UNIVERSIDADE EDUARDO MONDLANE

FACULDADE DE AGRONOMIA E ENGENHARIA FLORESTAL

DEPARTAMENTO DE ENGENHARIA FLORESTAL

Ph.D. IN FOREST RESOURCES

DETERMINANTS OF COMMUNITY PARTICIPATION IN SELECTED NON-TIMBER FOREST PRODUCTS MARKET IN NIASSA SPECIAL RESERVE, NIASSA PROVINCE, MOZAMBIQUE

BY

LUBEGA GERALD

Maputo August 2024

UNIVERSIDADE EDUARDO MONDLANE

FACULDADE DE AGRONOMIA E ENGENHARIA FLORESTAL

DEPARTAMENTO DE ENGENHARIA FLORESTAL

Ph.D. IN FOREST RESOURCES

DETERMINANTS OF COMMUNITY PARTICIPATION IN SELECTED NON-TIMBER FOREST PRODUCTS MARKET IN NIASSA SPECIAL RESERVE, NIASSA PROVINCE, MOZAMBIQUE

BY

LUBEGA GERALD

A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Forestry Resources – Environment and Wildlife at the Faculty of Agronomy and Forestry Engineering, Eduardo Mondlane University

Maputo

August 2024

UNIVERSIDADE EDUARDO MONDLANE

FACULDADE DE AGRONOMIA E ENGENHARIA FLORESTAL DEPARTAMENTO DE ENGENHARIA FLORESTAL.

Determinants of community participation in selected Non-Timber Forest Products market in Niassa Special Reserve, Niassa province, Mozambique

Student: **Lubega Gerald**

Supervisors**.** **Dr. Mario Paulo da Silva Falcão,**

Department of Forestry Engineering

Faculty of Agronomy and Forest Engineering

Eduardo Mondlane University

Maputo, Mozambique

Prof, Dr. Natasha Ribeiro,

Department of Forestry Engineering

Faculty of Agronomy and Forest Engineering

Eduardo Mondlane University

Maputo, Mozambique

Dr. Ssekandi Joseph.

Faculty of Agriculture

Uganda Martyrs University

Kampala Uganda

DECLARATION

I, Gerald Lubega, declare this thesis **"Determinants of Community Participation in Selected Non-Timber Forest Products Market in Niassa Special Reserve, Niassa Province, Mozambique."** has never been presented for obtaining any degree or otherwise and that it is a result of my work. This is submitted in partial fulfillment of the requirements for the degree of Ph.D. in Forestry Resources in the Department of Post Graduate Studies under the Faculty of Agronomy and Forestry Engineering of Eduardo Mondlane University.

Sign…….

Date…….

(Maputo August 2024)

DEDICATION

I dedicate this thesis to my beloved family, My Dad Vicent Yiga, My mum Magret Yiga, my son Mathias Muwonge, My Cousin Maria Assumpter Nassolo and My Niece Ingabire Viola. I was absent from your daily life for more than Five years. However, I am deeply grateful for your amazing love, patience, support, and wisdom. You were a source soul of my aspiration, encouragement and strength. There were many falls along the way, but you always reached out and lifted me. You taught me that in life the mistake is not falling but falling and not getting up.

ACKNOWLEDGEMENTS

With gratitude, I am grateful for the Regional Academic Exchange for Enhanced Skills in Fragile Ecosystems Management in Africa (REFORM) project which was funded by the Intra-Africa Academic Mobility Scheme of European Unions for choosing me as one of the beneficiaries of the Ph.D. fellowship that enabled me to study a Ph.D. and complete this research.

I thank my research supervisors Dr. Mário Paulo Falcão, Prof. Dr. Natasha Ribeiro, and Dr. Joseph Ssekandi who contributed to my academic guidance from the conceptualization of this research; data collection, publications stage, and writing of this thesis. Special thanks to the reviewers/Examiners (Dr. Agnelo Fernandes, Prof Coert Geldenhuys, Dr. Rosta Mate Munjovo, and Dr. Isilda Nhantumbo) of this thesis for the constructive comments.

I thank Dr. Franziska Steinbruch who supported me in acquiring support from the Wildlife Conservation Society (WCS) and the entire WCS Community who supported me during the entire process of data collection in Niassa Special Reserve. Special thanks to Mr. Muchanga Alberto who introduced me to the leaders and household heads in the different communities.

Finally, I thank my colleagues in my Ph.D. class for the support they rendered to me mostly when I had issues with the language barrier and the entire staff of the faculty of Agronomy and Forestry Engineering of Eduardo Mondlane University and Uganda Martyrs University.

God bless you all.

TABLE OF CONTENTS

LIST OF SYMBOLS AND ABBREVIATIONS

BSMs Benefit-Sharing Mechanisms.

DBH Diameter Breast Height.

DINAF National Directorate of Forests

FAO Food and Agriculture Organization.

FDGs Focus Group Discussion.

FPS Farmer Producer Companies.

IVI Importance Value Index.

MAP Mean Annual Precipitation.

MAT Mean Annual Temperature.

NSR Niassa Special Reserve.

NTFPs Non-Timber Forest Products.

NWFPs Non-Wood-forest products (NWFPs)

RA Relative Abundance.

RD Relative Dominance.

RF Relative Frequency.

WSC Wildlife Conservation Society.

LIST OF PAPERS PUBLISHED AND MANUSCRIPTS

Two research papers were published from this research and three manuscripts were prepared and are being finalized for publication.

Lubega, G., P.F. Mario, J. Ssekandi, and R.S. Natasha (2021) Evaluating the Effect of Non-Timber Forest Products on Rural Livelihoods in Macula-Marrupa Corridor Niassa Special Reserve, Mozambique: Implication for Income and Food Security. *American-Eurasian J. Agric. & Environ. Sci.*, 21 (1): 11-21, 2021. DOI: 10.5829/idosi.aejaes.2021.11.21

Lubega, G., P.F. Mario, J. Ssekandi, and R.S. Natasha (2022) Characterizing the Dependence on Non-timber Forest Products among Communities Living Around Forest Conservation Areas in Marrupa-Mecula Corridor, Niassa Special Reserve, Niassa Province of Mozambique. *Front. For. Glob. Change* 5:924959. doi: 10.3389/ffgc.2022.924959

Diversity and Importance Value Index (IVI) of Tree species with NTFPs attachment in Mecula-Lugenda Corridor NSR, Mozambique. (**MANUSCRIPT**)

Evaluate community participation in the value chain as collectors, producers, and sellers of NTFPs in Mecula-Lugenda Corridor NSR, Mozambique. (**MANUSCRIPT**)

The economic value of selected NTFPs towards household food security and income in Mecula-Lugenda Corridor NSR, Mozambique. (**MANUSCRIPT**)

GLOSSARY

Economic factors are those factors concerning proximity to markets, access to market information, demand, inequality, entrepreneurial ability, and income levels which can curtail or prompt utilization of NTFPs markets (Morgan and Pontines, 2014).

Economic Value is a concept in cost-benefit analysis that refers to the value derived by people from a natural resource, a man-made heritage resource, or an infrastructure system, compared to not having it. It appears in environmental economics as an aggregation of the (main function-based) values provided by a given ecosystem (Plottu, *et al.*, 2007).

Non-timber forest products were used to mean different categories such as extractive, edible, pharmaceutical plant, and bee products as well as handicrafts, and biofuels. This study adopted (FAO, 2010) the definition of NTFPs as: "products of biological origin other than wood derived from forests, and trees outside forests". Non-timber forest products (NTFPs) included forest plants and mushroom products, fruits, vegetables, honey, firewood, building materials, and services (Khosravi, *et al*., 2017).

Physical factors are geographical-related factors influencing the utilization of NTFPs and these are mostly related to access to information, distance to the market, and sources of NTFPs (Morgan and Pontines, 2014).

Socio-cultural factors refer to integrated communal factors determining the well-being of individuals in society (Morgan and Pontines, 2014). In this study, social factors are conceptualized to mean those factors concerning the age of the head of household, Land size, Distance from the forest, Source of NTFPs, and Gender-related factors that can curtail or prompt utilization of NTFPs (Zhu *et al.*, 2017).

ABSTRACT

The major purpose of this study was to determine the determinants of Community Participation in the Selected Non-Timber Forest Products (NTFP) Market in Niassa Special Reserve (NSR), Niassa Province, Mozambique. Specifically, this study aimed to (i) evaluate community participation in the value chain as collectors, producers, and sellers of NTFPs; (ii) determine the diversity, and Importance Value Index (IVI) of Tree species with NTFPs attachment; (iii) determine the economic value of selected NTFPs towards household food security and income; and (iv) examine the key factors that influence the decision of the household's participation in the selected NTFPs market in Mecula-Lugenda Corridor in NSR. Community-based analytical cross-section and longitudinal studies were done employing quantitative and qualitative approaches. Focus group discussions were held with members of the communities whereas key informant interviews were conducted with Wildlife Conservation Society officials (the management authority), traditional healers, and local leaders to help in identifying the different places where these species are being harvested. Twelve transects were established to identify tree species with NTFP attachment. Tree Species Diversity was determined using the Shannon diversity Index. Using households from selected villages along with local leaders, traditional healers, and officials managing NSR, a multistage sampling procedure was preferred whereby simple random sampling was used in choosing such households and villages. Data was collected using the household survey methods and market survey. The economic value of each NTFP was obtained based on the Shackleton and Shackleton model. Community participation in the value chain and key factors affecting the household decisions to participate in the selected NTFP market were investigated using the same sampling framework and process indicated above. Quantitatively, data was analyzed using STATA version 20 to generate descriptive and inferential statistics. A bivariate logistic regression model was used to determine the factors that primarily characterize dependence on NTFPs. Qualitatively, both thematic and content analysis were used. The study found that communities largely participated in the collection of NTFPs whereby 100% were collecting firewood, medicinal plants, fish, spices, grass, and ropes. The communities rarely participated in the collection of oil and bush meat. 80% of the community members preferred firewood, poles, ropes, wild fruits and nuts, grass, bamboo shoots, wild tubes, medicinal plants, and fish because they were associated with the value, they play about food security, health, economic security, and overall survival and economic growth of the area. It was also established that there is a total of 56 different tree species in 25 botanical families that were attached to NTFPs extraction. *Fabaceae* had the highest number of species (20). *Julbernadia globiflora* was the most dominant with a relative dominance of 19.37%, and *Diplorhynchus condylocarpon* (48.6048) had the highest IVI. The diversity of tree species was unevenly distributed in the study area however Ntimbo 2 had the highest diversity index. Different tree species with different families were distributed heterogeneously with diverse heights and sizes forming different layers. The different tree species were harvested from the roots, bark, trunk/branches, leaves, flowers, and seeds for the different NTFPs and were mostly harvested all year through. It was also established that 21 NTFPs ranging between food products, firewood, and construction materials were collected, produced, and traded by households living adjacent to the Mecula-Lugenda Corridor zones. The mean annual value of the identified NTFPs ranged from 600.00MZN/$9.68 to 6000.00MZN/$96.77. Fish and poles had the highest mean annual value followed by poles, oils, sisal, firewood, and ropes. The most dominant NTFPs in terms of mean annual value per household were firewood, mushroom, medicinal plants, and honey. The study

findings thus established that the collection of NTFPs generally contributes 38.6% to food security in NSR. Lastly, the study revealed that about 90% of the households participate in collecting, producing, and selling non-timber forest products. The binary logistic regression revealed sex, age, education, family size, and time spent in the area as significantly associated with dependence on NTFPs. Additionally, forest fires, strong cultural attachment to forests, seasonal engagement in the collection, , distance to the nearby forest, construction needs, forest being a major source of medicine, education, household food security, ready income, tourist attraction, and affordability of a distance to markets were found to have a significant influence on the community's dependence on NTFPs. It was recommended that there is a need to promote off-farm income-generating activities. Secondly, it was recommended that for effective conservation of NTFPs, strategies should take into consideration groups that were found to have more stake, such as the men and youth in planning and implementing sustainable utilization and management of forest resources. In addition, interventions aimed at conserving the forest should consider both *in-situ* and *ex-situ* conservation of the most utilized plants and trees. For instance, trees and plants that provide NTFPs in the form of spices, firewood, and medicines need to be preserved to avoid extinction or relieve pressure on the wild stock. The provision of energy-saving stoves and the promotion of biogas technologies as an alternative to fuelwood is recommended to reduce household overreliance on the forest wood plant. The NTFP value chain in the Mecula-Lugenda Corridor needs some focus action such as providing equipment to the collectors necessary for collection, processing, and conservation, building the capacities of collectors on drying, conservation, and processing techniques, creating, and empowering collectors' organization and their networking with buyers, developing of market information system and an enabling environment that facilitates market access to local collectors. In addition, the promotion of tourism would broaden the market for the NTFPs since most of the tourists would be interested in buying these products as souvenirs. Furthermore, improving NTFP quality can improve NTFP prices in rural, national, and international markets and then reduce the pressure on forest resources and biodiversity in general. Lastly, it is recommended that the domestication of indigenous tree species should be encouraged for the reduction of poverty and for balance to be maintained in the ecosystem. Therefore, the government should encourage the cultivation of edible and medicinal tree species around homes (home gardens) incorporated with honey production. This will reduce encroachment into the forest for tree species exploitation for economic and medicinal reasons.

Keywords: Non-Timber Forest Products, economic value, species diversity, value chain, Importance Value Index, determinants and community participation

RESUMO

O principal objectivo deste estudo foi determinar os determinantes da participação da comunidade no mercado de Produtos Florestais Não-Madeireiros selecionados (PFNM) na Reserva Especial da NIASSA (REN), província de Niassa, Moçambique. Especificamente, este estudo teve como objetivo (i) avaliar a participação da comunidade na cadeia de valor como colecionadores, produtores e vendedores de PFNMs; (ii) determinar a diversidade e o índice de valor de importância (IVI) de espécies de árvores com ligação aos PFNMs; (iii) determinar o valor econômico dos PFNMs selecionados para a segurança e a renda alimentar das famílias; e (iv) examinar os principais fatores que influenciam a decisão da participação da família no mercado dos PFNMs selecionados no corredor de Mecula-Lugenda na RFN. Os estudos transversais analíticos e longitudinais baseados na comunidade foram realizados empregando abordagens quantitativas e qualitativas. As discussões dos grupos focais foram realizadas com membros das comunidades, enquanto as entrevistas com informantes-chave foram realizadas com funcionários da Sociedade de Conservação da Vida Selvagem (Autoridade Gestora), curandeiros tradicionais e líderes locais para ajudar a identificar os diferentes lugares onde estas espécies tem sido colhidas. Doze transectos foram estabelecidos para identificar espécies da árvores com ligação aos PFNMs. A diversidade de espécies de árvores foi determinada usando o índice de diversidade de Shannon. Usando famílias das aldeias selecionadas, juntamente com líderes locais, curandeiros tradicionais e funcionários que gerem a REN, Foi preferido o procedimento de amostragem multiestagio no qual a amostragem aleatória simples foi usada na escolha de tais famílias e comunidades. Os dados foram coletados usando os métodos de pesquisa por inquérito às familias e pesquisa de mercado. O valor econômico de cada PFNM foi obtido com base no modelo Shackleton e Shackleton. A participação da comunidade na cadeia de valor e os principais factores que afectam as decisões familiares de participar do mercado de PFNM selecionados foram investigados usando a mesma estrutura e processo de amostragem indicados acima. Quantitativamente, os dados foram analisados usando o STATA versão 20 para gerar estatísticas descritivas e inferenciais. Um modelo de regressão logística bivariada foi usada para determinar os factores que caracterizam principalmente a dependência dos PFNMs.

Qualitativamente, tanto a análise temática quanto a de conteúdo foram usadas. O estudo constatou que as comunidades participaram amplamente da coleta de PFNMs, onde 100% coletavam lenha, plantas medicinais, peixes, especiarias, capim e cordas. As comunidades raramente participavam da coleta de óleo e carne de caça. 80% dos membros da comunidade preferiam lenha, postes, cordas, frutas e nozes selvagens, capim, brotos de bambú, tubérculos selvagens, plantas medicinais e peixes porque estavam associados ao valor que eles desempenham sobre segurança alimentar, saúde, segurança econômica e sobrevivência geral e crescimento econômico da área. Também foi estabelecido que há um total de 56 espécies de árvores diferentes em 25 famílias botânicas que estavam ligadas à extração de PFNMs. Fabaceae teve o maior número de espécies (20). Julbernadia globiflora foi a mais dominante com uma dominância relativa de 19,37%, e Diplorhynchus condylocarpon (48,6048) teve o maior IVI. A diversidade de espécies de árvores foi distribuída de forma desigual na área de estudo, no entanto, Ntimbo 2 teve o maior índice de diversidade. Diferentes espécies de árvores com diferentes famílias foram distribuídas heterogeneamente com diversas alturas e tamanhos formando diferentes camadas. As diferentes espécies de árvores foram colhidas das raízes, casca, tronco/galhos, folhas, flores e sementes para os diferentes PFNMs e foram colhidas principalmente durante todo o ano. Também foi verificado que, 21 PFNMs variando entre produtos alimentícios, lenha e materiais de construção foram coletados, produzidos

e comercializados por famílias que vivem adjacentes às zonas do Corredor Mecula-Lugenda. O valor médio anual dos PFNMs identificados variou de 600,00 MZN/$ 9,68 a 6000,00 MZN/$ 96,77. Peixes e estacas tiveram o maior valor médio anual, seguidos por óleos, sisal, lenha e cordas. Os PFNMs mais dominantes em termos de valor médio anual por família foram lenha, cogumelo, plantas medicinais e mel. Os resultados do estudo estabeleceram que a coleta de PFNMs geralmente contribuem com 38,6% para a segurança alimentar na REN. Por fim, o estudo revelou que cerca de 90% das famílias participam da coleta, produção e venda de produtos florestais não madeireiros. A regressão logística binária revelou sexo, idade, educação, tamanho da família e tempo gasto na área como significativamente associados à dependência dos PFNMs. Além disso, incêndios florestais, forte apego cultural às florestas, envolvimento sazonal na coleta, distância da floresta próxima, necessidades de construção, floresta sendo uma importante fonte de medicamentos, educação, segurança alimentar familiar, pronta renda, atração turística e acessibilidade de uma distância até os mercados foram considerados como tendo uma influência significativa na dependência da comunidade aos PFNMs.

