom	
Native Tree	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Baobab	136	100	123	100	65	100
Locust Beans	136	100	123	100	65	100
Lannea	136	100	123	100	65	100
Marula	136	100	123	100	65	100
Bombax	136	100	123	100	65	100
Jujube	0	0	123	100	65	100

Source: Study Survey (2022)

4.4 Native Tree Products Harvested by Groups

Fig. 4.1 depicts the frequency of harvesting native tree products by male, female, male youth group, and female youth groups. The results show that native tree

products seed is the native tree part most harvested in the three study districts. The locust beans seed emerged as the product most harvested by respondents with an average of 73% of respondents in all the three study districts reporting to harvest it. The result also indicates that fruits, and leaves are also heavily harvested by respondents in all the study areas. Flowers of bombax was also reported to be highly harvested by respondents.

Female respondents were the most harvesters of native tree products, recording an average of about 64% in Kumbungu, 73% in Navrongo and 69% in Nandom. Men and youth also engaged in the harvesting of native tree products. Female respondents were the most harvesters of seeds, fruits, leaves, and flowers, with male being the most harvesters of bark. For Kumbungu, about 66% of harvesters of seeds, leaves, fruits and flowers were women. Also, in Navrongo and Nandom, about 74% of respondents harvesting seeds, fruits, leaves and flowers were female. These findings mean that native tree product harvesting in the three study areas is a female dominated activity. This finding supports Sogodogo *et al*., (2021) findings in Mali that women are the majority in harvesting, processing, and selling baobab leaves. Again, the findings support the findings of Suleiman *et at*., (2017) in Nigeria that men are the most harvesters of tree bark. It is however contrary to the findings of Suleiman *et al*., (2017) that men are the dominant extractors of non-timber forest products in in Nigeria.

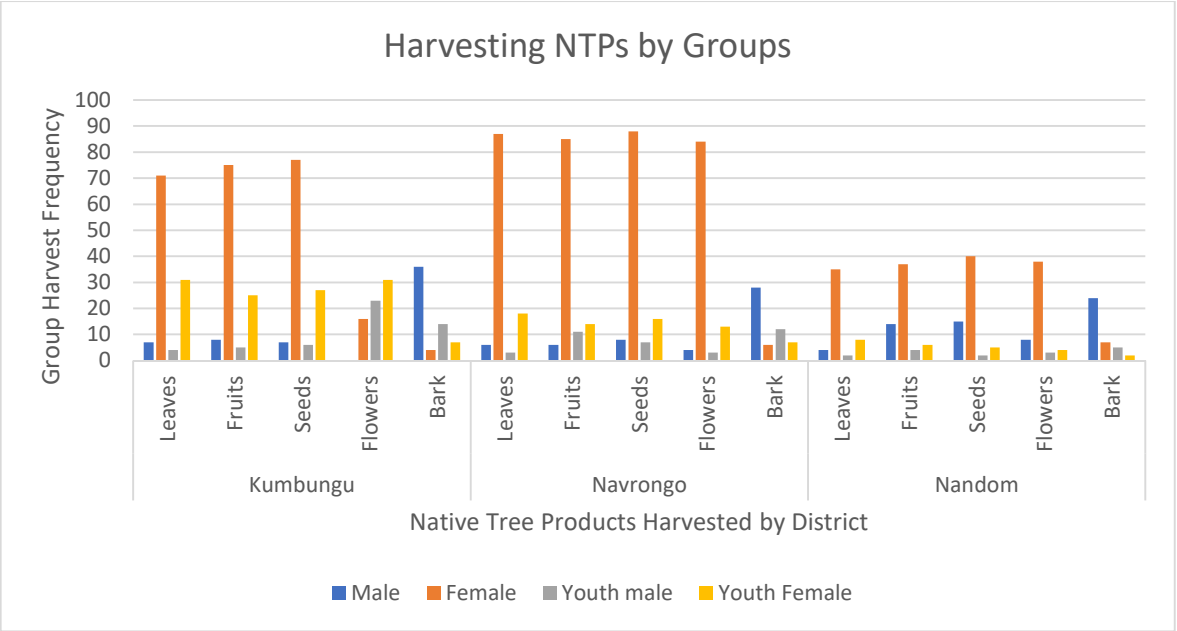

Figure. 4.1: Native Tree Products Harvesting by Groups

Source: Researcher's Field Work (2022)

4.5 Quantities of Native Tree Products Harvested

Table 4.3 depicts the native trees and the quantity of the products harvested in kilograms by respondents in the three study areas. The study found that the most important native tree species and products for the respondents in the 3 study districts are the locust beans and the baobab. Bombax and lannea were also reported to command some value to the household harvesters. The highest quantity harvested was the locust beans fruit with a recorded average annual seasonal harvest in the last fruiting season of 2021 to be 368kg in Navrongo, 288kg in Kumbungu, and 157kg in Nandom. This was followed closely by baobab fruit with average harvest of 356kg, 214kg, and 148kg in Navrongo, Nandom, and Kumbungu respectively. Baobab leaves also recorded a substantial quantity of harvest with an average of 168kg, 315kg, and 158kg in Kumbungu, Navrongo, and Nandom respectively.

Locust bean seeds also recorded high seasonal harvest with a seasonal mean harvest of 334kg, 126kg, and 103kg in Navrongo, Nandom, and Kumbungu respectively. Bombax flowers also recorded some high harvest volume in Naverongo with a seasonal mean harvest of 256kg. This was followed by lannea fruit, with seasonal mean harvest of 198kg, 185kg, and 110kg for Navrongo, Kumbungu, and Nandom districts respectively. It is also clear from the table that households in the Navrongo harvest most native tree products for both consumption and for sale. It is also clear from the findings that baobab leaves, and fruits; and locust beans seeds and fruits are the most important native tree products for the households in all the three study areas. This finding supports finding of Sogodogo *et al*., (2021), that baobab leaves appear to be the most NTFP product of high value to farmers in Mali.

Table 4.3: Quantity of Native Tree Products Harvested

Native Tree	Kumbung Mean Qty	Navrongo Mean Qty	Nandom Mean Qty
Baobab			
Leaves	168	315	158
Flowers	0	0	0
Fruits	148	356	214
Seeds	34	226	147
Bark	55	68	36
Locust Beans			
Leaves	43	49	23
Flowers	0	0	0
Fruits	288	368	57
Seeds	315	334	126
Bark	46	78	36
Lannea			
Flowers	0	0	0
Leaves	27	35	22
Fruits	185	198	110
Seeds	0	0	0
Bark	58	38	32
Marula			
Leaves	78	85	27
Flowers	0	0	0

Fruits	76	95	28
Seeds	37	54	18
Bark	43	52	13
Bombax			
Leaves	68	76	34
Flowers	72	256	49
Fruits	0	0	0
Seeds	0	0	0
Bark	54	69	51
Jujube			
Leaves	0	0	0
Flowers	0	0	0
Fruits	0	34	26
Seeds	0	0	0
Bark	0	0	0

Source: Study Survey (2022)

4.6 Native Tree Products Harvested for Household Consumption and for Sale

Table 4.4 shows the frequencies and percentage distributions of households harvesting native tree products for sale and for consumption. From the table, it can be seen that a greater majority of households in the three study areas harvest native tree products for consumption rather than for sale. An average of about 65% of households reported harvesting baobab leaves for household consumption. About 71%, 62%, and 63% respondents from Kumbungu, Navrongo and Nandom districts respectively reported to be harvesting baobab leaves for consumption. Again, majority of households, 100%, 85%, and 95% in Kumbungu, Navrongo, and Nandom respectively, reported to harvesting locust beans leaves for household consumption as medicine for the treatment of various ailments like stomach upsets, snakebites, and headache. Same majority of households reported harvesting marula, lannea, and bombax leaves as medicine.

As majority of households (65%) in Kumbungu reported harvesting baobab, and locust beans fruits for household consumption, most respondents, 57% and 63% in Navrongo and Nandom respectively, reported harvesting these fruits for sale. Again, whiles majority of households in Kumbungu and Navrongo reported harvesting baobab, locust beans and marula seeds for consumption, most respondents in Nandom reported harvesting for sale. This is because, as Azara Abukari (personal communication) stated, *''we harvest for consumption because the trees are depleted now and we do not get to harvest much volumes enough for sale''. The little we harvest is not even enough to last us up to the next harvesting season.* Also, an average of about 75% of respondents reported harvesting lannea fruits for sale, and none reported harvesting lannea, bombax, and jujube seeds. Bombax flowers was the only part of the bombax tree that respondents in all three districts reported harvesting, and majority harvested for sale. No respondent in Kumbungu harvested bombax flowers for household consumption.

All respondents in all three districts reported harvesting marula fruits, leaves and seeds for domestic consumption. Leaves of marula are particularly harvested to feed animals, and only children harvested marula seeds for consumption. These findings rhyme with De Caluwe (2011), in his study of market chain analysis of baobab and tamarin products in Mali and Benin that majority of baobab fruits harvested in Mali are for home consumption.

Table 4.4: Households Harvesting Native Tree Products for Sale and for Consumption

		Kumbung					Navrongo					Nandom				
	Freq	For Sale	HH con	% Cons	%Sale	Freq	For Sale	HH cons	% Cons	% Sale	Freq	For Sale	HH con	% Cons	% Sale
	88	26	62	70.45	29.55	94	36	58	61.70	38.30	51	19	32	62.75	37.25
	0	0	0	-	-	0	0	0	-	-	0	0	0	-	-
	88	31	57	64.77	35.23	94	55	39	41.49	58.51	51	32	19	37.25	62.75
	11	0	11	100	-	97	41	56	57.73	42.27	46	31	15	32.61	67.39
	21	5	16	76.19	23.81	68	21	47	69.12	30.88	13	4	9	69.23	30.77
										-					
	29	0	29	100.00	-	57	8	49	85.96	14.04	24	1	23	95.83	4.17
	0	0	0	-	-	0	0	0	-	-	0	0	0	-	-
	91	37	54	59.34	40.66	90	67	23	25.56	74.44	52	34	18	34.62	65.38
	91	31	60	65.93	34.07	90	33	57	63.33	36.67	52	22	30	57.69	42.31
Bark	48	16	32	66.67	33.33	65	17	48	73.85	26.15	34	9	25	73.53	26.47
Lannea										-					-