Foi recomendado que há uma necessidade de promover atividades geradoras de renda fora da fazenda. Em segundo lugar, foi recomendado que para a conservação efetiva de PFNMs, as estratégias devem levar em consideração grupos que foram considerados como tendo mais interesse, como os homens e os jovens no planeamento e implementação da utilização e gestão sustentável dos recursos florestais. Além disso, as intervenções destinadas à conservação da floresta devem considerar a conservação in situ e ex situ das plantas e árvores mais utilizadas. Por exemplo, árvores e plantas que fornecem PFNMs na forma de especiarias, lenha e medicamentos precisam ser preservadas para evitar a extinção ou aliviar a pressão sobre o estoque selvagem. O fornecimento de fogões de economia de energia e a promoção de tecnologias de biogás como uma alternativa à lenha são recomendados para reduzir a dependência excessiva das famílias em espécies arbóreas floresta. A cadeia de valor dos PFNMs no Corredor Mecula-Lugenda precisa de alguma ação focada, como fornecer equipamentos aos coletores necessários para coleta, processamento e conservação, desenvolver as capacidades dos coletores em técnicas de secagem, conservação e processamento, criar e capacitar a organização dos colectores e sua rede com compradores, desenvolver um sistema de informação de mercado e um ambiente propício que facilite o acesso ao mercado para colectores locais. Além disso, a promoção do turismo ampliaria o mercado para os PFNM, já que a maioria dos turistas estaria interessada em comprar esses produtos como souvenirs. Além disso, melhorar a qualidade dos PFNMs pode melhorar os preços dos PFNMs nos mercados rurais, nacionais e internacionais e, então, reduzir a pressão sobre os recursos florestais e a biodiversidade em geral. Por fim, é recomendado que a domesticação de espécies arbóreas indígenas seja incentivada para a redução da pobreza e para que o equilíbrio seja mantido no ecossistema. Portanto, o governo deve incentivar o cultivo de espécies arbóreas comestíveis e medicinais ao redor das casas (hortas caseiras) incorporadas à produção de mel. Isso reduzirá a invasão da floresta para exploração de espécies arbóreas por razões econômicas e medicinais.

Palavras-chave: Produtos florestais não madeireiros, valor econômico, diversidade de espécies, cadeia de valor, Índice de Valor de Importância, determinantes e participação comunitária

CHAPTER ONE: INTRODUCTION

1.0: Introduction.

Non-timber forest Products (NTFPs) are an important source of livelihood for rural populations worldwide. Rural communities depend on forests to fill subsistence needs like food, fodder, litter, and fuel wood. Mukul *et al.*, 2016; Saifullah, *et al*., (2018) revealed that a significant proportion of the world's rural population is highly dependent upon forest resources. For instance, according to an estimate by the World Commission of Forestry and Sustainable Development, 787 million people depend almost entirely for their subsistence needs on forests, and another 1 billion rely on forests and trees for fuel, wood, food, and fodder (Blaney, Beaudry and Latham, 2009). Along the same lines, the Food and Agriculture Organization (FAO) estimates that 80 percent of the population in developing countries relies on NTFPs for nutritional and health needs (Secretariat of the Convention on Biological Diversity (SCBD) *et al.*, 2014). Though the numbers estimated by different organizations may vary, these studies suggest that there is quite a significant proportion of the population living in or near the forests and depending upon it to some degree.

Forest products act as buffers during times of hardship and are often used as safety nets where the rural community depends on these resources to bridge the hunger gaps (Razafindratsima *et al.*, 2021). Non-timber forest products not only fulfill the subsistence needs of the rural population but also contribute to generating cash income (Pandey, Tripathi, and Kumar, 2016). For example, indigenous tribes in the Western Ghats of South India depend up to 50 percent on NTFPs as a source of income (Nguyen *et al.*, 2020), In the Palawan Island of the Philippines, the collection of NTFPs is the most important livelihood strategy of the Tagbanua tribe (Nguyen, T., *et al.*, 2019) Production and marketing of NTFPs form a major source of rural income in the South West Province of Cameroon (Pandey, Tripathi and Kumar, 2016). Trading of NTFPs in Zimbabwe (Charis, *et al.*, 2019, Dlamini, C S, 2020) and in many other countries in Africa where biodiversity is high and local communities still rely on the natural environment for their livelihoods, the expansion of environmentally protected areas raises issues of equity for those dependent on the forests for their livelihood (Matias *et al.*, 2018).

1.1.0: Background of the study

The background to this study is presented in four perspectives namely: the historical perspective which explains the origin of community participation in the NTFPs market, the Conceptual perspective containing definitions of the major concepts in the study topic, the theoretical perspective which unfolds the theory used to guide the research, and contextual perspective unfolding information about the area of study about the research problem as summarized in figure 1 below.

Figure 1.1: Demonstration of the historical, theoretical, conceptual, and contextual roots of the study.

1.1.1: Historical background

Historically, community participation in NTFPs is rooted in the idea of benefit-sharing mechanisms (Dlamini, R. M. 2007). For instance, in Vietnam, Nepal, and Mexico, benefit-sharing mechanisms (BSMs), are a form of co-management or participatory management, a partnership arrangement with all parties involved sharing responsibilities, rights, and benefits (Nguyen Vu Linh, 2015). In Vietnam, the BSM in the Bach Ma National Park was based on co-management principles to manage, protect, and sustainably develop special-use forests, generate income, and improve the living standard of local people (Huynh *et al.*, 2016). From the early days, co-management and BSMs have been used as a potential way to reduce poverty amongst the estimated 450 million people who live in and around forests in Asia, including Vietnam. After the reunification of Vietnam in 1975, natural forest resource management and use were placed under state forest enterprises established by the provincial government. In 1986, the Vietnamese government launched the "Doi Moi" policy, which led to the recognition of non-state forest organizations' contribution to forest management (Kimdung, *et al.*, 2016).

In Nepal, at the end of 1986, the government introduced new forest policies and programs for transferring forests to local communities to deal with the continuous decline in forest coverage. One of the cornerstones of decentralization policies was the allocation of degraded forest and barren land targeted for the restoration of trees, to individual households and communities for long-term use and management (Hong and Saizen, 2019). In Mexico, the 2003 Land Law and the 2004 Forest Protection and Development Law further defined local responsibilities and associated legal rights. Local communities were gradually recognized as legal recipients of land use rights (Marshall, *et al.*, 2003). Since mid-2008, several co-management project-level initiatives have been conducted across Mexico to prepare for a new policy, which would allow the establishment of pilot BSMs between the management boards of SUFs and local communities (Reuben. G, *et al.*, 2010). Two studies in Vietnam, one in Tram Chim National Park (Dong Thap province) (Vo *et al.*, 2013) and the other in a mangrove forest (Ca Mau province) Lele *et al.*, (2013) showed that local people could contribute to forest protection and management if they were given more rights and responsibilities over forest management. However, a study by Ha. T, *et al.*, (2016) in Song Tranh Nature Reverse in Quang Nam province suggested that the BSM agreement needed to assure less powerful people (usually the poor or ethnic minority) that they would have equal opportunities to share in the benefits of co-management or benefit-sharing agreements. In all forested countries,

community participation at the level of collection and selling of NTFPs has been found crucial for the sustainability and conservation of forests.

Globally, sustaining forests is important to the food security of the poor because they rely on their products (Mulenga *et al.*, 2014a). In countries like Nepal, forests form an integral part of rural livelihoods. Forest products not only provide the rural population with subsistence needs like fuel wood, fodder, and litter but also provide wild foods during periods of food shortage when grain storage starts dwindling and the new harvest is not yet available (Nguyen, T., *et al.*, 2019). Many NTFPs also have medicinal and socio-cultural values (Other *et al.*, 2018). Besides these subsistence uses, the trade of NTFPs forms a source of cash income for many of the rural population (Ulrichs *et al.*, 2019). In India, over 50 million people depend on NTFPs from the catchment forest to sustain their life as a source of food and income *(*Tekle, T., *et al.*, 2018).

In developing countries, about 220 million people are food insecure (Wood, E., *et al.*, 2004.). It is estimated that about 60 percent of the population in Sub-Saharan Africa live and work near forested land (Awono and Levang, 2018) and they rely on NTFPs to satisfy their basic needs such as food, medicine, wood, fodder for animals, shade, and soil fertilization (Kinyili and Ndunda, 2022). For example, fuel wood is collected to meet domestic energy needs and income generation while wild fruits and leaves are also collected because they are the major source of micronutrients for rural households (Razafindratsima *et al.*, 2021). Further, in most parts of Sub-Saharan Africa, forests are considered important for rural livelihoods as sources of food, medicine, shelter, building materials, fuels, and cash income (Teshome, 2019). More than 15 million people in Sub-Saharan Africa earn their income from forest-based enterprises such as fuel and charcoal sales, small-scale sawmilling, commercial hunting, and handicraft production (Tugume *et al.*, 2016). Thus, forests are a source of many products on which households depend for both subsistence consumption and income generation. Non-Timber Forest Products provide a variable source of income that contributes to meeting domestic expenditure (Huynh *et al.*, 2016) and serves an insurance function in times of crisis like crop failure (Tugume *et al.*, 2016). By acting as a source of income, forests are tools for poverty alleviation among rural households (Schaafsma *et al.*, 2014a). Furthermore, in Sub-Saharan Africa, fuel wood and charcoal remain the main source of fuel for populations in rural and urban areas (Saifullah, *et al.*, 2018). In developing countries, about 15 million people earn their income from forest-related activities such as fuelwood and charcoal sales, commercial

hunting, and handicraft production (Endamana, D. *et al.*, 2016). The catchment forests play an important role in improving rural and urban livelihood through the provision of NTFPs.

Mozambique is endowed with forest and woodland resources covering a total of 32 million hectares 40% of the total area (Talukdar, N.R., *et al.*, 2019). Catchments in the forests offer direct and indirect NTFPs, which support both rural and urban communities (Lubega, G., *et al.*, 2021)**.** Non-Timber Forest Products (NTFPs) include wild fruits, poles, fodder, honey, firewood and vegetables, and medicinal plants (Syampungani, *et al.*, 2020). Thereby, NTFP collection provides an important source of income for poor households and a temporary safety net in times of food or income scarcity (Huynh *et al.*, 2016).

1.1.2: Theoretical background

Households' decision-making process can be explained by the utility maximization theory whose basis is rooted in random utility theory (McFadden, 1960). Utility maximization means a strategic scheme whereby individuals and companies seek to achieve the highest level of satisfaction from their economic decisions. For example, when a company's resources are limited, management will implement a plan of purchasing goods or services that provides the maximum benefit (Fuad, *et al.*, 2007). Utility maximization theory assumes that households evaluate each opportunity that comes to them with complete knowledge of alternatives and choose the opportunity that maximizes the utility. According to this theory, a choice that households make among a set of options depends on the utility of each alternative relative to the utilities of all alternatives (Västberg, O.B., *et al.*, 2020). In other words, given two options that are selling NTFPs or not, for example, households confronted with a choice between the two options assign each alternative a perceived utility. Hence households choose the option that maximizes the utility after comparing the expected utility of participation in NTFP selling with non-participation. If a household chooses to participate in NTFP selling, that means it yields the highest utility.

This study was also based on stakeholder management theory which was pioneered by Frank, E., (2004) and advanced by (Bourne and Walker, 2005). This theory postulates that the successful completion of organizational deliverables is critically dependent upon relationship management skills; amongst these is the need to achieve organizational objectives that fully address stakeholder expectations throughout the project life-cycle (Bourne and Walker, 2005). This theory predisposes

that one major task that needs to be undertaken in developing a project's strategic aims is to identify stakeholders to develop a project brief that best addresses their often-conflicting range of needs and wishes (Donaldson, T. and Preston, 1995). Stakeholder theory offers several perspectives and expectations that stakeholders may hold. This theory tends to focus on concepts of justice, equity, and social rights having a major impact on the way that stakeholders exert moral suasion over project development or change initiatives which in the end may affect the overall performance (Wood, E.., *et al*., 2004.). Thus, one prevailing view is that a stakeholder is someone affected by a project and has a moral (and perhaps a non-negotiable) right to influence its outcome. This view is very broad and its consequences unmanageable because there are so many ways in which a project can impact a very wide range of people from affecting a business environment to other more physical or social dimensions that relate to the quality-of-life issues. It further holds that stakeholders and managers interact and their relationship is contingent upon the nature, quality, and characteristics of their interaction (Donaldson and Preston, 1995). In this view, the identification of stakeholders is more concerned with their instrumentality, agency capacity, or being vectors of influence. This implies a need for negotiation, and expected reactions ranging from standoff to mutual adjustment, depending on intermediate variables such as trust and commitment, and motivational forces (being harmonized or in conflict).

This theory is based on the theorem that the reactions from stakeholders always force the performance of the organization to meet their standards since they always come up with the best ways how they want things to be done in an organization (Bourne and Walker, 2005). This current study was interested in understanding 'legitimate and valid' stakeholders' need to be identified and their power and influence mapped so that their potential impact on NTFP can be better understood. Appropriate strategies can then be formulated and enacted to maximize a stakeholder's positive influence and minimize any negative influence. This becomes a key risk-management issue for project managers to avoid many project failures (John Wateridge, 1998). Therefore, based on the assumptions of this theory, it can be assumed by this study that if NFD endeavored to involve its user departments, consult different internal committees, and involve internal stakeholders in the tendering process in the overall management of forests, this may lead to improved performance.

Further, the Basic Needs Theory was also adopted to guide this study. This theory was rooted in the basic needs theory which was first introduced by the International Labor Organization in 1976. This theory emerged as a way to react to the prevailing modernization and structuralism, or top-down strategies used in developing approaches that had failed to achieve development and poverty reduction to the required satisfaction (Frey, C., *et al*., 2021). Modernization and structuralism had failed to achieve equality and clear all forms of poverty that existed in developing countries. The main tenet of the theory is meeting basic needs (Tassou, 2017). The proponents of the theory argue that to understand that poverty has been alleviated; people must be able to meet their basic needs. Basic needs are used as the absolute requirement, as a starting point to achieve sustainable development. The proponents of basic needs indicate that eliminating absolute poverty is one way of making people more active in communities to wholly safeguard natural forests to avoid looking at NTFPs as the only source of food and survival. It is the best way to ensure that financial inclusion and sustainable inclusive development have been achieved (Frey, *et al.*, 2021).

The basic needs theory became more relevant for this study since perceived degradation in many parts of Africa is because of the Basic Needs of commercial ventures which are dominated (often from outside) where communities look at forests for socio-cultural needs with little attention to sustaining the natural bio-physical environment. Natural forests are an integral part of biodiversity and livelihoods in rural communities of developing countries (Johansson *et al*., 2020). Although scholars now know the significance of biological diversity, less is known about its economic value and the socio-economic costs of losing it. Costs of environmental damage and depletion of natural resources have frequently been disregarded (Liu & Faure, 2018). For instance, communities using wood as sources of food, fuel, and farming put strain on the area (Tadele *et al*., 2020). To the extent that rural people's livelihoods are dependent on natural forests, poverty, food insecurity, and population pressure, all contribute to the loss of forest cover, locking rural residents in a cycle of permanent poverty. While millions of individuals continue to cut down trees to improve their living conditions, large-scale agribusiness, which is driven by increasing consumer demand, is becoming a major cause of deforestation (Ordway *et al*., 2017).