Flowers	0	0	0	-	-	0	0	0	-	-	0	0	0	-	-
	21	5	16	76.19	23.81	64	29	35	54.69	45.31	12	3	9	75.00	25.00
	84	60	24	28.57	71.43	86	65	21	24.42	75.58	54	42	12	22.22	77.78
	0	0	0	-	-	0	0	0	-	-	0	0	0	-	-
	15	6	9	60.00	40.00	64	26	38	59.38	40.63	21	8	13	61.90	38.10
		0					0			-		0			-
	16	0	16	100.00	-	27	7	20	74.07	25.93	23	5	18	78.26	21.74
	0	0	0	-		0	0	0	-	-	0	0	0	-	-
	23	0	23	100.00	-	41	0	41	100.00	-	38	0	38	100.00	-
	17	0	17	100.00	-	34	10	24	70.59	29.41	26	0	26	100.00	-
	19	7	12	63.16	36.84	25	10	15	60.00	40.00	21	8	13	61.90	38.10
		0					0			-		0			-
	37	17	20	54.05	45.95	46	25	21	45.65	54.35	24	7	17	70.83	29.17
Flowers	25	25	0	-	100.00	96	84	12	12.50	87.50	54	49	5	9.26	90.74
Fruits	0	0	0	-		0	0	0	-	-	0	0	0	-	-

Seeds	0	0	0	-		0	0	0	-	-	0	0	0	-	-
	46	32	14	30.43	69.57	58	35	23	39.66	60.34	27	10	17	62.96	37.04
															-
	0	0	0	-	-	0	0	0	-	-	0	0	0	-	-
	0	0	0	-	-	0	0	0	-	-	0	0	0	-	-
	0	0	0	-	-	26	0	26	100.00	-	20	0	20	100.00	-
	0	0	0	-	-	0	0	0	-	-	0	0	0	-	-
	0	0	0	-	-	0	0	0	-	-	0	0	0	-	-

S Researcher's Field Work (2022)

4.7 Factors Influencing Harvesting Intensity of Native Tree Products

Table 4.5 below presents parameters that determine the harvesting intensity of NTPs in Northern Ghana. The rationale behind this regression analysis is to measure how parameter estimates influence the harvesting intensity of NTPs. The overall significance of the model is tested using the F-value which came out as zero (0.000), indicating that the predictions from the analysis are true and on average without errors and explaining that all the parameters are jointly and not equal to zero (P>F=0). The R-square is used to determine the strength of the model on the response variable, harvest intensity. R-square of 0.670 indicating that about 67% of the model explains the harvesting intensity of NTPs from different respondents.

Thirteen (13) parameters were used for the analysis, out of these; sex of respondents, access to credit, household size, group membership, primary occupation, distance to native trees, income, and availability of trees, jointly formed significance on the harvest intensity in the study areas. Amongst the variables that turned out significant gender of respondents was negative and significant at 1% indicating that females are more likely to harvest NTPs as compared to the males by 18%. This is in tandem with the findings of Mwema *et al.*, (2013), that gender of household head is significant determinant of harvesting indigenous fruits for sale. This also rhymes well with the results of Sogodogo *et al.*, (2021) that women are the majority of harvesters of baobab leaves in Mali. Murye (2017), in his analysis of environmental and socio-economic sustainability of marula harvesting in the Lubombo Region, Swaziland found a statistically significant relationship between gender and harvesting marula products. He discovered that women were more inclined to harvest marula for household income generation than their male counterparts.

Income of household head was found to be negative and significant at 1% level. This indicates that household heads with larger incomes are less likely to engage in harvesting native tree products. This rhymes well with Mwema (2013), finding that middle to higher income earners is less likely to engage in harvesting indigenous tree products in Kenya. It also confirms findings of Murye (2017), that households with larger incomes are less likely to harvest marula products for sale in Swaziland. Access to credit also turned out negative and significant at 5%, indicating that a percentage decrease in credit increases the harvesting of NTPs by 12.73%.

Again, household size is positive and significant at 5%, indicating that larger households harvest more NTPs as compared to smaller households. This finding means that households with larger membership have more hands at their disposal to assist in harvesting native tree products to ensure higher volumes of harvest than smaller households. This confirms Murye (2017) findings in Swaziland that larger households are more inclined to harvest marula products for sale to supplement their household income. It is also in support of findings by Adikhari, *et al*., (2014), and Mujawamariya and Karimov (2014), who both found that significant influences of household size on the harvesting of non-timber forest products in Nepal and Nigeria respectively.

Awareness of the benefits of native tree products to households returned negative and significant at 1%, indicating that a percentage increase in households' awareness of the benefits derived from native tree products reduces the likelihood of harvesting native tree products by 18.46%. This is contrary to study priori expectation of an increase in quantum of harvest as a result of household awareness of product benefits. It is also contrary to the findings of Omotesho *et al*., (2013) that consumers

who are aware of baobab products and their benefits were more likely to use the products.