The basic needs theory is further qualified on the basis that the primary determinants of people's livelihoods, typical interactions between those determinants, and potential adaptation solutions are all limited to sustainable livelihoods framework along with the desired outcomes. According to

this idea, to maintain sustainable livelihood outcomes and strategies, one must have access to capital assets or livelihood resources (such as natural, human, physical, financial, and social capital assets). The ability of households to self-insure and manage risk in the face of catastrophe is determined by assets in the form of physical and human resources, human capital, and social networks, which in turn, affects their susceptibility to shocks (World Bank, 2001). People must therefore combine, therefore, capital endowments/assets that they have access to and control over and on which they draw when pursuing various livelihood strategies to develop and sustain livelihoods (Xu *et al*., 2015.). This becomes a major determinant for the utilization of NTFPs.

1.1.3: Conceptual background.

This study was based on two main concepts: determinants and community participation. Determinants in this study referred to those factors explaining the causation of a phenomenon. In the utilization of NTFPs, several factors have been described as economic, socio-cultural, and psychical factors (Adewumi, 2021). Economic factors were used to mean those factors concerning proximity to markets, access to market information, demand, inequality, entrepreneurial skills, and income levels that can curtail or prompt the utilization of NTFPs (Morgan and Pontines, 2014). Socio-cultural factors were integrated communal factors determining the well-being of individuals in society (Sakai *et al.*, 2016). In this study, social-cultural factors were conceptualized to mean those factors concerning the age of the household head, land size, distance from the forest, source of NTFPs, and gender-related factors, that can curtail or prompt utilization of NTFPs (Amusa, *et al.*, 2017). The psychical environment represents the biological component which is also nonrenewable.

On the other hand, community participation refers to a broad field of involvement and a multi-layered concept, with the term being used to describe many different processes (Suleiman *et al.*, 2017). Wongnaa, *et al.*, (2020) Consider participation as the focus of decision-making, the content of decision-making, the nature of the participation activity, frequency, and duration of participation. The level and nature of participation can vary. Harbi *et al.*, (2018) Asserted that in a state there are two interpretations of the term participation. It can simply mean taking part, being present, being involved, or being consulted. Alternatively, it can denote a transfer of power so that participants have power over decisions and know that their actions and views are going to make a

difference and may be acted upon, thus leading to what is known as empowerment. Not much is known about whether community members have full power to influence decisions as they participate in decision-making about the use of NTFPs which include firewood, vegetables, wild fruits, bush meat, and poles. Others are honey, weaving materials, fodder, ropes, and mushrooms (Khosravi, *et al.*, 2017)**.** This study therefore addressed the level of community participation in NTFPs value chain as collectors and/or producers and/or sellers. Increased attention was being paid to participation by people and local organizations because such participation is positively correlated with appropriate and sustainable development practices. This is illustrated in the figure below.

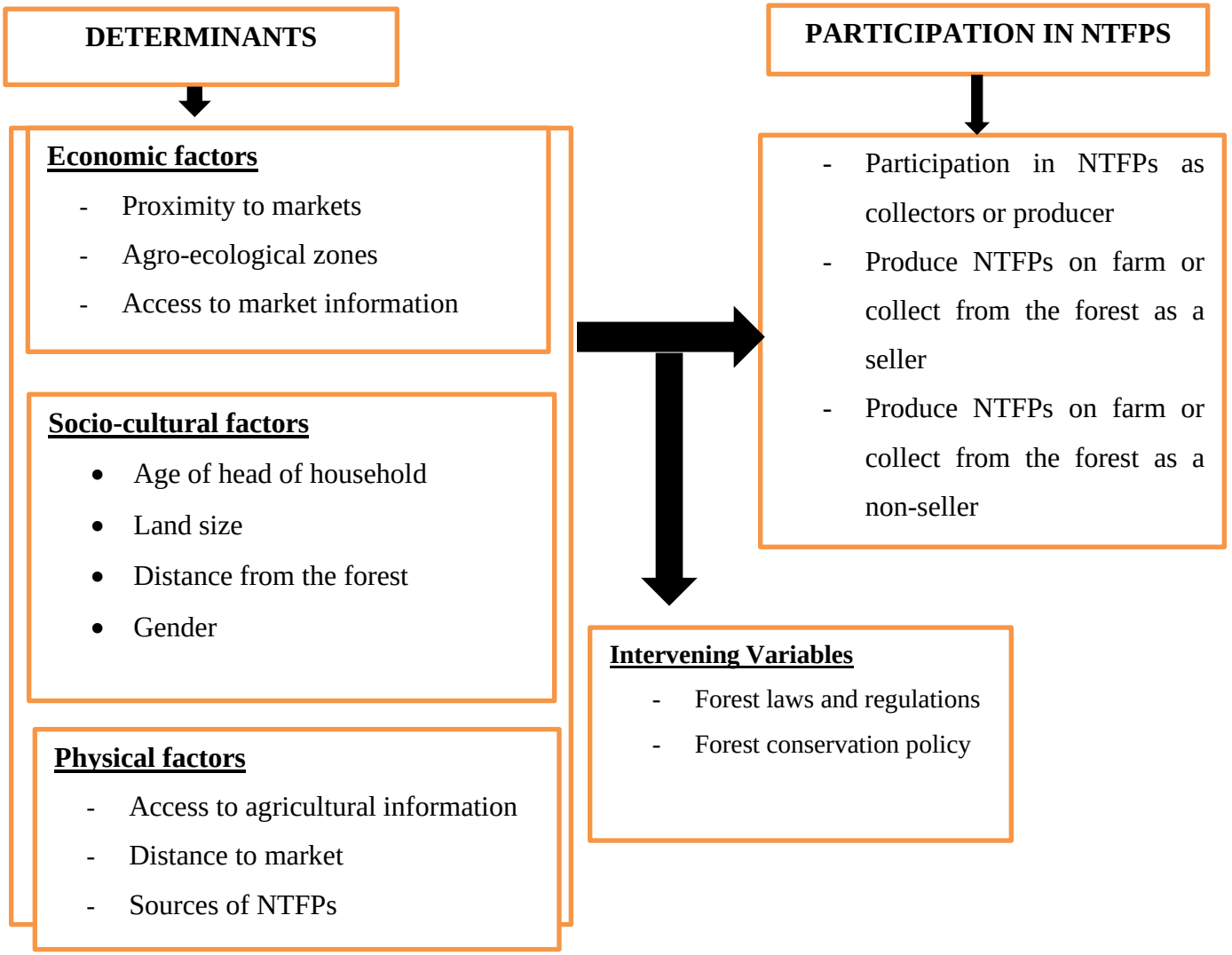

Figure 1.2: Conceptual framework for the linkage between socioeconomics characteristics of households and their decisions in the three hurdles.

1.1.4: Contextual background

The geographical location of Mozambique, from 10 to 26 degrees south of the equator, provides a diversity of climates that determine different forest-related systems. Forests are conceptualized as a complex set of ecological systems and natural resources where trees become the most dominant form of life (Côte, W. & Purves, 2018). However, in Mozambique, this is largely dominated by woodland which is commonly known as Miombo woodlands. This occurs to the north of the Save River and occupies approximately two-thirds of the natural forest area, followed by mopane woodlands (Massingue, 2019). Mozambique's richest woodlands in terms of wood products and biodiversity are the mosaics of semi-deciduous forests with Miombo woodlands that occur in northern Mozambique, southern Tanzania southeastern Malawi, and south and north of the Zambezi delta. Other countries include Angola, Botswana, Burundi, the Democratic Republic of Congo, Namibia, and Zimbabwe (Chirwa, P.W. and Adeyemi, 2020). Other rich areas can be found on the slopes of high mountains mostly in the Chimoio plateau (Ali, 2021).

Niassa Special Reserve (NSR) is a nature reserve lying partially in the provinces of Cabo Delgado and Niassa, in northern Mozambique. This reserve covers over 42,000 square kilometers, it is the largest protected area in the country representing 30% of the total protected area in the country (Mbanze, A. A. *et al.*, 2019). The reserve is part of the Trans-frontier Conservation Area and links to the Tanzanian Lukwika-Lumesule Game Reserve (Zella, Saria, and Law, 2018).

Niassa Special Reserve is part of the Eastern Miombo woodlands, which also encompasses parts of Tanzania and Malawi. The reserve is one of the largest Miombo woodland preserves in the world, with Miombo forest covering more than half of the reserve. The remainder is mostly open savannah, with some wetlands and isolated patches of forest. 95% of the Reserve's biomass is vegetation, which includes 21 types of plant and 191 species of trees and shrubs (Mate, *et al*., 2014). Mecula-Lugenda Corridor is a nature reserve lying within the province of Niassa, Mozambique. This reserve covers over 42,000 square kilometers (16,200 square miles), and it is the largest protected area in the country (Reserve and Mariri, 2018). It is worth noting that on high altitudes, forests with flora and fauna occupy over 1500m above sea level whereas settlements and

agriculture zones occupy the lowest altitudes below 1500m. Mecula-Lugenda Corridor is among the corridors with the most fertile and productive soils which are favorable to agriculture. This has been attracting a bigger population of wildlife (Salimo *et al*.,2022).

This is the fact behind the increased collection, production, and selling of NTFPs and at worse, encroachment of the corridor and clearance of fragile fertile forests for settlements and shifting agriculture (Immaculada and Yadvinder, 2016; Mbanze, 2020). For instance, the Maraca region in the Mecula-Lugenda corridor was found to have lost over 33% of its land cover which is categorized as largely dense humid forests for the period 1990-2010(Félix, *et al.,* 2020). Consequently, such losses have ended up causing degradation of land and forests, flash floods, and increasing causalities within the local areas (Mbanze, 2020).

The subsistence and commercialization of forest products were presumed to play a major role in local economies. Building materials are commercialized as much as firewood is. Other products such as wild foods (including fruits, leaves, meat, and honey) and charcoal are commercialized in local markets in the cities or by the roadsides. They represent income to rural people, including women and children. Medicinal plants are prescribed by traditional healers to their clients or sold in urban markets (Boadu and Asase, 2017).

1.2: Statement of the Problem

NTFPs are available in many catchment forest systems in Niassa Special Reserve (NSR) and contribute to household livelihoods (energy, construction material, provision of food, medicine, and cosmetics) (Balama *et al.*, 2016). They also contribute to poverty alleviation through the generation of income (Soe and Yeo-chang, 2019)**.** It has been argued that the value of NTFPs' contribution to the existing low-value woodlands in Mozambique can have quite a substantial addition to the national economy (Suleiman *et al.*, 2017). In NSR, rural households depend on NTFP collected from the forest or produced on the farm for their nutritional needs (Polesny *et al.*, 2014). Their diets are mainly made up of staple grains and the main source of vitamin C (Mukul *et al.,* 2016). Trees provide products such as oil seeds, edible leaves, and fruits rich in important vitamins (Pandey, *et al.,* 2016). NTFPs also contribute to increased household purchasing power. Several studies (Heubes *et al.*, 2012; Schaafsma *et al.*, 2014a; Tassou, 2017) have shown that catchment forests support rural livelihoods through the provision of NTFPs. However, the extent

to which the community participates in the NTFP market, the total economic value attached, and their contribution to household food security and income are little known and not well documented in NSR. Therefore, this study is intended to fill this gap by generating information that can be used to inform decisions about sustainable use and management of NTFPs. It has been argued that the importance of NTFPs to household food security and income equals or surpasses that of other products (i.e. non NTFPs) yet their worth and potential are rarely quantified (Turreira-García *et al.*, 2018). In addition, several interventions have been planned such as the development of markets for forest products and services, the promotion of forestry in rural development planning, and the scaling up of Agro-forestry-based alternative livelihood systems (FAO, 2018)**.** To achieve these objectives, there is a need to ensure that households have access to a tradable quantity of NTFPs through appropriate sources and are able to attach economic value to other products. However, there are limited studies on factors that determine household decisions to collect or produce NTFPs. The findings from this study add input for research, development institutions, and policymakers in planning relevant interventions to promote the use of NTFPs for better contribution to household food security and poverty alleviation. Furthermore, the findings may be vital in reducing forest degradation and deforestation. The results are supportive in making decisions for the sustainable use of NTFPs thus reducing impacts on Miombo. In addition, several studies including De Sousa, *et al.*, (2021) and Hempson, Archibald & Staver (2019) had been done in the broad-leaved woodlands of southern Africa, showing that resource use through the selective cutting of suppressed and deformed stems, and pruning of branches from remaining stems, during earlier stand development stages and clear-felling in mature stands, as the best methods to ensure recovery of the biodiversity, productivity, and diverse resource use value (the products that had been used) of the woodlands, including Miombo woodland. This study is critical to contribute towards the sustainable use of NTFPs in NSR and sub-Saharan Africa in general.

1.3: Justification of the Study

This study provides information about the sociocultural, economic, and bio-physical factors that contribute to the literature on the community's decisions to collect NTFPs from the forest or to produce them on farms. This study is an academic study that gives useful information to international organizations aimed to promote the long-term conservation of the NSR ecosystems or biodiversity and also supports rural development. The identification of the significant factors

that affect households' decision to sell NTFPs will help the Mozambique Government in designing effective programs to boost households' income in the short term, develop conservation measures for the different species that are instrumental in providing the different NTFPs, and the country's economy in the long term through collection and sale of NTFPs. Moreover, smallholders and development organizations alike can clearly understand the important factors for community members' decision to participate in the NTFP market.

1.4.0: Study Objectives

The overall objective of this study was to assess the factors that affect community decision to participate in selected NTFP markets by collecting them from the forest or producing them on farms in Mecula-Lugenda corridor NSR, Mozambique. The household's decision to sell selected NTFPs is contingent on their decision to collect them, where they collect them, and how much is available for harvesting.

1.4.1: Specific Objectives

i. Evaluate community participation in the value chain as collectors, producers, and sellers of NTFPs.
ii. To determine the diversity and Importance Value Index (IVI) of tree species with NTFPs attachment.
iii. Examine the key factors that influence the decision of the household's participation in the selected NTFPs market.
iv. Determine the economic value of selected NTFPs towards household food security and income.

1.5: Research questions

i. How does the community participate in the value chain of NTFPs?
ii. What kinds of NTFPs species are found in the Mecula-Lugenda corridor in NSR?
iii. Which NTFPs species are most preferably extracted from the area under study?
iv. What key factors influence the decision of the household's participation in the NTFP market?

v. How does the economic value of selected NTFPs contribute to household food security and income?

1.6: Significance of the study

The study of factors behind the community's decisions to collect/produce/sell NTFPs may contribute to significant land use changes and better land use practices towards integrated multiple use of resources. For example, selective stem thinning and branch pruning, with charcoal and fuelwood production, crop production in charcoal production sites and facilitation of productive regeneration through coppice growth in the crop fields to maintain a productive cycle of non-timber use and productive recovery of the forest systems. This has been shown elsewhere that this is a very promising approach to maintain biodiversity, productivity, and diverse resource use value in the same landscape. The reality is that this approach is aligned with the disturbance-recovery processes of the different forest-systems and the traditional resource use practices of the rural societies, with more productive, diverse, and cost-effective recovery of the different woodland/forest species than what could be achieved through planting by rural resources users with their diverse daily livelihood activities.

The livelihood options of rural dwellers and their degree of reliance on the available natural resources particularly the NTFPs are further explored in this study. Understanding the livelihood strategies of people will help to formulate a forestry establishment program to: mitigate any impacts on rural livelihoods, monitor livelihood criterion indicators over time, and identify conservation requirements to manage the Reserve in a way to conserves livelihood aspects (ex. natural plant species, cultural Areas, agricultural resources, water). Specifically, a household livelihood survey of rural residents provided insight and understanding of aspects such as the different NTFPs collected or produced, the different NTFPs that are of high economic importance and the total economic value attached to each specie, the skills and education levels of the residents, their coping mechanisms to shocks and stresses, and their views on the conservation of the reserve resources. Sustainable human development in the communities will be ensured by placing people above the reserve's material well-being and concentrating only on chances for economic development and forest protection measures. Hence one would want to understand the importance of forestry for sustainable livelihoods beyond economic benefits.

The study is also significant for the academic community who would love to make a further investigation about community participation in the value chain as collectors, producers, and sellers of NTFPs, the diversity, and Importance Value Index (IVI) of tree species with NTFPs attachment, examining the key factors that influence the decision of the household's participation in the selected NTFPs market and determining the economic value of selected NTFPs towards household food security and income.

1.7: Limitations of the Study

Some of the primary challenges faced included a lack of response from the participants. Some participants considered the topic sensitive (It involved finding out information from communities hunting wild animals for food, medicine and cosmetics and this is not acceptable in this area being a conservation area) and therefore hesitated to take part in the study. Others were hesitant to participate since the previous researchers did not give feedback to the participants. Also considering that it targeted forest communities and staff, these had time constraints since it was conducted during the time when most of them preparing their gardens for the next planting season. In this case, the researcher considered friendly schedules and avoided the busy times of the term, during work time, Friday was a preferred day for the survey since most of the respondents had to gather in their communities for Juma prayers. The Researcher also promised to organize workshops in the respective communities as a form of knowledge dissemination as soon as data analysis and report writing is done. The Researcher also took time to explain in brief the purpose of the study and reassure them that their comments and data from the study will not be used for any other purpose other than that of the study. Some of the personal, professional, or practical challenges that were encountered while carrying out this study included time constraints and language barriers. For the case of time constraint, we had to split the team into two to be able catchup with time, and for language barrier we contracted research assistants who know the local languages and Portuguese for better communication between the community members and Researcher.

The research work required to dedicate a certain amount of time to always allow for data collection and adequate consultations with the supervisor. In addition, the researcher selected research assistants to support with translation to Portuguese and local language. During data collection and

data analysis periods, the researcher used some time off work, to dedicate more time to the fieldwork, data processing, and analysis. However, the issue of Covid-19 affected the quality of data collection given the fact that some of the study participants could not allow meeting the research assistant face to face. However, this was resolved by switching to the data collection app called Kobo Toolbox. This helped in reducing the use of papers and even spreading the disease. Lastly, some respondents could not recall some information, such as crop yield for the previous year and sales of NTFPs. This was overcome by allowing respondents to seek remembrance from fellow family members, abandoning some of those who failed to totally recall, and allowing estimations.

1.8: Thesis Organization

This thesis has been written or designed under eight (8) major chapters.

The first chapter is the introduction. This has provided the initial conceptualization and operationalization of study variables as well as directed the study toward the objectives for investigation.

The second chapter is the literature review. This dug deeper into discovering previous literature that is in line with the study objectives while sighting the gaps envisaged in those studies.

The third chapter is about the general methodology. This chapter details of the study area and the general methodology that cuts across all the objectives.

The fourth, fifth, sixth and seventh chapters give the detailed methodology, results, discussion and summary for each objective whereby each objective constitute a chapter.

The eighth and last chapter is about conclusions, and recommendations. This dwells much on providing the study findings conclusions for easy understanding and implementation

CHAPTER TWO: LITERATURE REVIEW

2.0: Introduction

This chapter provides a discussion based on the available literature on community participation in harvesting NTFPs. The review emphasizes those studies carried out on the role of community participation in the value chain as collectors, producers, and sellers of NTFPs understanding the diversity and economic importance of NTFPs, the determinants or factors influencing household decisions to collect and sell NTFPs and the economic value of NTFPs towards food security and income. The existing gaps have been also highlighted.

2.1: Community participation in the value chain as collectors, producers, and sellers of NTFPs

The participation of communities in the value chain of NTFPs in numerous studies is rated higher as collectors than producers and sellers (Mugido and Shackleton, 2019). The majority of NTFPs community participation is collecting. This is followed by sellers and the last activity is largely producing. The notion of producing NTFPs means reliance on NTFPs to obtain or harvest fruits and berries, nuts, spices, medicinal extracts, oils, gums, resins, charcoal, cones, seeds, smoke wood and flavor wood, greenery and other floral products, honey, mushrooms, specialty wood products, syrup, weaving and dying materials, aromatics, and fishing (Thomas and Schumann 1993). Andrés and Delvaux, (2018) found over 96% of community members engaged in the collection, 2.8% engaged in producing and 17% engaged in selling NTFPs. They added that a good number of NTFPs collectors were engaged as sellers. In the collection, Mugido and Shackleton, (2019) largely collected firewood, fish, species, grass, ropes, and medicinal plants. They rarely collected bush meat and oils since these were highly restricted by authorities. Andrés and Delvaux, (2018) argued that the reason why communities are largely engaged in selling is associated with several factors which are largely related to food and human security as well as income generation.

Several studies have demonstrated the determinants of communities to participate in the value chain as collectors, producers, and sellers of NTFPs. Matias *et al.*, (2018) in a study conducted in Palawan, Philippines on commercializing traditional NTFPs. The study used a quantitative research design while studying 88 community members as the sample size who are relying on

NTFPs. They found out that demographic factors are primary determinants for communities to participate in the value chain as producers, collectors, and sellers. Matias *et al.*, (2018) Ascertained that the probability of community participation as collectors, producers, and sellers of NTFPs was 7.9 times higher among non-educated members when compared with those who were educated. This means that the less the education, the higher the likelihood of involving as collectors, producers, and sellers of NTFPs. The study revealed that 45% of NTFPs collectors, producers and sellers were illiterate, 33% were educated up to primary level and the remaining percentage was from different levels of education. This implied that community participation in value chain as sellers, producers and collectors is dependent on their level of education. The shift in education upwards reduces dependence on NTFPs.

Furthermore, Nguyen *et al.*, (2020) studied about access to common resources and food security while relying on evidence from National Surveys in Nigeria. They ascertained that an increase in community participation as collectors, producers, and sellers of NTFPs is higher with married people compared to other marital statuses. This means that marriage comes with more demands for involving in collection, production and selling NTFPs. (Hong and Saizen, 2019) indicated that about 70% of married couples and in these women were largely engaged in collection of NTFPs. Only 13% of married women were engaged in selling and none was engaged in producing NTFPs. However, married men constituted the largest percentage of people who were engaged in selling and producing NTFPs. For instance, 50% of married men engaged in fishing and planting trees (producing NTFPs). It can therefore be concluded that the collection of NTFPs is largely associated with married women whereas selling and producing NTFPs is associated with married men. This implied that marital status occupies a central role in collection, production and selling of NTFPs.

Swamy, *et al.*, (2018) also studied the future of tropical forests under the United Nations Sustainable Development Goals and found out that the future was highly unsustainable due to expansion of family sizes and populations per density. They found out that the likelihood of community participation as collectors, producers, and sellers of NTFPs went high with the increase in family size. This means that larger family sizes were associated with higher participation in collection, production and selling NTFPs. Largely, Swamy, *et al.*, (2018) found out that a family with above 10 members engaged in collection more than those with numbers or size below 5 members. Families with limited numbers engaged mostly in selling and these were families headed

by men. Single headed families (headed by a woman) with more than five household members were also associated with collection more than producing and selling. This was because they wanted to obtain food and income for survival.

Hong and Saizen, (2019) also studied interactions on Agricultural Land between Indigenous People and Immigrants and Consumption Patterns of Forest Products in the Buffer Zones of Vietnam. He studied the participation of communities in collection and selling of NTFPs in relation to antecedents of time and poverty. In relation to time, the community member had spent in the area. Nguyen Vu Linh, (2015) found out that the more years households stayed in the area, the more likelihood to participate as collectors, producers, and sellers of NTFPs. For instance, those who had lived for 20-30 years were associated with high likelihood to participate in both collection and selling. By percentage, 95% of those who had spent above 20 years in the community were engaged in collection and 25% were engaged in selling. However, as the years spent in the community descended, the less the engagement of community members in selling but largely engaging in collection. For certainty, the more people stay in community, the more they associate and condition themselves to relying on NTFPs more than those who happen to spend less time. In addition, Awono and Levang, (2018) in Cameroon found out that the probability of community participation as collectors, producers, and sellers of NTFPs was 5.4 times higher with the length in collecting NTFPs. This meant that the longer the community members are engaged in collecting NTFPS, the longer they participate as collectors, producers, and sellers of NTFPs. Further, when it comes to production, Razafindratsima *et al.*, (2021) urged that the length in producing NTFPs also determines the participation. Length in selling NTFPs was also found to have a higher association with selling NTFPs. The selling of NTFPs was much associated with the generation of 1990-2000.

Ulrichs *et al.*, (2019) While studying on how best resilience to climate risks can be built through social protection. They discovered that it was going to become harder for resilience to be achieved since majority of community members remain relying on firewood and other NTFPs for survival. Even though they are restricted to a certain degree, the factors forcing them to participate in collection and selling are too huge. Ulrichs *et al.*, (2019) Found out that the probability of community participation as collectors of NTFPs was higher depending on types of NTFPs collected. For instance, majority engaged in collecting firewood and medicinal plants in

comparison to other NTFPs. Majority of members who engaged in collection of firewood (85%), only 15% were engaged in selling and only 1.8% were engaged in producing firewood. This means that the need to collect firewood is spurring many to engage in collection and selling of NTFPs due to its need in cooking rudimentarily in poor communities.

Singh and Chatterjee, (2022) did a value chain analysis of Rhododendron arboreum squash 'buransh'as a NTFP in Western Himalayas using a case of Chamoli District, Uttarakhand in India. They found out that season of collecting NTFPs is associated with community participation as collectors, producers, and sellers of NTFPs. This meant that community participation increased since collection of mushrooms was highly conducted in rainy season. On the other hand, the collection and selling of firewood increased with the entry of dry season. However, producing was also increasing with emergency of rainy season more than dry season. To NTFPs which would be collected and sold all year round like firewood, ropes, and poles, these had a big attraction to community participation as sellers, producers, and collectors in the community. Generally, community participation according to Singh and Chatterjee, (2022) was not even burred by covid-19 pandemic, it only widens all year round since at least every season comes with several NTFPs of interest among the collectors, producers and sellers in Chamoli district.

In support of the above, Kinyili and Ndunda, (2022) in their community-based study on potential of agroforestry to improve rural income and livelihoods in sub-Saharan Africa. They found out that the use of NTFPs as raw materials in construction was found to have a likelihood of 7.7 times association with community participation as sellers of NTFPs than nonparticipation. This meant that since NTFPs was playing a significant role in providing wall materials of constructions, the participation of the community increased. However, since majority obtained much of the money in business related to NTFPs, this increased the participation of community members in collection of NTFPs. 75% of sellers of NTFPs were engaged in wall materials as constructions. Pedersen, G. and Chetri, (2020) indicated that participation of community members as producers reduced with the types of NTFPs produced. Much of the engagement lied in fish, berries, and mushrooms. The participation in production increased with medicinal plants, poles, and honey.

Tugume *et al.*, (2015) while studying socio-economic predictors of dependence on NTFPs from Mabira Central Forest Reserve Communities, they reported that the presence of men/husband was found to have a higher association with the likelihood of community participation as sellers of

NTFPs. Tugume *et al.*, (2015) found out that in 40% of families were men or husbands were present, their level of participating in selling NTFPs was higher than where there were single mothers. This also concurred with Tugume *et al.*, (2016) who discussed the role of dry forests in rural socio-economic development in Sub-Saharan Africa. They also found out that 90% of men/husbands in families are engaged in selling NTFPs collected by their wives and children. These usually transport these using bicycles to the markets.

In addition, Tassou, (2017) and Västberg, *et al.*, (2020) also studied about the factors affecting household participation in NTFPs market in Eastern Uganda. They found out that community participation is higher in selling of unprocessed NTFPs. The participation reduces when it comes to selling processed NTFPs. This meant that there is a need for authorities to regulate the kind of NTFPs sold whether processed or unprocessed. Turreira-García *et al.*, (2018) explored the factors affecting community participation in the value chain of NTFPs. They found out that individual mode of selling NTFPs contributed 3 times on the likelihood of community participation as sellers of NTFPs. Since 80% of community members were selling their NTFPs directly, their level of participation increased since this came with a recognizable saving more than those who sold through fellow farmers or associations. These were only benefiting others, and this reduced their engagement in selling.

Adewumi, (2021) also studied the effect of Utilization of Selected NTFPs on Rural Households' Poverty Status in Southwestern Nigeria among collectors. They found out that the utilization of NTFPs increased with presence of small trade as the major buyer type of NTFPs. This increased the number of community members to engage in selling more collecting. About 5 markets were found at local basis dealing in NTFPs. This widened the easier ways of selling NTFPs.

Lastly on this segment is ignorance on the distance (KM) to the buyer. This was found to have a higher contribution on participating in selling of NTFPs. Suleiman *et al.*, (2017) while analyzing the economic value, utilization, and conservation of selected NTFPs in the Falgore Game Reserve in Kano, Nigeria, they found out that distance to the market was a major determinant in community participation in value chain of NTFPs as sellers. Majority feared the distance which was a little far. They also lacked an affordable form of transport and many others. These had contributed to less participation of community members in selling than production and collection of NTFPs.

2.2: The economic value of NTFPs towards household food security and income.

Non-timber forest products (NTFPs) provide a range of products that, when incorporated into the livelihood strategies of rural people, aid in reducing their vulnerability to risks like air contaminants, toxic waste, radiation, disease-causing microorganisms and plants, Pesticides, chemicals in consumer products and extreme temperatures and weather events (Gurung *et al.*, 2020). These products are used for food, energy, shelter, medicines, tools, and fiber. They are used to meet basic needs, are sold in local, regional, and national markets to generate cash, and serve an important gap-filling or safety-net function (Mahonya, *et al.*, 2019). Over the last decade, research has elucidated the value of NTFPs both to rural livelihoods and as an alternative land-use option and has found the value of NTFPs to be considerable (Mahonya, *et al.*, 2019). In South Africa, the gross annual direct-use values averaged across households range from R1000 to R7000 ($159 to $1111) (Mahonya, *et al.*, 2019) and case studies on the mean gross value of woodland resources in communal areas indicate an average of approximately R950 ($151) per hectare (Delgado, *et al*., 2016). The gross annual direct-use value (excluding trade) of NTFPs in three villages in the Eastern Cape province of South Africa was between R2000 and R5500 ($318 and $873) per household (Gurung *et al.*, 2020). Research on the direct-use values of NTFPs harvested from communal savannas in Bushbuckridge, South Africa found the total annual value per hectare was R810 ($129), whilst the total per household was as high as R6630 ($1052): R2218 ($352) for home consumption and R4412 ($700) traded. The values of NTFPs (per household per year) included fuel wood (R465/$74), construction wood (R218/$35), and wild fruits and herbs (R525/$83 and R2625/$417 respectively). Other NTFPs valued included, thatch grass, carving timber, medicinal plants, reeds for construction, and so forth (Dash, *et al.*, 2016).

Zimbabwe found environmental income[1] constituted 35.4% of the average total income per person from 1993–1994 and 36.9% from 1996–1997 (Matias *et al.*, 2018). This includes income from gold panning, however even if this is excluded, the environmental income is considerable since it was hitting above $565 annually. Comparing values across countries becomes complicated in terms of how the value was derived, how many resources were considered, and whether the value is gross or net, however, despite these complications, the values still indicate an important contribution made by NTFPs to rural households. Considering the percentage of the total income

[1] *Environmental income refers to rent captured through alienation or consumption of natural capital within the first link in a market chain, starting from the point at which the natural capital is extracted or appropriated.*

above 35% of the general income, it gives a better indication of the contribution made by NTFPs relative to other livelihood strategies. Dash, *et al.*, (2016) Considering the value of NTFPs across various countries, it was established that in Nicaragua, the average annual net value of NTFPs per person was $411 whilst the contribution made to individual households was approximately 40% of the total annual income. In Sri Lanka, the annual net value per family was between $32 and $820 with 63% of the total income coming from forest products. NTFPs have often been undervalued because studies failed to examine the range utilized by communities and only considered them in terms of their direct-use values, not their existence and option values, their role in establishing social ties, local exchanges for goods and services, sacred areas, and ecological services (Soe and Yeo-chang, 2019). According to Shanley *et al.*, (2015) ‘‘Activities that deplete biodiversity for short-term gain appear economically rational because many of the values of biodiversity are not recognized and accounted for in decision-making.’’ Although the literature highlights the important role of NTFPs in rural livelihoods, this information is yet to be effectively translated into policy.

Aluko and Bobadoye, (2020) also ascertained that rural households in Kaduna Nigeria obtained over 80% of their incomes from selling NTFPs. Additionally, Zaku *et al.*, (2013) also found out that over 70% of households depended on fuel wood in the country as their major source of energy with an estimated consumption of 27.5 million Kilograms on daily basis in Nigeria. This thus informs us that dealing with NTFPs in several countries is shifting from subsistence exploitation and selling locally and nationally to international trade. In the Western part of Nigeria, game meat and snail harvesting for selling were found to be the main income-generating activities for close to a whole year (Opaluwa., *et al.*, 2011; Secretariat of the Convention on Biological Diversity (SCBD) *et al.*, 2014). In the Eastern Arc Mountains in Tanzania, honey, firewood, locust beans, gum Arabic, and charcoal provide a lot of income for rural-based households (Jimoh, S. O., *et al.*, 2017). These forms of contribution are mentioned in different countries in Africa like Nigeria, Kenya, Uganda, and Tanzania (Boon, 2009; Secretariat of the Convention on Biological Diversity (SCBD) *et al.*, 2014). The world is struggling with a multiplicity of problems in forest-based communities ranging from poverty and lack of employment. These communities are living in areas that are remote with no access to important social services. In consequence, these communities find themselves relying on natural resources in their proximity. Therefore, forest resources especially the NTFPs must be looked at as a solution for communities to obtain the required income

and food. This study aimed at assessing the contribution or influence of NTFPs on the rural livelihoods of households. This can be an important parameter that can be a good guide in the formulation of policy, its practice, and management.

Soe and Yeo-chang, (2019) Established that the collection of NTFPs generally contributes about 40% to food security in most forested zones. This is further supported by Verma, S.K. and Paul, (2016) who had earlier ascertained that NTFPs contributed over and above 40% on food security in South Africa and Zambia respectively. Specifically, the study also showed that spices contributed much to securing daily food at home. They found out that they not only use spices for food but also for income generation. The natural flavors found in these spices influence a good number of consumers to use these spices. In Kano, Nigeria, many NTFPs collectors add value to spices which makes them marketable (Suleiman *et al.*, 2017). In the context of NSR conservation action and rural development, the harvesting of spices is central in the continued preservation of the woodland.