Households' head primary occupation was negative and significant at 5%. This indicates that a respondent's primary occupation was less likely to influence his decision to harvest native tree products. Households' heads without a primary occupation, would increase the harvesting of native tree products by 8%. This is contrary to Suleiman *et al.*, (2017) findings in Nigeria that main occupation significantly influences his decision to participate in the collection and utilisation of NTFPs.

Table 4.5: OLS Regression Estimates of Factors Influencing Harvesting Intensity of Native Tree Products

Variable	Coefficient	Standard error
Sex of respondents	-1.800***	0.396
Age of respondent	-0.008	0.025
Access to Credit	-1.273**	0.624
Educational level	-0.592	0.362
Household size	0.040**	0.018
Awareness	-1.846***	0.434
Marital status	0.259	0.495
Primary occupation	-0.080***	0.028
Distance to market	0.079	0.066
Distance to native trees	-0.484***	0.167
Income of household head	-4.631***	0.454
Tree availability	3.274***	0.901

Group membership		-1.071	0.720
Constant		15.940***	1.992
R-squared	0.670		
F-test	8.223		
Prob > F	0.000		

*** p<.01, ** p<.05, * p<.1

Distance to native trees was negative and significant at 1%, this indicates that a one-kilometer increase in distance to the native trees from the households, would result in a decrease in the quantum of harvest of native tree products by 48.40%. hence, households are less likely to collect NTPs if they have to travel longer distance from their homes to the harvesting points. This rhymes with Mujawamariya and Karimov (2014) findings in Kenya that there is a higher dependency on forest resources for closer forest reserve dwellers. It also supports findings of Suleiman *et al*., (2014), that households living farther from forest reserves are less likely to engage in forest products harvesting.

The availability of native trees came out positive and significant at 1%, indicating that the abundance of native trees in the community leads to an increase in the harvest of native tree products by 327.4%. This finding is in support of findings by Ndayambaje *et al*., (2012), findings of a strong impact of tree product sales on the availability of trees on farms.

4.8 Contribution of Native Tree Products to Livelihoods Outcomes

From table 4.6, and from the well-being status categories, it is evident that with an overall index of 0.57 and 0.63 for harvesters and non-harvesters respectively, both

respondent categories have the same medium livelihood status. This means that harvesting native tree products has not contributed in improving the well-being status of harvesters as compared to non-harvesters. Again, with an index of 0.57, it means that most harvesters of native tree products are not wealthy but are of medium well-being status. This is in sharp contrast to the findings of Uberhuage *et al*., (2012), in Bolivia that wealthier households were the most harvesters of NTFPs. It is also contrary to the findings of Kibria *et al*., (2018) in Bangladesh that households with larger financial capital tend to harvest higher volumes of NTFPs.

However, native tree product harvesters' human asset index recorded 0.61 as compared to 0.4 for non-harvesters. This means that harvesting native tree products has made positive changes to the well-being of harvesting households as compared to non-harvesting households.

4.8.1 Household Asset Portfolio

Native tree product harvesting households and non-harvesting households were used for a comparison of their household livelihoods based on the assets held or controlled by members. To ascertain the contribution of native tree products to livelihoods, focus group discussions were held between the researcher and the harvesting and non-harvesting groups. This was to identify the livelihood indicators dear to the households. Table 4.6 depicts the results of the brainstorming sessions.

Table 4.6: Household Asset Portfolio

Asset Category	Sub-Category
Natural Asset	1 or more agricultural Land potable water Native trees stone or sand quarry
Physical Assets	Poultry

	Sheep
	Goat
	Cattle
	Building
	Furniture
	motor cycle
	Bicycle
	Vehicle
	waged employment
	income generating business
Financial Assets	savings/bank deposits
	training on best business practices
	toilet at home
	eat (well) three square meals a day
Human Assets	Education
	Belong to a group/association
	networking group
	access to wider institutions in the society
	no domestic violence
Social Assets	feelings of trust and safety

Source: Researcher's Survey (2022)

Based on these livelihood indicators in table 4.7, the Simple Index Construction (SIC) was applied to compute the livelihood indices for the various asset categories for both harvesters and non-harvesters of native tree products as presented in table 4.7 below.

Table 4.7: Household Asset Portfolio Index

Asset Category	Harvesters					Non-Harvesters				
	Freq	**Number**	**Observed**	**Expected**	**Index**	**Freq**	**Number**	**Observed**	**Expected**	**Index**
Natural Asset	233	4	544	932	0.58	91	4	211	364	0.58
Physical asset	233	9	1,230	2,097	0.59	91	9	585	819	0.71
Financial asset	233	3	288	699	0.41	91	3	189	273	0.69
Human Asset	233	4	573	932	0.61	91	4	146	364	0.40
Social Asset	233	5	675	1,165	0.58	91	5	295	455	0.65
Total Asset Portfolio		**25**	**3,310**	**5,825**	**0.57**		**25**	**1,426**	**2,275**	**0.63**

Source: Researcher's Field Work (2022)

From these livelihood portfolio indices as in table 4.7, the livelihood endowment pentagon is constructed as in figure 4.1 below. The result in figure 4.1 aids in observing the strength and relations among the 5 household livelihood asset capitals under study. The middle point on the pentagon with index 0.00 represents the lowest point, whiles the highest point is at the edge of the pentagon. The lowest point implies that the household has minimum livelihood assets, whiles the maximum attainment of livelihood assets is depicted at the edge. This also means that a household with a greater possession of livelihood assets, lies farther away from the center of the pentagon.

As can be seen in the pentagon, non-harvesters outperform harvesters in asset acquisition in tree livelihood asset categories: financial assets, physical assets, and social assets. Both harvesters and non-harvesters are almost on the same level on the pentagon for natural assets indicating equal attainment. However, harvesters performed better than non-harvesters in the human assets category. This may be because households harvest mostly for domestic consumption.

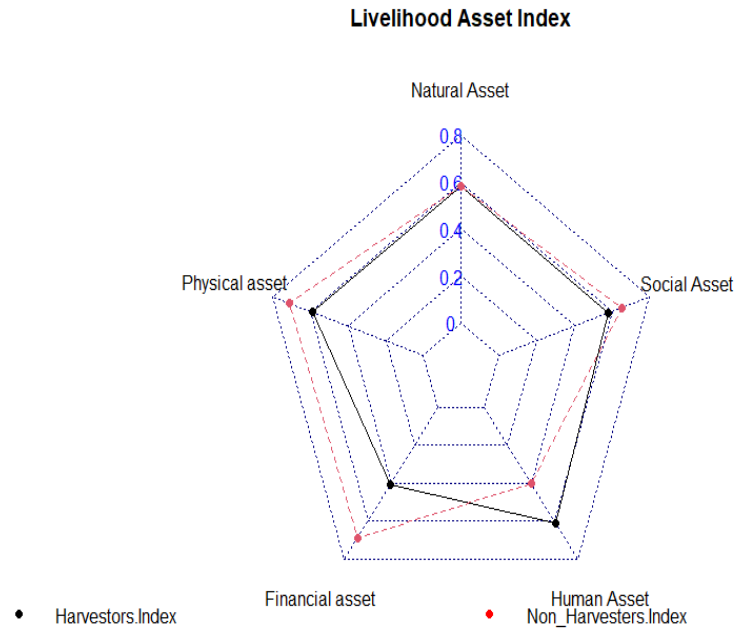

Figure 4.2: Livelihood Endowment Status Pentagon

Source; Researcher's Construct (2022)

Harvesting native tree products has contributed in attaining at least one of the sub-asset categories in all the livelihood asset categories. In the natural asset category, harvesting native tree products has contributed positively in attaining potable water for households. It has also resulted in households' acquisition of poultry and livestock, household appliances and furniture in the physical asset category. This supports the findings of Kehlenbeck *et al*., (2013), in their study of the diversity of indigenous fruit trees and their contribution to nutrition and livelihoods in sub-Saharan Africa that the cultivation of indigenous plants contributes to livelihood improvement of households.

Within the financial asset category, native tree product harvesting has contributed in attaining income generating businesses and savings. This rhymes well with Kibria

et al., (2016) findings in Bangladesh that households with larger financial capital tend to harvest higher volumes of NTFPs. This was also corroborated by Tanimonure, *et al*., (2021) study of underutilizes indigenous vegetables for households' dietary diversity in Southwest Nigeria. Harvesting native tree products has also contributed in households' provision of toilet facilities and some training on business management among the human asset category. Households have also been able to join associations and networking groupings within the social asset category.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the findings of the study. It provides the conclusions of the study and proffer recommendations that may be of benefit to the harvesters and non-harvesters, institutions involved in native tree exploration and their vale chains, as well government of Ghana in her desire to find alternative livelihoods for marginalised groups and to reduce poverty in the country. The chapter ends with suggestions for further studies in the field of native tree products exploration.

5.2 Conclusions

The main focus of the study was to assess the harvesting of native tree products and their effects on the livelihoods of rural households in Northern Ghana. it focused on the household demographics and other socioeconomic factors that influence household decision to harvest native tree products. It also assessed the quantities of native tree products harvested in terms quantities harvested for household consumption and for sale. The contribution of these native tree products on the livelihood outcomes of households were then assessed based on their household asset endowments. Based on the methodology applied on 324 households in the three study districts, comprising both harvesters and non-harvesters of native tree products, the following findings and conclusions were made:

1. Most households in all the three study areas are headed by males, with an average age of 48 years. About 71.90% reported to be harvesting native tree

products, and the remaining 28.10% reported not harvesting native tree products. These 28.10% were however using native tree products as part of their daily livelihood strategies. Also, majority of household respondents were predominantly farmers, returning about 72%.