Ulrichs *et al.*, (2019) further found out that forage has a significant influence on food security. This suggested that community members who collected forage increased their food security by looking after their domestic animals. This is tallied with the findings of Suleiman *et al.*, (2017) who had earlier ascertained the role of forage collected as NTFPs on food security from Tropical Rain forests in Wudi in Nigeria. The collection of forage is essential for preservation since they act as a good substitute for community members to look after their animals without encroaching forests. This can also improve rural developments in the form of increased ability to rear animals needed on national markets (Ulrichs *et al.*, 2019). Furthermore, Matias *et al.*, (2018) found out that the collection of wild fruits and nuts contributes on the food security of collectors by 13%, This was found as a great contribution of NTFPs toward food security.

The role of mushrooms in food security was also reported by Mahonya, *et al.*, (2019) who established that the collection of mushrooms was found to contribute close to a margin of 28.7% to food security. This has the potential to improve rural development by acting as source of animal proteins for most of the families who would go for important wild animals. Further, the collection of wild vegetables was also explored to range between 50-70% of food security in forested zones in South Africa (Shackleton, *et al.*, 2017). This is confirmed by the study done on NTFPs in the Eastern Arc Mountains in Tanzania. These found out that the collection of wild vegetables,

medicinal plants, and grass had a positive and significant influence on food security. These can act as harbors for environmental degradation because rural households collectively benefit from them (Ulrichs *et al.*, 2019).

The economic value of NTFPs is not limited to food security but also income generation. Ojea, *et al*., (2016) conducted a study in Lesotho where they established a contribution of 33% of NTFPs on income generated by farmers indirectly from rain forests since they would save the money, they would use to buy firewood to do something else, either way, it is a contribution to income generation. Particularly, they found out that firewood had greatly contributed to savings among households. This implied that community members who collected firewood were highly likely to have an income growth. These findings concur with earlier studies done by Jimoh, *et al.,* (2013) who had found that firewood took priority among the NTFPs consumed in Ecuador and Peru. These were consumed both at household or subsistence and commercial levels by many rural dwellers. These were contributing to 70% of the income generated by a good number of community members who relied on forests for a living. In addition, in line with the above study, Zaku *et al.*, (2013) conducted a study in Kaduna State, Nigeria. These also found that wild vegetables constituted a frontline position in generating incomes just like how this current study established.

Furthermore, Shackleton, *et al*., (2017) found a significant role of wild vegetables in income generation. This suggests that community members who collected wild vegetables like greens, pepper, eggplants, etc. increased their income by a margin of 30%. Further, the collection of mushrooms increased the seasonal income of farmers by 15.6%. Further, the collection of medicinal plants contributed to increased income generation among herbalists by 75% in South Africa. This concurred exactly with what Schaafsma *et al.*, (2014a) and Newton, *et al.*, (2016a) established that medicinal plants like Quinine, Physostigmine, Cortisone, Tubocurarine, Vincristine and vinblastine, Calanolide A, and Calanolide B etc. contributed 51.2% to the incomes generated by neighboring communities in the Eastern Arc Mountains in Tanzania. Secretariat of the Convention on Biological Diversity (SCBD) *et al.*, (2014) also found out that charcoal was contributing 35% of the incomes generated from NTFPs. This tallies with Munanura *et al.*, (2014) who had done a study in Rwanda on forest dependence at Volcanoes National Park. These found

out that the number of people selling spices collected from the volcano forest was higher and this had contributed to the employment and incomes generated.

NTFPs remain an important source of income for the rural poor throughout the developing world, especially in Sub-Saharan Africa. In a study of household use of natural resources in the Kat River Valley of South Africa, Singh and Chatterjee, (2022) noted that NTFPs' share of total household income was about 20%. The study revealed that households purchased significantly more NTFPs as wealth increased, and a greater proportion of wealthy households did so. On the other hand, a greater proportion of poor households were involved in the sale of one or more NTFPs, and they sold greater quantities and volumes per household, as compared to wealthy households. A detailed examination of the use and value of four NTFPs (wood fuel, wild fruits, edible herbs, and grass) revealed that in all instances, the poorest households used more of the resource per capita than the other wealth classes. Even if absolute amounts used were similar between poor and rich households, the income derived from NTFPs by poor households makes a greater contribution to their welfare because it represents a higher proportion of income, relative to wealthier households. Wealthy households typically have a greater number of income streams, thus NTFPs represent a lower, but still important, proportion of total livelihood income. This is a clear indication that the poor tend to rely more on NTFPs than wealthier households. Kinyili and Ndunda, (2022) reported that ad hoc trade in NTFPs is a common safety net for rural households in South Africa and other African countries (for example, as a fallback for income in the off-season or during periods of weak crop yields), which in some instances becomes a permanent source of livelihood. Although the cash incomes from NTFP trade are small, they provide an important contribution that complements the diverse livelihood strategies within a household, especially for the poorer sectors of rural society (Andrés and Delvaux, 2018). In developing countries, most rural households and a large proportion of urban households depend on NTFPs to meet some parts of their nutritional, health, and raw material needs, and for income from selling these products in local markets. In some cases, NTFPs are the only source of income for local communities (Pedersen, *et al.*, 2020), and they form an integral part of the rural economy. Kinyili and Ndunda, (2022) observed that NTFPs are an important source of livelihood for rural communities in Mozambique, especially during times of economic, social, or bio-physical shocks.

2.3.0: Factors that influence decision of the household's participation in NTFPs

Factors which influence the decision of the households to participate in NTFPs are categorized as physical, social, and economic in nature by several studies. The combination of physical, social, and economic factors has been acknowledged to determine the extent to which households participate in marketing of NTFPs in different areas.

2.3.1: Physical factors

Physical factors are categorically regarded as exogenous factors, which have an impact on household members' decision-making, but on which households have little influence. They are reported to have a significant and strong influence on the decision of the households in participating in NTFPs markets. Among the key physical factors reported in several studies include; fear of dangerous wild animals, restriction of collection by the community, inaccessible forests which are nearby, restriction of hunting, forest fires, restriction of grazing and presence of NTFPs. Wongnaa, *et al.*, (2020) investigated the contribution of NTFPs utilization to rural and urban incomes in Ghana. They focused on the physical makeup of the forests. They ascertained that 40% of households in forest zones were not participating in markets of NTFPs, that is; selling and collection because of the dangerous animals found in DenLo zones in Eastern Ghana. Endamana *et al.*, (2016) found out over 20 cases of community members who had lost their lives and others obtaining severe injuries from wild animals found in their forest zones. This was hindering several people to decide to take part in collection and selling of NTFPs in fear. The views of Andrés and Delvaux, (2018) were found synonymous with those of Adewumi, (2021) who had also studied the level of community participation in NTFPs utilization in South Western Nigeria. He had concluded that wild animals were scaring several households to engage in collection of NTFPs in bushy forested zones.

Harbi *et al.*, (2018) studied ways of making a bridge between livelihoods and forest conservation while taking lessons from NTFPs' utilization in South Sumatera, Indonesia. They established that restriction of collection of NTFPs hindered several community members to engage in markets of NTFPs in the area. For instance, they reported that over 70% of communities living in forested zones face a ban from authorities to access forested zones. This had affected them to obtain firewood, berries, and medicinal plants needed for food security and income. However, the

findings of Harbi *et al.*, (2018) differed with what was established by Massingue, (2019) in his study about ecological assessment and Biogeography of Coastal Vegetation and Flora and utilization in Southern Mozambique. He asserted that the utilization of coastal vegetation was only regulated but not restricted from communities. This had increased on the decision of households to engage in NTFPs markets in the area.

Chirwa, and Adeyemi, (2020) investigated the factors contributing to deforestation and collection of NTFPs in Zambia as well as their implications on Food and Nutritional Security. They found out that restriction of cultivation in non-gazetted forests was a primary limitation to households deciding to participate in markets of NTFPs in Zambia. They found out that clear punishments or sentence were legally communicated in communities by authorities for those families found to be engaging deforestation and harvesting NTFPs in non-gazetted forested zones. However, Chirwa, and Adeyemi, (2020) discovered that in areas where there was no restriction, over 90% of households decided to participate in the value chain of NTFPs. This thus informed the study that participation in markets of NTFPs is dependent on restriction of cultivation in non-gazetted zones.

In support of the above, Wongnaa, (2020) further established that that this same issue applied in Ghana to all communities in reserved forests nearby. The more reserved the forested zones are made, the higher the inaccessibility. Figueira Fernandes Elizalde, (2020) in his study about the factors hindering community participation in NTFPs harvesting and engaging in beekeeping in Angola and community. They found out that these people were limited by restrictions on hunting in non-gazetted forests. The presence of such restrictions was forcing very many communities to refrain from participating in NTFPs marketing process. In line with the above, Muimba-Kankolongo, (2018) while studying about agricultural production by Smallholder Farmers in Southern Africa while looking at challenges and opportunities for improvement found out that restriction of grazing in forested zones limited the collection and selling of NTFPs.

Figueira Fernandes Elizalde, (2020) further found out that historical forest fires were also a primary physical factor affecting community participation in collecting and selling of NTFPs in Angola. For instance, 56% of forested zones where restriction was done to collect NTFPs where to those areas which had experienced forest fires. Lastly, Muhammad, *et al*., (2002) investigated the underlying factors influencing the decision of communities to participate in markets of NTFPs. They established that availability of NTFPs had increased dependence on NTFPs. This means that

the availability of NTFPs increases the dependence on NTFPs. They gave an example of forests were restrictions to collection of NTFPs had been done in some communities; the participation of communities was absent compared to communities where households would freely have access to NTFPs.

Timko, *et al.*, (2010) ascertained that household decision to sell NTFPs is influenced by where they are physically situated in relation to forests. Dash, *et al.*, (2016) found that in India, living far from the forest is clearly associated with low commercialization. Wood, *et al.*, (2004.) also found that in Malawi households close to forests had higher forest incomes than those who are far from forests, suggesting that households close to forests were more likely to sell NTFPs. While Agro-ecological zones help to capture variation across different regions particularly in terms of climatic risk, according to Wood, *et al.*, (2004.) it can be used as a proxy to assess distance to the forest. In Eastern Uganda there are three Agro-ecological zones which are high, middle, and low Agro-ecological zones. Households in high and middle Agro-ecological zones are closer to the forested areas; hence they have better access to the resources that it provides (Paumgarten, 2007). Therefore, it is expected that household living in high and middle lands are more likely to sell NTFPs.

2.3.2: Social factors

Social factors are categorically regarded as people factors, which have an impact on household members' decision-making, but on which households have a high influence. They are reported to have a significant and strong influence on the decision of the households in participating in NTFPs markets. Among the key physical factors reported in several studies include demographic factors, taking collection of NTFPs as a family enterprise, cultural attachments on forests, seasons of collection, forests being homes for community members or leaders, minimal distance to forests, the role of forests in construction needs, source of medicine and forests being a resource for educational institutions.

In relation to demographic factors, Hutauruk *et al.*, (2018) had earlier conducted a study in Kenya, Malinau District regarding the effect of socio-demographic factors on the dependence on NTFPs. It was established that females depend on NTFPs more than males. This was associated to the fact that females are culturally tasked to undertake domestic duties which certainly involves collection

of firewood, cultivation, collection of foods, collection of medicine for their children and several traditional rituals performed by women in communities which are done in forests. Wood, *et al.*, (2004) found that in Ethiopia men like taking risk and hence are more likely to go to the forest and collect NTFPs compared to women. In contrast, Opaluwa, *et al.*, (2011) found that in Nigeria women were more likely to collect NTFPs as compared to men. Therefore, in this study gender is hypothesized to positively or negatively affect household decision to participate in NTFPs as collector or producer as well as their decision to choose the forest as their main source of NTFPs in Uganda.

The age of the head of household may positively or negatively influence household decision to collect NTFPs. Collection of NTFPs is labor intensive, hence young people may be more dependent on forest products than elderly people (Tugume. *et al.,* 2015). Kalaba *et al.,* (2009) also analyzed the socio-economic factors that affect household's decision to collect forest products. They found that the elderly people are less likely to collect NTFPs from the forest, hence they rely more on their farm because they may not have the strength to carry out forest-related activities. However, Sisak, *et al.,* (2016) found that adult household heads were more likely to collect NTFPs in India. Many other researchers Tugume.*et al.,* (2015) had found a positive association between age and decision to collect NTFPs. Therefore, in this study age is hypothesized to positively or negatively affect household decision to participate in NTFPs as collector or producer as well as their decision to choose the forest as their main source of NTFPs.

In addition, Hutauruk *et al.,* (2018) also established that the education level of a household members was highly likely to determine the dependence on NTFPs. This means that the less educated the higher likelihood of depending on NTFPs. For instance, they found out that less educated community members participated more than those who are not educated. This was because none educated family members had whole their lives dependent on forests and NTFPs more than those who were educated. Wood, *et al.,* (2015) studied the relationship between household characteristics and collection of NTFPs in Nepal and found that a higher level of education provides opportunities for better jobs and reduces the household's dependency on NTFPs; hence they are less interested in collecting NTFPs. Therefore, in this study, education is hypothesized to negatively affect household decision to participate in NTFPs as collector or producer as well their decision to choose the forest as their main source of NTFPs.

Further, Lopes, *et al.*, (2019) had earlier conducted a study in Amazon, Brazil regarding socio-demographic factors and dependence on NTFPs. It was established that dependence on NTFPs increases with the increase in family size. Family size was also found to characterize dependence on NTFPs. It was discovered that the larger the family size, the high likelihood to depend on NTFPs. Endamana *et al.*, (2016) also found out that time spent in the area characterize dependence on NTFPs. It was discovered that the longer the households have lived in the area, the high likelihood to depend on NTFPs. Time spent in the area determine household access to market information of NTFPs. Household access to market information such as prices and availability of buyers affects households' decision to collect NTFPs. According to Mugido and Shackleton, (2019), greater access to prices and buyers' information often accelerates NTFPs extractions and contribute to people's more income by selling the NTFPs in the market. Therefore, in this study access to agricultural and market information is expected to positively affect household's decision to participate in NTFPs as collector or producer as well as their decision to choose the forest as their main source of NTFPs.

Zella, *et al*., (2018) studied the factors leading to consequences of climate change and variability in managing Selous Niassa trans frontier conservation area. They found out that most of community members who lived closer to forested zones in Brazil regarded collection and selling NTFPs as a family enterprise. This meant that their level of participation increased more than families which did not look at the collection of NTFPs as a family job. However, Zella, *et al.*, (2018) indicated that regarding collection of NTFPs as a family job partly facilitated the protection of important tree species and increased afforestation since these members never wanted to see their jobs being lost. These same people provided natural and spontaneous protection of those who negatively encroached on forests. This was the same case with what Wood, E.., *et al*., (2004) established in Chiradzulu District, Malawi in relation to income and dependence on NTFPs.

Sundriyal, (2020a) also studied about attachments people had on forests and their level of participating in collection of NTFPs in Himalayan communities. They found out that strong culture attachment to forests was increasing dependence on NTFPs. This means that the stronger the cultural attachment on forests, the high likelihood to depend on NTFPs. This factor alone was a main determinant for engaging of communities in marketing of NTFPs since some NTFPs were seen by some people as worshiping creatures or conveyors to God. Many families had buried their

ancestors in different trees and others had had their worshiping places or shrines located under trees. The views of Sundriyal, (2020a) were in line with Tugume *et al.,* (2016) in Uganda who had established that many communities staying closer to forests take them as a source of spiritual fortunes which has helped them to increase the protection and utilization of NTFPs.

In another study done by Mutenje, *et al.,* (2011) in Southern Zimbabwe confirmed that seasonal engagement in collection increases dependence on NTFPs. This meant that the change in seasonal engagement in the collection, the higher likelihood to depend on NTFPs Newton, *et al.,* (2016a) in line with the above study found a strong relationship between distance to nearby forest and dependence on NTFPs. This meant that the smaller the distance to the nearby forest, the high the likelihood to depend on the nearby forest. For instance, Newton, *et al.,* (2016a) ascertained that over 80% of families staying alongside forests (1-3kilometers) participated in collection and selling of NTFPs. However, families or households which stayed 4-7 kilometers and above 8 kilometers found it hard to decide to participate in NTFPs markets. This is because distance came along with a price of transport.