2. It was discovered that except jujube, which recorded zero responses for tree availability in Kumbungu, the remaining five species under study recorded positive responses for availability even though some were more prevalent than others as a result of destruction from factors such as bad farming practices, bush burning, chemical application and machine plough.
3. The study revealed that most native tree products are harvested for household consumption. Only a small fraction of harvests is sold in the local markets leading to low sales volumes of native tree products. This may be as a result of the low volumes of harvest as a consequence the lack of awareness of the marketability of these products in the local and international markets.
4. The study found that locust beans fruits and seeds, baobab leaves, fruits, pulp and seeds were the parts most harvested of the native tree species. The locust beans fruits and seeds turned out to be the most parts harvested of the locust bean tree. Only the fruits were harvested for lannea, marula, and jujube, while that of the flowers were seen to be the most harvested for bombax even though the bark and sometimes the leaves were reported to be harvested from the lannea, marula and bombax trees.
5. The study discovered that women are the most harvesters of leaves, fruits and seeds of locust beans and baobab, whiles the youth are the most harvesters of marula fruits and seeds. Women also emerged as the most harvesters of lannea fruits and bombax flowers. The leaves, and fruit/pulp of

baobab were the most parts harvested for home consumption in the three districts. Respondent households also reported greater volumes of Locust bean fruit/pulp and seeds harvested for household consumption.

6. The study found household demographic factors that influence their decision to engage in intensive harvesting of native tree products are sex, household size, remittances, primary occupation, distance to native trees, income, and availability of native tress. These variables emerged significant in explaining how the socioeconomic factors affect respondents' decision to harvest native tree products.
7. It also discovered that, with an index of 0.57, most harvesters of native tree products are not wealthy but of medium well-being status. The study however revealed that harvester of native tree products gained significantly in terms of human assets category. This is as a result of the findings that most native tree products are harvested for household consumption rather than for sale.

5.3 Recommendations

Based on the findings and conclusions of the study, the following recommendations are proffered for policy considerations on native trees and their products for sustained livelihoods:

1. Government should establish native tree nurseries for native trees to make species available for households to harvest for their improved livelihoods. Such nurseries will encourage native tree planting and exploration among youth and women in the communities to replace the destructed tree species.

2. Government, and other policy makers in tree product development should foster community engagements to create awareness of native tree products and their potential uses beyond the traditional and already known uses of the tree species products. Such engagements would bring to light the need to train harvesters and households on the potential marketability of native tree products to generate income for households instead of only harvesting for household consumption.
3. Government should develop markets for native tree products by promoting the sale of native tree products in the Ghanaian local markets so as to increase the rate of harvest. Again, international markets should be explored to link local harvesters to emerging markets for native tree products.
4. Government and other policy makers in the agriculture and tree development sectors should promote value addition to native tree products to make it attractive to harvesters and households to engage in more exploration of the products to improve their livelihoods.
5. Native tree products production systems and value chain should be developed to ensure quality of tree products to meet the demands of local and international markets.
6. Government, chiefs and land owners should design ways to protect the native tree species from destruction to ensure the continuous existence of the trees for harvesting.

5.4 Suggestions for Further Research

The study brought to fore a number of areas for further studies. Many livelihood studies on natural resources exploration have concentrated on income and

expenditure without the incorporation of empowerment dimensions. There is therefore the need to conduct a study into how native tree product harvesting can empower marginalised groups such as women and the youth to engender quality livelihoods for households.

Again, since respondents reported of the decline of the native tree species in all the three study areas, there is the need to study the impact of intensive harvesting on the decline of the native tree species int the three districts. Further, the study of the value chain analysis of native tree products in Northern Ghana will help harvesters to understand the various values and linkages of native tree products and to tap into the unexplored parts of the trees to enhance their livelihoods.

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APPENDIX 1

UNIVERSITY FOR DEVELOPMENT STUDIES

FACULTY OF AGRICULTURE, FOOD AND CONSUMER SCIENCE

DEPARTMENT OF AGRICULTURE AND FOOD ECONOMICS

WACWISA-CRES PROJECT

QUESTIONNAIRE

EFFECTS OF NATIVE TREE PRODUCT HARVESTING ON LIVELIHOODS OF RURAL HOUSEHOLDS IN NORTHERN GHANA

Dear Sir/Madam,

My name is Salifu Sualihu Tahiru Alabira, an MPhil candidate at the University for Development Studies, Nyankpala Campus. This questionnaire has been designed to solicit information for my MPhil thesis on **''effects of native tree product harvesting on livelihoods of rural households in Northern Ghana''.**

The information you will provide is very vital to the success of the study and will be used exclusively for academic purposes. It will therefore be treated with utmost confidentiality. Your kind cooperation and highest sincerity in response to each of the following questions is therefore highly anticipated in this regard.

There are three types of questions in this questionnaire; closed ended questions, open ended questions and semi open questions. Please circle or tick the choices for the close ended and semi open questions, write your answer in the space provided for open questions. You can circle more than one response for semi open questions.

Household Index

Questionnaire number:	Date: Household No.:
Region:	Respondent contact:
District:	District code:
Community:	Community code:

SECTION A

RESPONDENT DEMOGRAPHIC AND SOCIOECONOMIC DATA

1. Age of respondent: ……
2. Sex of respondent. a. Male [ ] b. Female [ ]
3. Respondent's highest level of formal education:
   a. No formal education [ ]
   b. Basic education (Primary/JHS/Middle school) [ ]
   c Secondary education (Secondary/Vocational/Technical) [ ]
   d. Tertiary edu. (Teacher & Nursing Training college/polytechnic/University) [ ]
4. What is your religious affiliation? a. Islam [ ] b. Christianity [ ] c. Traditional [ ] d. Others (specify) …….
5. Marital status of respondent: a. Single [ ] b. Married [ ] c. Divorced/Separated [ ] d. Widowed [ ]
6. How many persons are in your household: ……
7. What is your primary occupation? a. Farming [ ] b. Petty trade [ ] c. Artisan [ ] d. Fishing [ ] e. Government worker [ ] f. Others (specify). ……
8. Approximately how much do you earn monthly from your primary occupation? GHC…….. ….
9. Do you have other occupations other than the primary occupation (s)? a. Yes [ ] b. No [ ]
10. If yes specify. ……
11. Approximately how much do you earn monthly from the other secondary occupation(s) in GHC ……

12. Do you earn other incomes as remittances from friends or relatives for the past one year? a. Yes [ ] b. No [ ]
13. If yes, how much remittances do you received GHC. …….

SECTION B

Availability of Native Tree species

14. Which of these native tree species is/are mostly found in your community? a. Baobab [ ] b. Locust bean [ ] c. Bombax [ ] d Lannea [ ] e. Jujube [ ] f. Marula [ ]
15. Which product(s)/part(s) of the native trees do you eat? a. Leaves/floral [ ] b. Fruits/pulp [ ] c. Seed [ ] d. Stem [ ] e. Bark [ ] f. Others specify……
16. In which form do you eat it? a. Raw [ ] b. Processed [ ] c. Both [ ]
17. If processed, what is the name(s) of the processed product(s)? …….
18. Which part(s) do you sell? a. Leaves/floral [ ] b. Fruits/pulp [ ] c. Seed [ ] . d. Stem [ ] e. Bark [ ] f. Others specify…….
19. In which form do you sell the products product(s)? a. Raw [ ] c. Processed [ ] d. Both [ ]
20. In which market do you sell the tree products? ……
21. What is the distance of your home to the market? ……..
22. Does the distance of your home to the market prevent you from harvesting the native tree products? 1. Yes [ ] 2. No [ ]

SECTION C

Native Tree Ownership and Management

23. In what ways are native trees important? a. provides Income [] b. Firewood [ ] c. Medicinal purposes [ ] d. Marketing of products (fruits and seeds) [ ] e. Source of food [ ] f. Soil conservation [ ]
24. Do you think that the number of native trees in your community have increased in the last 5-10 years? 1. Yes [ ] 2. No [ ]
25. How about the last 30 years, what was the native tree population in your community?
26. Has the native tree population been stable in your community? 1. Yes [ ] 2. No [ ]
27. If yes what has accounted for the stability of the tree species?.....
28. If the number of native tree species have increased, who has been planting new trees? a. Land owners [ ] b. Community members [ ] c. NGOs [ ] d. Government organizations [ ] e. Others specify.....
29. If the native trees have decreased, what might be the cause? a. Lack of planting [ ] b. poor harvesting practices of existing trees/poor handling of trees [ ] c. Farming activities [ ] d. Natural disaster [ ] e. Mining activities [ ] f. Bush fire [ ] e. Others (specify). ……
30. Have the changes in farming practices over the years affected the number of trees? 1. Yes [ ] 2. No [ ]
31. If yes, which recent farming practice has caused the destruction of native tree species in your community?.....

32. Who owns the native economic trees in this community? a. Tree chiefs [ ] b. Tindanas [ ] c. Community chiefs [ ] d. Individual landowners/farmers [ ] e. Communal/community members [ ]
33. Who takes care of/manages the native trees in your community? a. Tree chiefs [ ] b. Tindanas [ ] c. Individual landowners/farmers [ ] d. Community chiefs [ ] e. Community members [ ] f. Nobody/survivors for the fitters [ ]
34. Who benefits from the products of the native trees? a. Everybody in the community [ ] b. Only tree chiefs and their families [ ] c. Landowners/farm owners where the trees grow [ ] d. Only Tindanas and families [ ]
35. Do individual community members have access to products (fruits, seed or fuel wood) from the native trees? 1. Yes [ ] 2. No [ ]
36. What is the distance of your home to the native trees? ……
37. Does the distance prevent you from harvesting the native tree products? 1. Yes [ ] 2. No [

SECTION D

Harvesting/Collection of Native Tree Products (NTPs)

Tree species	Product	Quantity Harvested	Quantity sold	Quantity consumed
Baobab	Leaves Fruits Seeds Bark			
Locust bean	Leaves Fruits Seeds Bark			
Bombax	Leaves			

	Flower Fruits Bark			
Jujube	Leaves Fruits Bark			
Marula	Leaves Fruits Bark			
Lannea	Leaves Fruits Bark			