Hutauruk *et al.,* (2018) also studied about construction needs and how they influence decisions of households in participating to NTFPs collection in Malinau district in Indonesia. They established that the dependence of households on NTFPs is primarily because many of the households obtain construction facilities for their own use or for selling to other builders in the Malinau district. For instance, the extraction of perimeter wall merchandise, grass, perimeter fences and poles were contributing to increased participation by communities. This finding was congruent with what Mahonya, *et al.,* (2019) who had also established that forests are a source of medicine, and this explains the increasing number of households depending on them. This means that forests being a major source of medicine increases dependence on NTFPs. Forests in hills and mountains of Nepal are home to many medicinal and aromatic plants. With commercialization of such plants and opening of new markets, NTFPs have evolved as an important source of income for many rural communities in Nepal. These NTFPs are commonly gathered by local communities in the remote rural villages of Nepal and are sold to road-head businessmen and nearly 90 percent of which are exported to India in crude form, which is then supplied to other countries by the Indian wholesalers (Jaquet *et al.,* 2015). Still on resources, Mujawamariya and Karimov, (2014b) also found out that since many studies are ongoing in relation to forests, this has increased on the number of people

depending on them. This means that dependence on NTFPs increases with an increase in the need for education.

2.3.3: Economic factors

Economic factors are regarded as interest-oriented factors, which have an impact on household members' decision-making, but on which households have a high influence. They are reported to have a significant and strong influence on the decision of the households in participating in NTFPs markets. Among the key economic factors reported in several studies include forests being perceived as a major source of household food security, ready source of income for households, engaged in value chain, source of tourist attraction, affordability of distance to markets, easy ways of starting with no capital and ready market of NTFPs.

Matias *et al.*, (2018) undertook a study to determine the commercialization of traditional NTFPs. They established that a good number of families are relying on NTFPs as a source of food. This has increased the dependence on forests. This means that the higher the household takes forests as being a major source of household food security, the higher the dependence on NTFPs. Non-timber forest products (NTFPs) constitute an important source of livelihood for millions of people across the world. In India alone it is estimated that over 50 million people are dependent on NTFPs for their subsistence and cash income (Mugido, 2017). Forest-based activities in developing countries, which are mostly in NTFPs area, provide an equivalent of 17 million full-time jobs in the formal sector and about 30 million in the informal sector. In addition, it provides 13-35% of all rural non-farm employment (Mulenga *et al.*, 2014b). The NTFPs form alternative sources of livelihood, contribute to poverty alleviation through generation of income, and foreign exchange earnings (Swamy, L., *et al*., 2018). More than 800 million people worldwide live in or near tropical forests and savannas and rely on these ecosystems and their services and welfare benefit such as fuel, food, and income (Schaafsma *et al.*, 2014a). For example, it is estimated that more than 15 million people in Sub-Saharan Africa earn their income from forest-related enterprises such as fuel wood and charcoal sales, commercial hunting, and handicraft production (Wood, *et al.*, 2004). In rural areas of Nigeria NTFPs contribute significantly to household income and food security and thus, play an important role in income generation (Adewumi, 2021). In Tanzania, rural households largely depend on agriculture or NTFPs as their main source of income (Kilonzo *et al.*, 2018). In

Tanzania, direct dependence on NTFPs is high (Howley, *et al.*, 2012), 92% of rural households use firewood as their main cooking fuel, whereas over 50% of the urban population uses charcoal (Kilonzo *et al.*, 2018). Many people living in and around forests harvest a range of products from forests for trade or consumption as compared to timber, due in large measure to less expensive extraction technology and ease of access (Schaafsma, 2012). Nambiza, (2013) found that the integrity of forests is vital to household food security, mostly because of the dependence of the poor on forest resources. The collection of NTFPs for house construction and household use is also widespread. This is mainly driven by poverty and household food insecurity caused by lack of means to invest in better quality construction and non-wood substitute products.

Kyando, M.T., *et al.*, (2019) had also ascertained that a good number of families are relying on NTFPs as a source of income. This has increased the dependence on forests. This means that the perception of forests as a major source of ready income for a household, the higher the likelihood to participate in collecting NTFPs. Household income level has a significant effect on the decision to collect NTFPs. On one hand, higher income households might not be interested in collecting or selling NTFPs compared to lower income households because they can afford to purchase NTFPs from local markets (Ndayambaje, and Heijman, 2012). Therefore, poor households are more likely to collect NTFPs. Moreover, the better-off households collect lower amount of NTFPs especially firewood because they can afford substitutes like gas for cooking. On the other hand, higher income household may be attracted by prices of forest products; hence they might be interested in NTFPs collection (Teshome, 2019). Material used for wall construction can be used to capture the state of wealth of the household. In rural areas in Uganda, walls are constructed with permanent materials like cement, burnt bricks and stones or with temporary materials like mud, dirt, zinc, and iron. Households who have their walls built with permanent materials are wealthier than others. Therefore, in this study wealth status is hypothesized to positively or negatively affect household's decision to participate in NTFPs as collector or producer as well as their decision to choose the forest as their main source of NTFPs.

Further, Nabaloum *et al.*, (2019) indicated that many households want to live close to forests because they benefit from selling merchandise to tourists or students who always come to witness these forests. This means that forests being the major source of tourist attraction increase the level of dependence on NTFPs.

Royalties and taxes accruing from concessions constitute a source of income for communities. Sharing of this dividend is a statutory requirement as per Ministerial Directive 93/2005 and is pegged at 20 percent of the licensing rates paid by the forest operator to the state. This legal statute will be discussed later in the paper. However, the eligibility of communities to benefit from this is not a straightforward matter, as the communities are first required to constitute a representative committee registered in the district administrative post. This committee is tasked with managing funds, including opening a bank account on behalf of the community. The committee, as the legal entity recognized by the state and the representative of communities, is also expected to present reports of activities funded by the income, together with associated accounts of income and expenditure. The registration requirements for communities to benefit from the above royalties are too stringent and constitute a major bottleneck, restricting communities from accessing benefits from resources that occur in their areas. For example, out of a total of 700 communities involved in community management projects in the whole country, only 37 have formed local committees, whilst a paltry 17 communities have satisfied all the requirements, with only one having received the statutory 20 percent royalty. The bottlenecks mainly arise from constraints related to the formation of the committees and openings of community bank accounts as well as the relatively low financial incentives (Smit, M., *et al.*, 2005).

Lastly, Kar, (2010) and Chou, (2018) further indicated that people find forest resources important since NTFPs have a ready and accessible market. In Mozambique the rural poor can be described as living in extremely isolated and self-contained households (Västberg, *et al.*, 2020). As a result of the isolation, they tend to be subsistence orientated and their survival strategy is focused on self-sufficiency rather than trade related exploitation. In parts of Mozambique trade activities have increased over the last 10 years, in terms of numbers of kiosks, shops and visits by traders. However, most of the market interaction is local and small scale (Eriksen, and Silva, 2009). Several studies of rural poverty in Mozambique have noted the importance of access of rural households to cultivable land and how it is considered the critical factor in their survival (Kinyili and Ndunda, 2022). Mozambique resembles poor rural areas in other countries, where local communities either inhabit or use resources on lands under the custodianship of the state according to customary rights of resource tenure (Charnley, 2005). Despite a slight differentiation regionally, in general, the poor in Mozambique can be described as peasants. Typically, the most disadvantaged in the communities are the women, especially those in female headed households. For this reason,

special attention should be paid to female headed households and other relevant categories of people when looking at poverty in communities (Pedersen, *et al.*, 2020).

Distance from homestead to the source of NTFPs has negative and significant relationship with NTFPs collection. A study conducted by Opaluwa, *et al.*, (2011) on determinants of NTFPs collection and utilization in Nigeria revealed that the distance separating the households to the source of NTFPs negatively affected their decision to collect NTFPs. It suggested that households residing close to the source of NTFPs are more likely to collect NTFPs or to acquire higher amount of NTFPs. This result contrasts the findings by Wood, *et al.*, (2015) who found that distance to the forests positively affect household decision to collect NTFPs like firewood in Nepal indicating that as distance to the source of collection increases household still collect firewood because it is not easily substituted by other source of energy in that area. According to Ndayambaje, and Heijman, (2012) Agro-ecological zones can be used as a proxy to assess distance to the forest. In Eastern Uganda there are three Agro-ecological zones which are high, middle, and low Agro-ecological zones. Households in high and middle Agro-ecological zones are closer to the forested areas; hence they have better access to the resources that it provides (Wood, E., *et al.*, 2015). It is expected that they are more involved in NTFPs collection. Based on these findings, it is hypothesized that households in high and middle lands are more likely to participate in NTFPs as collector or producer and to choose the forest as their main source of NTFPs.

Access to credit positively affects market participation because credit is a production-enhancing input which boosts productivity and consequently increases the level of marketable surplus, hence encouraging farmers to sell their products. Hlongwane, *et al.*, (2014) in South Africa and Musah, *et al.*, (2014) in Ghana found that households who have access to credit were more likely to sell maize in South Africa and Ghana respectively. Similarly, Jamnadass, *et al.*, (2011) found that lack of capital, especially during the rainy season is a constraint for effective trade in NTFPs as collectors who have access to credit could afford transportation means, market information hence they are more likely to sell NTFPs as compared to those without credit. For these reasons it is also suggested that access to credit is positively related to households' decision to sell NTFPs.

The reviewed literature thus confirms numerous factors associated with community participation in collection, producing and selling in NTFPs. However, even though these factors had been expressed from empirically conducted studies, much of these studies had been done globally and

in some developing countries of Africa. There was a need to undertake a current study of this nature to determine what was taking place in Niassa, Mozambique.

2.4 Economic value.

In **Figure 2.1** below, it is evident that based on the ideals of Masiero *et al.*, (2019), the total economic value of NTFPs is essential in the collection, selling, and production of NTFPs. This is associated with the fact that whether the community is using NTFPs as optional or does not use them, they can all engage in preservation. Those who directly and indirectly use NTFPs find them highly valuable and will engage in programs to ensure that forests are preserved. Those who do not use NTFPs are informed by the existence and bequest theorem which means that they want to see the forests continually exist for future generations.

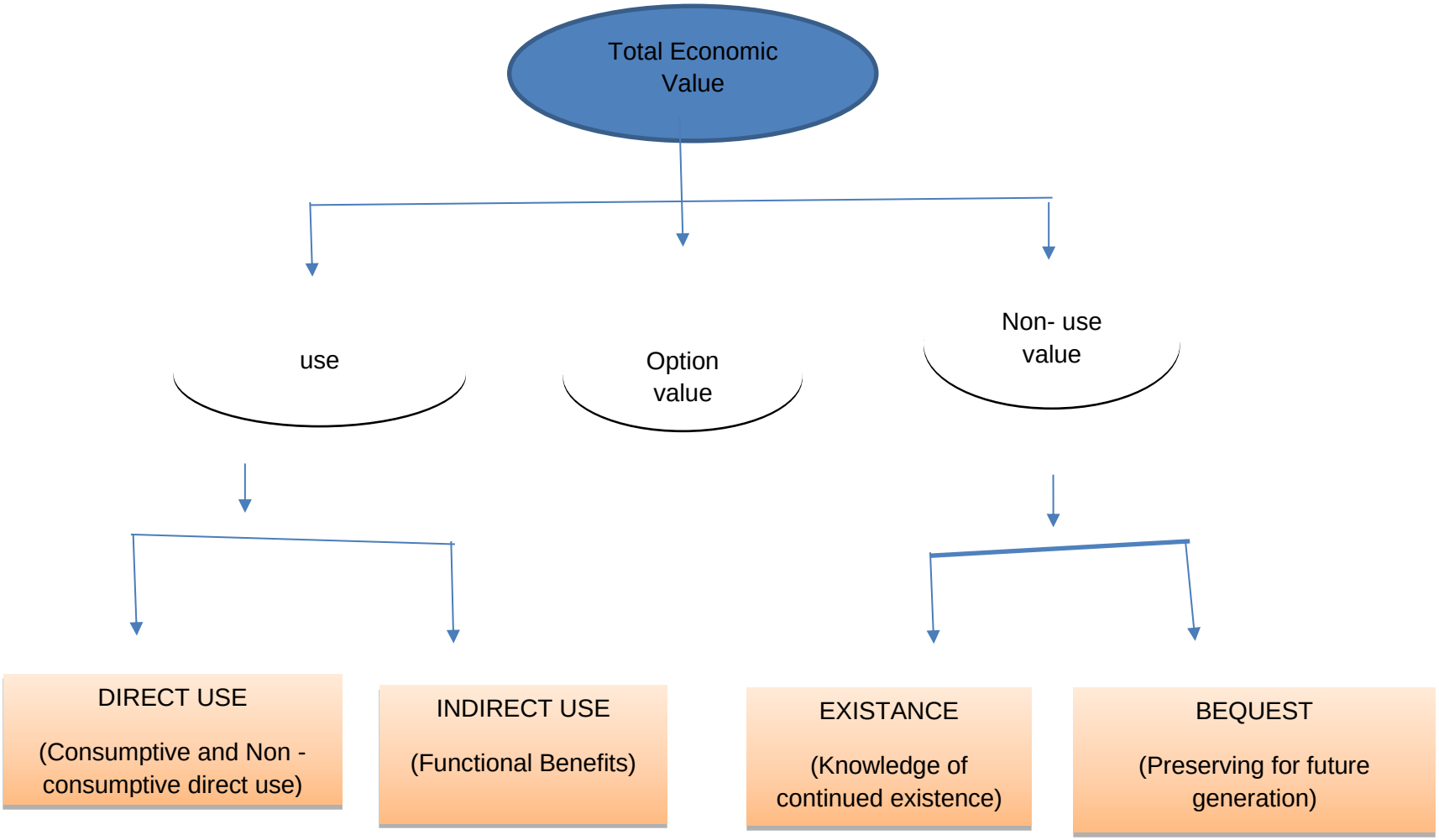

Figure 2:1: measuring The Economic Value

Source; Krieger (2001)

2.5: Literature Review Gaps

In reviewing the literature, five major gaps arose including geographical, contextual, conceptual, methodological, and time gaps. Geographically, all reviewed literature was largely conducted outside the geographical scope which the current study was conducted from. This meant that there was a need to undertake a current study to establish the prevailing situations on determinants of household participation in the NTFPs Market in the Mecula-Lugenda corridor (Niassa Special Reserve Forests). Contextually, most of the reviewed literature was entirely conducted in the context of different forest covers applying different theories before or after investigation. In this new context, the current study was done particularly in NSR Forests, Mozambique while specifying study objectives within a limited scope. Conceptually, determinants were restricted to socio-physical and economic factors, however, this current study expanded to three determinants including economic, social, and bio-physical factors. In addition, the study was conceived as important to cover the economic value and topographic explanation of areas where NTFPs were being collected.

The major methodological limitation or gap rotates around differing sample sizes, research designs, data collection methods, and analysis tools used in reaching the study findings. It was imperative therefore that a current study be undertaken to find an integration of the above in a single study to arrive at a conclusive philosophical understanding to determinants and community participation in NTFPs.

CHAPTER THREE: GENERAL METHODOLOGY.

3.1: Location and Geographical Characteristics

This study was carried out along the Mecula-Lugenda Corridor in NSR Northern Mozambique comprising of communities of Cuchiranga, Mussoma/Lugenda, Lisongole, Ntimbo 1, Ntimbo 2, Lichegue and Mecula. Mecula-Lugenda corridor is located between latitudes 12.1849° S, and longitude 37.4681° E in north-western Mozambique (James, *et al*., 2017). Niassa Special Reserve is a nature reserve lying partially in the provinces of Cabo Delgado and Niassa, Mozambique. This reserve covers over 42,000 square kilometers, it is the largest protected area in the country. The reserve is part of the Trans-Frontier Conservation Area and links to the Tanzanian Lukwika-Lumesule Game Reserve (Wood, *et al.*, 2004).

Niassa Special Reserve is part of the Eastern Miombo woodlands, which also encompasses parts of Tanzania and Malawi. The terrain is rugged with rocky ridges and outcrops. The annual rainfall is about 900mm (Zella, Saria and Law, 2018). The decision to focus on the Mecula-Lugenda Corridor for study is motivated by the substantial loss of forest cover observed in this district. According to Allan, Grossmann, Craig, *et al.* (2017), close to 41.4 square kilometers (0.9%) of forest cover was lost in this area. This loss represents a significant environmental change within the corridor and raises concerns about its ecological implications. The forest cover has been lost due to communities practicing shifting agriculture, bush burning, commercialization of trees and their products, and many other factors.

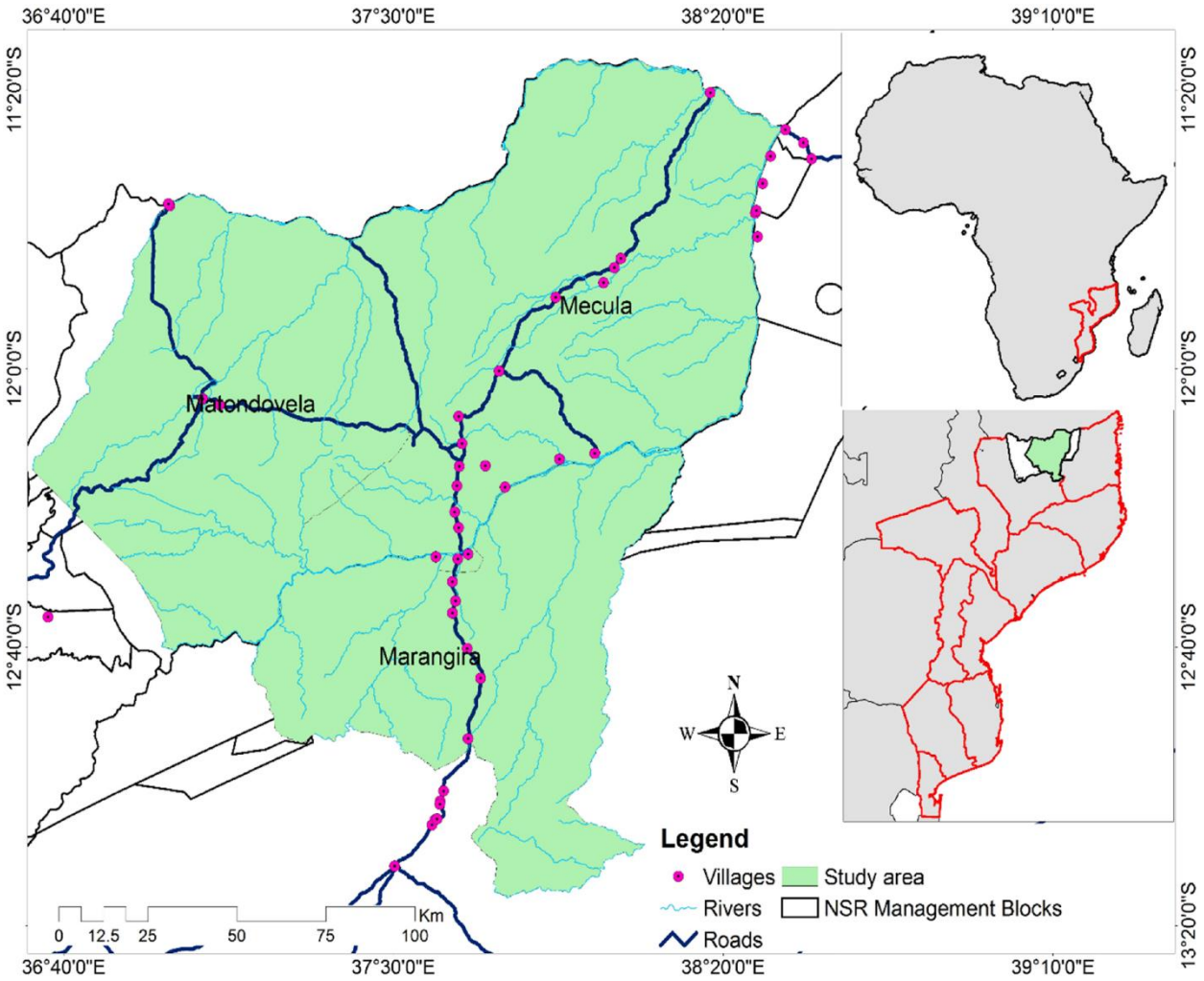

Figure 3.1: Map of the Study Area.

3.2: Climate and Vegetation.

In the Niassa Special Reserve (NSR), the climate can be characterized as tropical sub-humid, featuring a distinct dry and relatively hot season from May to October. The average annual rainfall is approximately 900 mm, with a gradual increase in precipitation from the Eastern (800 mm) to the Western (1,200 mm) parts of the reserve. Altitudes within NSR range from 200 m to 1,400 m above sea level, while temperatures typically fluctuate between 20 and 30 °C. Rainfall predominantly occurs over four to five months, spanning from December to April, highlighting the pronounced seasonality of the climate. Notably, approximately seventy-two percent of NSR's total land area is enveloped by dry Zambezian Miombo woodlands, primarily characterized by the

prevalence of species such as *Brachystegia spiciformis Benth*, *Brachystegia boehmii Taub*, and *Julbernardia globiflora Benth*, as noted by White (1983).

3.4: People and Livelihoods

The human population living inside NSR is about 60,000 people and is concentrated around the two main villages of Mecula and Lugenda along the main road (NCP, 2017; Zafra-Calvo & Moreno-Peñaranda, 2018; Mbanze *et al*., 2021). Communities in the reserve depend on the natural resources provided by the Reserve for their livelihood and basic needs (Allan *et al.,* 2017). Shifting slash-and-burn agriculture has been the primary means of subsistence (Cunliffe *et al.,* 2009; NCP, 2017; Zafra-Calvo & Moreno-Peñaranda, 2018). One major concern is food insecurity, which fuels illegal activity within the reserve and leads to the loss of biodiversity (Allan *et al*., 2017; Mbanze *et al.,* 2021).

Human intervention in NSR during the 20 years of the Civil War (1981 – 1992) and Post-War (1993 – 1997) in Mozambique was limited. Consequently, NSR has been considered one of the most pristine areas in the region. The commercialization of forest products plays a major role in local economies. Building materials are commercialized as much as firewood is. Other products such as wild foods (including fruits, leaves, meat, and honey) and charcoal are commercialized in local markets in the cities or by the roadsides. They represent income to rural people, including women and children. Medicinal plants are prescribed by traditional healers to their clients or sold in urban markets (Boadu and Asase, 2017).

3.5 Ethical considerations

Privacy was one of the serious ethics to guard against in this study by informing the participants in advance that their names were not required and therefore the information they gave remained anonymous, and if the participants felt uncomfortable answering certain questions, they had a right to leave them out and were coerced (Mugenda, and Mugenda, 2003). Further, voluntary participation was observed whereby respondents were not forced to participate in the study without their will. They were persuaded through rapport. To ensure that the study avoids bias, the researcher decided to be objective and ensure the views of every respondent were appreciated without being encroached upon. In cases of non-responses, the researcher built a rapport with

respondents to ensure that non-response is minimized. To guard against plagiarism, all scholarly articles and journals used were referenced.

3.6.0: Quality Control of Data Collection

Here, tools were tested for possible replicability by determining their validity and reliability.

3.6.1: Validity

Validity depends on the validity of research tools, which is the ability of tools to measure what is intended to be measured. This was achieved by having questions in the questionnaire, formulated according to the research objectives. The questionnaire was pre-tested to ensure that it can measure the concept being studied. Internal validity encompasses whether the results of the study were legitimate because of the way respondents were handled. This was achieved by treating all the respondents in the same way by administering the same questionnaire all throughout the data collection period. Data was checked before leaving the field daily for correctness and completeness. The principal investigator and research assistants verified the questionnaires at the end of each day for completeness and consistency. Any missing data was collected from the respective respondents the following day.

3.6.2: Reliability

In this study, reliability, which is the extent to which a research tool can consistently produce the same results on different yet similar settings/situations/circumstances, was realized by pre-testing the research tool, (questionnaire) in different yet similar settings and comparing the results before the tool was eventually used to collect the data in the targeted/real research area. Pre-testing of the questionnaire was done at a site in Macula-Lugenda Corridor NSR, and the parts used in pilot testing were not included in the study. The questionnaire was adjusted according to findings from the pre-test to ensure quality and validity.

3.7: Data Collection Procedures.

The researcher obtained an introduction letter from the university after a successful proposal defense and presented it to NSR to obtain approval and conduct the research. The researcher pilot-tested the questionnaire on a sample of ten respondents and the interview guide on two respondents. The researcher then used comments from these respondents to improve the questionnaire and interview guide. At this point, research assistants were recruited, and trained on the ethical considerations and the main purpose of the study. The researcher then contacted coordinating officials to come up with agreeable schedule so that work was not affected. The researcher ensured that during the data collection questions were discussed in the presence of the respondents so that he was well understood; and where necessary adjustments were made to reduce the chances of non-compliance and non-reliability of the tool. Data collection was carried out for a period of four months. In the event of any incompleteness of the data collection exercise; the researcher rescheduled the appointments in consultation with the respondents. After data collection, data analysis was done, a report was made, which marked the final activity of the research process.

CHAPTER FOUR: COMMUNITY PARTICIPATION IN VALUE CHAINS AS COLLECTORS, PRODUCERS AND SELLERS OF NTFPS.

4.0: Introduction

This section presents both quantitative and qualitative results about evaluating community participation in the value chain as collectors, producers, and sellers of non-timber forest products. The results are presented as per the levels of analysis; descriptive, bivariate, and multivariate analysis.

4.1.0: Methodology.

4.1.1: Population and Sample Size.

The study population consisted of households from selected villages in the Mecula-Lugenda corridor using NSR community members, local leaders, traditional healers, and officials managing NSR. The sampling frame in this study is the household. A multistage sampling procedure was used to sample households in selected villages. The villages were chosen to ensure a representation of NTFPs collectors from the forest and producers on the farm. Secondly, villages were purposively selected in the Mecula-Lugenda corridor between Mussoma near the Lugenda river bridge and Mecula district headquarters. Finally, the lists of households in each village were provided by the head of each village. Simple random sampling was used to select households from the twelve selected villages. The names of the household heads in each locality were numbered and the tables of random numbers were used to select those that appeared in the sample.

Table 4.1: Target population.

Target population	Sampling Techniques
Household Heads	Simple random sampling
Village Leaders	Purposive
Market Vendors	Purposive
Wildlife Conservation Society staff.	Purposive

Traditional Healers	Purposive

The sample size was determined by using the Yamane's formula (1967)

n=N/((1+〖Ne〗^2)) ……..(6)

Where

n= sample size,

N = population size, and

e = Margin of error (MoE), e = 0.05.

In this study, the population size (N) is 3537.

e= 0.05 or 5%

Previous studies have shown a good response rate of over 98% (Koch, *et al.,* 2022), therefore, only a non-response rate of 5% was considered to cater for non-response, which brought the sample size to 377 respondents. Therefore, the sample size was 377 households.

4.1.2: Data Collection Methods and Instruments

The researcher utilized the following data collection methods: Community meetings, Household Survey Method, Market Surveys, Face-to-Face Interviews, FGDs, Observation, and document reviews.

4.1.2.1: Community meetings

Community meetings, with an average of between 7-12 attendants in each village, were held through regular and repetitive village visits. In the meetings, the researcher presented his research purpose, assessed local interest, and asked for villagers' participation, then later validated his findings. Meetings were held in a suitable area/ spot close to the forest from where the whole forest and village are visible; the researcher with his team of research assistants explained the purpose and process of participatory mapping to the community members. This was followed by gathering

the materials (e.g., sticks, stones, wood ash, flowers, leaves, and other materials that are available locally) to develop the participatory resource map.

4.1.2.2: Focus Group Discussions.

These were used for interactive explanation of the NTFPs marketing concepts and need for conservation. During the community meetings, we tried to keep a gender balance, so that women, who played a major role in NTFP harvesting and trade, could express their concerns and wishes. To do so, we used the ‘‘talking stick’’ method (Sari, and Sembiring, 2019). The speakers passed a small bamboo stick to each other to use like a microphone. We used men and women assisting in the meetings, especially with the people who were usually quiet. Attendance for these meetings varied among villages and according to the season and villagers’ free time. During the meetings, the researcher facilitated the preparation of a sketch map showing the forest resources, topographic features (river, terrain structures), community household locations, and physical infrastructure including road and foot trails. Support the sketching of the potential habitat of commercially important NTFP species and discuss with community members the prominent features of forest NTFP distribution, differences in topography, and other physical features and how that would help in the promotion of their markets and distributions.

4.1.2.3: Household surveys.

Once the NTFPs collected and produced in the study were identified, household surveys were conducted to attach value to the different NTFPs, in this case, the main area was located where each household collects NTFPs. Then the amount collected per year, and what income they generate from the sale of NTFPs was collected. A representation of households was surveyed in each village. Resource persons (e.g., hunters or specialists in the collection of one specific product) were also interviewed on harvesting/hunting techniques.

4.1.2.4: Observation.

This is a determined, orderly, and particular way of watching, listening, and recording an event as it occurred (Bharath, *et al*., 2011). This method was used to learn about interactions in a group, ascertain the contribution of different individuals in the communities in the NTFPs value chain, study behavior and personality traits, and allow the collection of information where there is a lack

of will or inability to respond by the respondents. The researcher intended to use a non-participant observation technique (Wood, *et al*., 2015). This technique involved collecting data by observing the presence or absence of community participation in NTFPs market in NSR to confirm or fill gaps found when using questionnaires and interview guides. It should be noted that an observation checklist was used in the entire process. In undertaking the study, observation was largely used a complementary tool not a main tool for data collection.

4.1.2.5: Face to Face Interviews.

Interview refers to the method of collecting data by asking people questions and following up or probing and prompting their answers (Kothari, 2004). An interview is a verbal communication, often face to face, though the telephone may sometimes be used, in which an interviewer tries to elicit information, beliefs, or opinions from another person–Burns 1997 cited in (Bharath, *et al.*, 2011). A key informant interview was used in undertaking interviews. This allowed an in-depth understanding of factors impeding community participation in the NTFPs market in NSR, strategies put in place to conserve the mostly harvested NTFPs species, and reasons for findings expressed in the questionnaires. The interview guides were used to conduct face-to-face interviews with open-ended questions. The obtained responses were noted down to get data through probing and clarifying the questions which helped the researcher get relevant responses and meet study objectives (Mugenda, and Mugenda, 2003). Structured key informant interviews were conducted with staff of WCS and village leaders in the study area because of the key information they hold surrounding the management of the reserve.

4.1.2.6: Market Survey.

During the market survey, information on market price, how prices change across seasons, market capacity, and quantities of different NTFPs that reach the market were collected. Types, prices, and amounts of NTFPs supplied and sold at the market were recorded. Total sales per year were also determined to obtain the total income. This was done at Markets (Mecula, Mussoma, Marrupa municipality, and Lichinga municipality) and households located in the study area where NTFPs from the Mecula-Lugenda corridor are traded. Sellers and buyers of NTFPs were interviewed to give the average amount of the products sold/purchased per day. The amount of these products was determined by converting the local measuring units to conventional units like kilograms. The

market chain information was also collected linked to markets, and actors in the trade, this information was extracted from the questionnaire.

The questionnaire consisted of close-ended questions. This was adopted because the response options for a close-ended question were complete and incompatible. The questionnaire was used in this case because it proved to be an invaluable tool for collecting a wide range of data from a large number of respondents (Sekaran, 2003). The close-ended questionnaire captured all the questions on the dependent and independent variables. A close-ended questionnaire was administered with the aid of research assistants. The questionnaire was administered to all the respondents (household heads and NTFPs sellers in the nearby markets). The data collected was processed for analysis in password-protected computers to avoid alteration.

The researcher used an observation schedule to document his assessment of community participation in the NTFPs market in NSR. This technique involved the researcher ticking against a list of expected items on the checklists to indicate their presence or absence in the study area. Other observations included socio-cultural, economic, and psychical factors affecting community participation in the NTFPs market in NSR.

4.1.3: Data Analysis.

The data collected was assessed to ensure that there was no missing information. Households with missing information were removed from the sample. To ensure that the assumptions of the econometric models are met heteroscedasticity and multicollinearity were tested for. Heteroscedasticity exists when the assumption that the variance of the error term is constant across the observation is violated (Greene, 2008). In this case, standard errors are large leading to a small t-value. Tests for the presence of heteroscedasticity were done by use of the Breusch-Pagan and Cook Weisberg test. Williams and Dame, (2015) the specification tests of the null hypothesis, that the error term variances were not constant across the observations. The test was implemented using the latest command in STATA software version 20. Multicollinearity refers to the presence of linear relationships among the explanatory variables used in a model. In the presence of Multicollinearity, the model yields wrong signs of coefficients, high standard errors of coefficients, and high R2 value even when individual parameter estimates are not significant (Gujarati, 2007). The variance inflation factor (VIF) for each variable was assessed to check for Multicollinearity

(Elum, *et al*., 2017). If the VIF of a variable exceeds 10, that variable is said to be highly collinear and can be excluded from the model. Data analysis was conducted using quantitative and qualitative tools.

Qualitative data analysis involved both thematic and content analysis and was based on how the findings related to the research questions. Content analysis was used to edit qualitative data and reorganize it into meaningful shorter sentences. Thematic analysis was used to organize data into themes and codes were identified (Sekaran, 2003). After data collection, information of the same category was assembled, and their similarity with the quantitative data was created after which a report was written. Qualitative data was interpreted by composing explanations or descriptions from the information. The qualitative data was illustrated and substantiated by quotations or descriptions.

4.2.0 Results.

This section presents both quantitative and qualitative results about evaluating community participation in the value chain as collectors, producers, and sellers of NTFPs. The results are presented as per the levels of analysis; descriptive, bivariate, and multivariate analysis.

4.2.1: Demographic Characteristics of the respondents.

Here, results are tabulated and presented regarding the distribution of respondents by age, sex, education, religion, marital status, family size, and time taken while living in NSR.

Table 4.2: Socio-demographic characteristics of respondents.