38. Indicate the quantity of native tree parts harvested in your household

39. Which category of people engage in harvesting native tree products in your community?

    a. Men

    b. Women

    c. Youth

40. Indicate the product part harvested by these categories of people.

Tree species	Product	Men	Women	Youth
Baobab	Leaves Fruits Seeds Bark			
Locust bean	Leaves Fruits Seeds Bark			
Bombax	Leaves Flower Fruits Bark			
Jujube	Leaves Fruits Bark Fuel wood			
Marula	Leaves Fruits Bark			
Lannea	Leaves Fruits Bark			

SECTION F

Native Trees and Household Livelihood Outcomes

41. How many times do you consume native tree products in a week in your household?

Tree species	Response (#no. of times in a week)
Baobab products	
Locus bean products	
Bombax products	
Marula products	
Jujube products	
Lannea products	

42. Do you think native tree products contribute significantly to meeting household dietary requirements? 1. Yes [ ] 2. No [ ]
43. If yes, how?
44. Do you think native tree products contribute significantly to your health and other people in the household? 1. Yes [ ] 2. No [ ]
45. If yes, how?
46. Are native tree products available throughout the year for your household consumption? 1. Yes [ ], 2. No [ ]
47. If no, how many months is the native tree products available for your household consumption in a year? ……..
48. What proportion of your household daily food consumption is contributed by native tree products? ……
49. Do you think native tree products can reduce malnutrition and stunted growth among children in your community? 1. Yes [ ], 2. No [ ].
50. If yes, how do they contribute to the reduction of malnutrition and stunted growth of children in your community?.....
51. Which of these natural assets do you have in your household? a. 1or more acre agricultural land (b) potable water (c) Native trees (d) stone or sand quarry (e) mineral mines
52. What is the value of your Natural assets?.....
53. Which of the natural assets were acquired from your harvest of native tree products? ……
54. Which of these physical assets do you have in your household? (a) poultry and other livestock b. household appliances (c) machinery/vehicle (d) building (e) furniture

55. What is the value of your physical assets?.....
56. Which of the physical assets were acquired from your harvest of native tree products?.....
57. Which of these financial assets do you have? (a) waged employment (b) income generating business (c) savings/bank deposits (d) stocks/ shares in a company
58. What is the value of your financial assets?.....
59. Which of the financial assets were acquired from your harvest of native tree products?.....
60. Is your income generating business a native tree product business? 1. Yes [ ] 2. No [ ]
61. If yes, which native tree product business are you operating? ……

62. How much is your monthly income?
    a. ≤ 3,000
    b. 3,001-6,000
    c. 6,001-9000
    d. 9,001-12,000
    e. 12,001-15,000
    f. 15,001-18,000
    g. > 18,000
63. What proportion of your monthly income is from sale of NTPs?.....
64. What proportion of your monthly income is from farming/Agriculture?.....

65. What proportion of your monthly income is from non-farming activities?.....
66. Have you made any savings from harvesting native tree products? 1. Yes [ ] 2. No [ ]
67. If yes how much savings have you made since you started your business?.....
68. Which of these human assets do you have? (a) training on best business practices (b) toilet at home (c) eat (well) three square meals a day (d) education
69. What is the value of your human assets?.....
70. Has native tree product harvesting contributed in attaining these human assets? 1. Yes [ ] 2. No [ ]
71. If yes, which of them has native tree product harvesting contributed in acquiring? (a) training on best business practices (b) toilet at home (d) eat (well) three square meals a day e. education
72. Which of these social assets do you have? (a) Belong to a group/associations (b) networking group (c) access to wider institutions in the society (d) no domestic violence (e) feelings of trust and safety
73. What is the value of your social assets?.....
74. Has native tree product harvesting contributed in attaining these social assets? 1. Yes 2. No
75. If yes, which of them has native tree product harvest contributed in attaining? (a) member of several associations (b) networking group (c) access to wider institutions in the society (d) no domestic violence

Thank you

APPENDIX 2

FOCUS GROUP DISCUSSION

INTERVIEW GUIDE

Group Index

Group Number:	Date:
Region:	Group contact:
District:	District code:
Community:	Community code:

Groups

Men Group

Women group

Youth Group

1. The role of women, youth and men in native trees in this community.
2. Role of women and youth in harvesting native tree products.
3. Benefits of women, youth and men in native trees
    a. Products
    b. Women, youth, children and men
4. Ownership of native trees-discuss
5. Management of native trees in the community. Who manages?
6. Quantities of native tree products harvested
    a. For sale and for consumption
    b. For household consumption
7. Sources of household income
    a. NTPs

b. Farming

c. Non-farming

8. Contribution of native tree products to household livelihood outcomes

   a. Frequency of consumption

   b. Contribution to household income

   c. Contribution to household assets

9. Which category of people are engaged in harvesting/collection of native tree products in this community?

   a. Men

   b. Women

   c. Youth

   d. Products mostly harvested; quantities harvested.

10. What is influencing native tree product harvest intensity

   a. Distance to tree

   b. Sex

   c. Age (household head)

   d. Availability of native trees/Seasonality

   e. Access to native trees

   f. Household size

   g. Education

   h. Distance to market

   i. Income level

   j. Group membership

   k. Marital status

11. Population of native trees over the years by women, youth and men

a. 5-10 years

b. 15-20

c. 30 and Above

Thank you