Variable	**Frequency (N=377)**	**Percentage (%)**
Age (years)		
Below 18	4	1.1
18-27	64	17.0
28-37	64	17.0
38-47	86	22.8
48-57	63	16.7
58-67	40	10.6

68++	56	14.9
Gender		
Male	230	61.0
Female	147	39.0
Level of education		
None	214	56.8
Primary	147	39.0
Secondary	16	4.2
Religion		
Muslim	376	99.7
Christian	1	.3
Marital status		
Married	289	76.7
Single	52	13.8
Divorced	24	6.4
Widowed	12	3.2
Family size		
Below 5 people	200	53.1
5-10	165	43.8
More than 10	12	3.2
For how long you have been in this area (Years)?		
0-10	48	12.7
10-20	72	19.1
20-30	133	35.3
30-40	28	7.4
40++	96	25.5

The age of the respondents was normally distributed with a mean age of 42.5 years and standard deviation of 14.5 years. **Table 4.2** above shows that males took the highest percentage of 61% of

the respondents. Regarding the highest attained level of education, the highest proportion 56.8% of respondents had no education. Close to 100% of the respondents were Muslims. Further, the highest proportions 76.7% of respondents were married with a family size of 5 people and below constituting 53.1%. Lastly, close to 35.3% had been living in the area for 20-30 years.

4.2.2.0: Collecting NTFPs.

The study assessed whether the respondents were engaged in Collecting NTFPs. **Figure 4.1** below has more details.

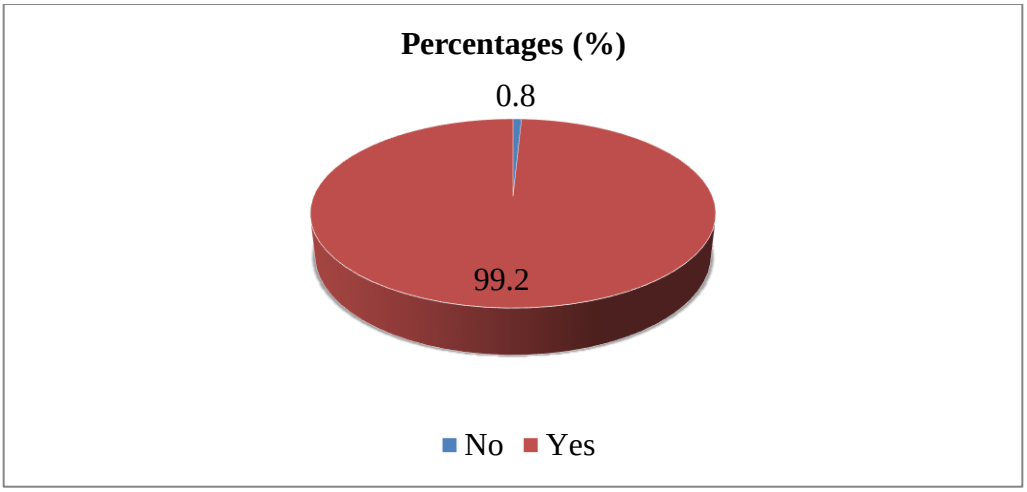

Figure 4.1: Percentage of respondents Collecting NTFPs.

It is evident in **Figure 4.1** above that 99.2% of the respondents were engaged in the collection of NTFPs in NSR.

At this point, the study was tasked to establish how the community was participating in the collection of NTFPs in NSR as collectors, producers, and sellers as a way of measuring the extent of community participation.

4.2.2.1: Community as collectors.

To ascertain the involvement of the community as collectors of NTFPs in NSR, an investigation was done by identifying the types of NTFPs collected, Most Preferred NTFPs by the community, quantity of NTFPs collected**,** collecting NTFPs from the catchment forest, season of collecting

NTFPs, length of collecting NTFPs, species of NTFPs collected, and constraints faced in collecting NTFPs.

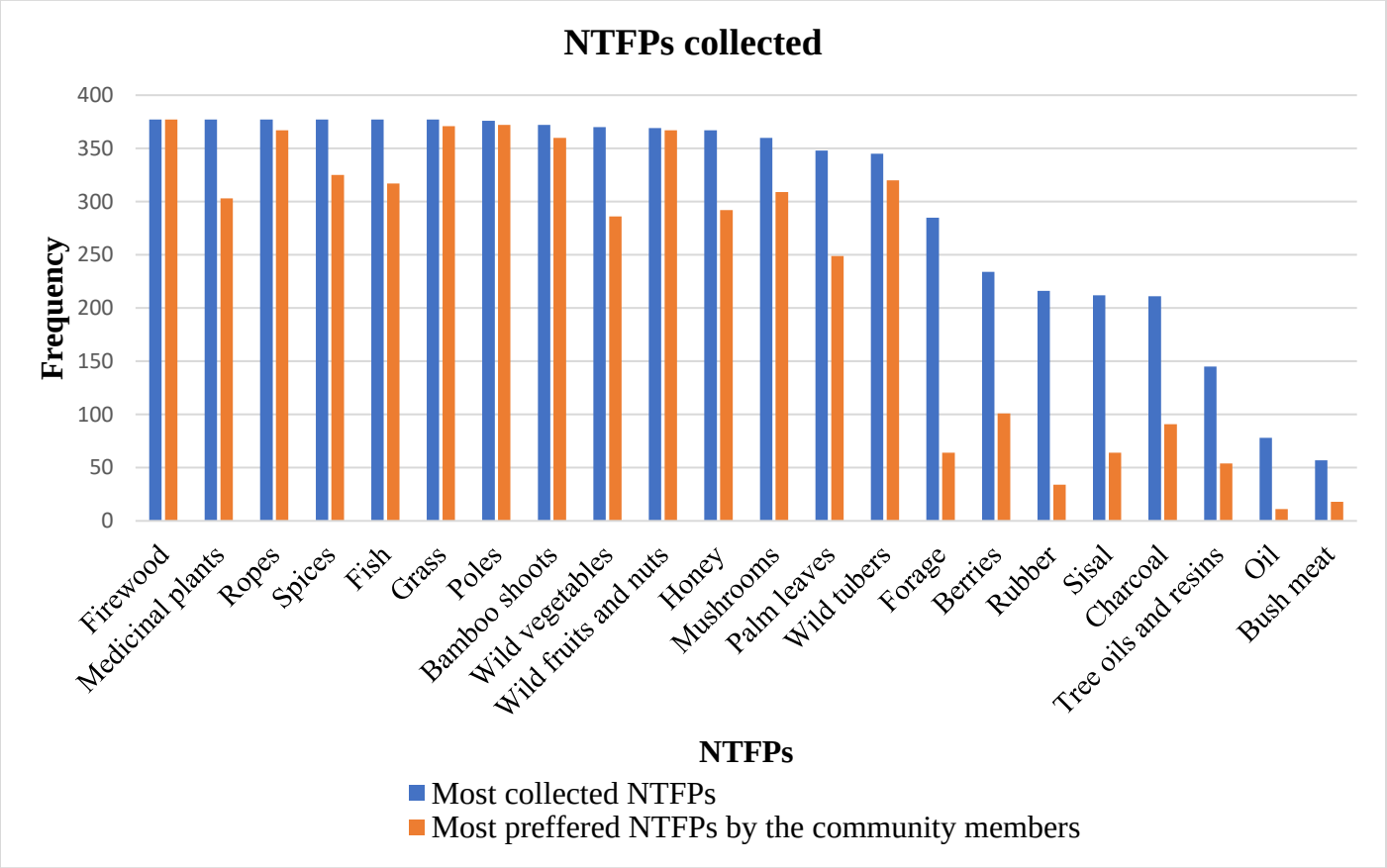

Figure 4.2: Different types of NTFPs collected.

Figure 4.2 above indicates that the majority were collecting firewood, medicinal plants, fish, spices, grass, and ropes, and these were reported by 100%. Those that were less collected included oil and bush meat. These are important NTFPs that directly and indirectly contribute to food security, health security, economic security, and overall survival and economic growth of the area. One of the participants noted,

> *"Even when you who are not residents of this area……you need firewood to live, now what about me who is surrounded by forests which is a free resource? For fish, it is collected because it generates enough income, source of food and has a ready market……and for medicinal plants, species,*

berries, grass, and ropes are harvested because of the differing major purposes they have in our communities" **Participant 85 noted**.

"…we have an enormous number of traditional healers and cultural practitioners in place who are always in search of medicinal tree species and herbs in forests…. In addition, before most of us seek medical assistance from the hospital in Mecula we first use traditional medicine collected from the forest surrounding us and this has seriously worked for us…… , We also have two cultural sites that are visited so often by the community members and the communities around like Mussoma, Cuchiranga, Lisongole and Ntimbo1 basically for healing, blessings and asking the ancestors for rain and big harvest just in case of prolonged drought and during the harvesting time we take sacrifice to these places as a mode of appreciation" **Key informant 11 noted**.

On the most preferred NTFPs by the community, it was evident that most of the community members preferred firewood, poles, ropes, wild fruits and nuts, grass, bamboo shoots, wild tubes, medicinal plants, fish, and these were reported by above 80%. For instance, one of the participants was quoted saying,

*"In addition, health services are quite far we either go to Mecula or Mussoma which is also far, and we don't have good means of transport to these places apart from walking so in most cases we resort to local medicine collected from the forest**." Participant 198***

Those that are most preferred are associated with the value they play in relation to food security, health security, economic security and overall survival and economic growth of the area. Those which are least preferred included, bush meat, oil, rubber, forage, sisal, tree oils and resins and charcoal. These were reported by 25% of respondents and below. Further, parameters were analyzed, and statistics related to the quantity of NTFPs collected were established. It was concluded that by rate of quantity of NTFPs collected, firewood, medicinal plants, fish, berries, grass, and ropes emerged on top. These are associated with the nutrition, culture, lifestyle, trading, and economic wellbeing of the households in the area.

4.2.2.2: Length of collecting NTFPs.

It was established that since 1940s, the existing households have been engaged in collecting a series of NTFPs. By length in collecting NTFPs, majority had been collecting NTFPs since 1980 and 1990s. This was supported by majority of community leaders saying,

> *"Serious collection of NFTPS began after civil wars because most of those forests were hiding cities for rebels or fighters that is why you will find many respondents telling you that they started engaging in collection, production and selling NTFPs after 1990..... some people were brought in the reserve during the resettlement program from the different parts of the country however there were some who came in as far as from Tanzania"* **Key informant 2**

Particularly, it should be noted that on the collection of firewood, 17.8% of the respondents had been collecting firewood since 1980-1990, 14.9% started sometime back between the 1960s-1970. The differences in the distribution of years when community members began collecting NTFPs vary with age differences. Further, 19.1% had been collecting bamboo shoots since the 1990s. In addition, honey has also been collected from 1980 by close to 19.1% of the respondents, though a big number joined around 1990-2000. This was supported by the majority of participants in an interview saying,

> *"The size of the population has greatly grown, and the majority of this population is finding its survival, income, food, and employment in the forest recently"* **Key informant 2.**

Whereas medicinal plants have been booming among collectors since 1990, 2000 and 2000++.

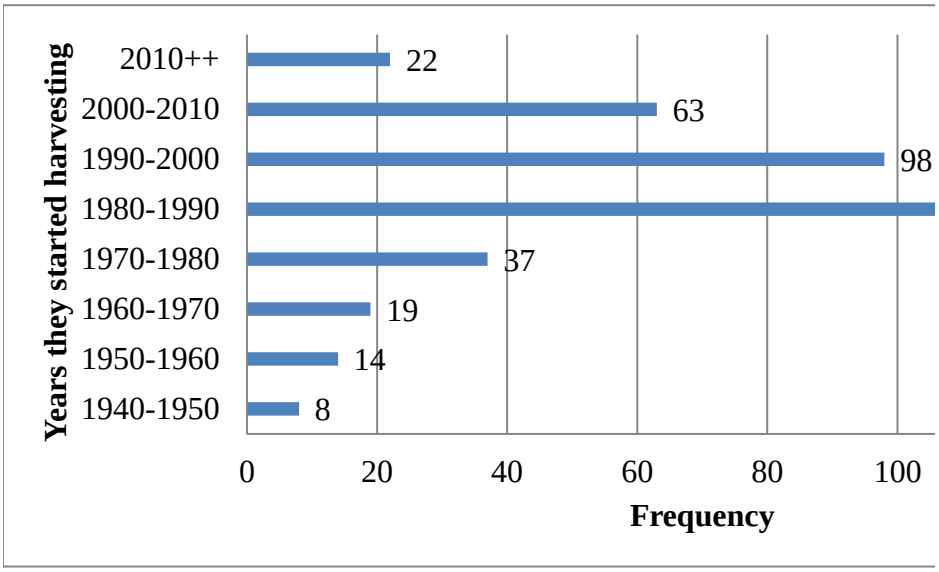

Figure 4.3: Length of collecting NTFPs in Mecula- Lugenda Corridor NSR by the respondents.

It emerged that collection reduced around 1940-1950s, and this can be explained by the less importance people attached to NTFPS by then. This was different between1960s and 1980s to 2010. The increase in the number of people engaging in NTFPs is associated with the fact that a good number of people were transferred from the central and other parts of the country during the civil war and damped in the reserve. It is clear in **Table 4.3** below that the older the person, the longer the length of collecting NTFPs. For instance, 271 of them had been collecting NTFPs since the 1980s. In 1940, 8 were collecting whereas in 2010 and above, 63 of them had joined.

Table 4.3: Different Age groups and length of time when collecting NTFPs.

		What is your Age							Total
		Below 18	18-27	28-37	38-47	48-57	58-67	68++	
Length when collecting NTFPs	1940-1950	0	0	0	0	2	2	3	7
	1950-1960	0	1	2	2	2	1	7	15
	1960-1970	0	10	7	6	7	10	15	55
	1970-1980	0	1	6	6	8	8	2	31
	1980-1990	0	6	6	24	20	5	8	69
	1990-2000	0	17	20	26	11	4	4	78
	2000-2010	1	11	8	7	4	5	11	51
	2010++	3	18	15	15	11	5	6	73
Total		**4**	**64**	**64**	**86**	**63**	**40**	**56**	**377**

4.2.2.3: Season of collecting NTFPs

It was established that seasons for collecting several NTFPs have been rotating around three seasons, that is dry season, wet season, or all year round**.** It was evident that most of the NTFPs were being collected all year round and this is an indication why community participation in the collection is presumably high. For instance, 49.1% reported that they collect firewood, spices, palm leaves, poles, ropes, honey, bamboo shoots, and medicinal plants all year round. In the second batch, 23.3% were collected during the dry season. For instance, tree oil resins and charcoal. A few were being collected mostly in wet season and these included berries, mushrooms, wild fruits and nuts, and wild vegetables. One of the key informants said,

> *"Our communities are relying on NTFPs all year round especially when it comes to some trees, plants, and animals which are yielding all the year...if you take a look at firewood, this is annually collected just like spices, poles and ropes"* **Key informant 5.**

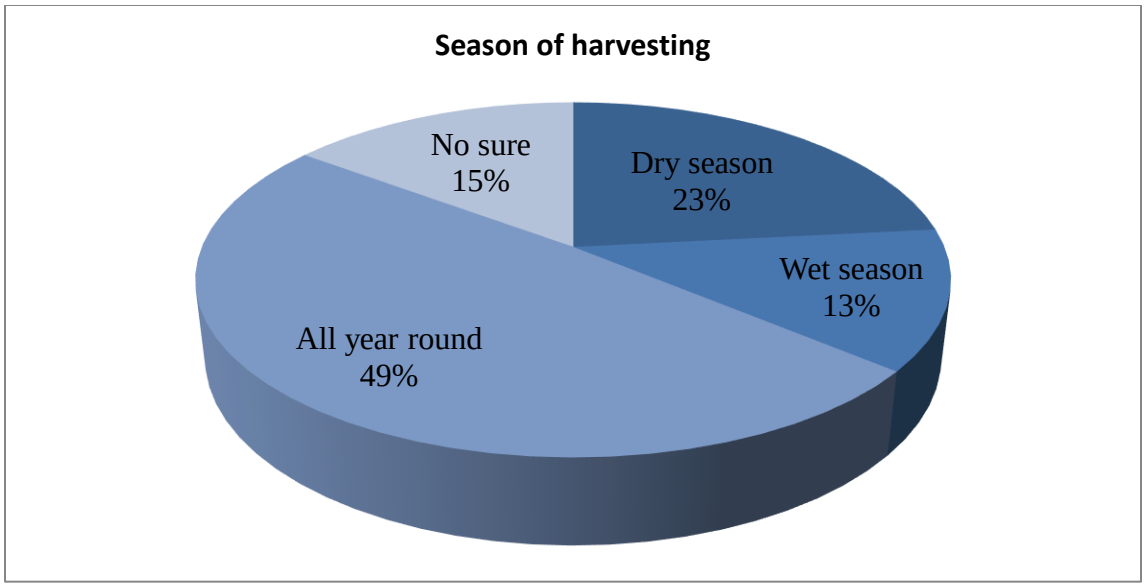

Figure 4.4: Season of collecting NTFPs by the respondents in Mecula-Lugenda Corridor NSR.

Concerning understanding the season of collecting NTFPs, different NTFPs were found to have differing seasons of collection. Analysis was done to establish the relationship between types of NTFPs and the season of collecting NTFPs. It was established that most of the NTFPs were collected all year round. This is further exemplified in **Figure 4.5** below.

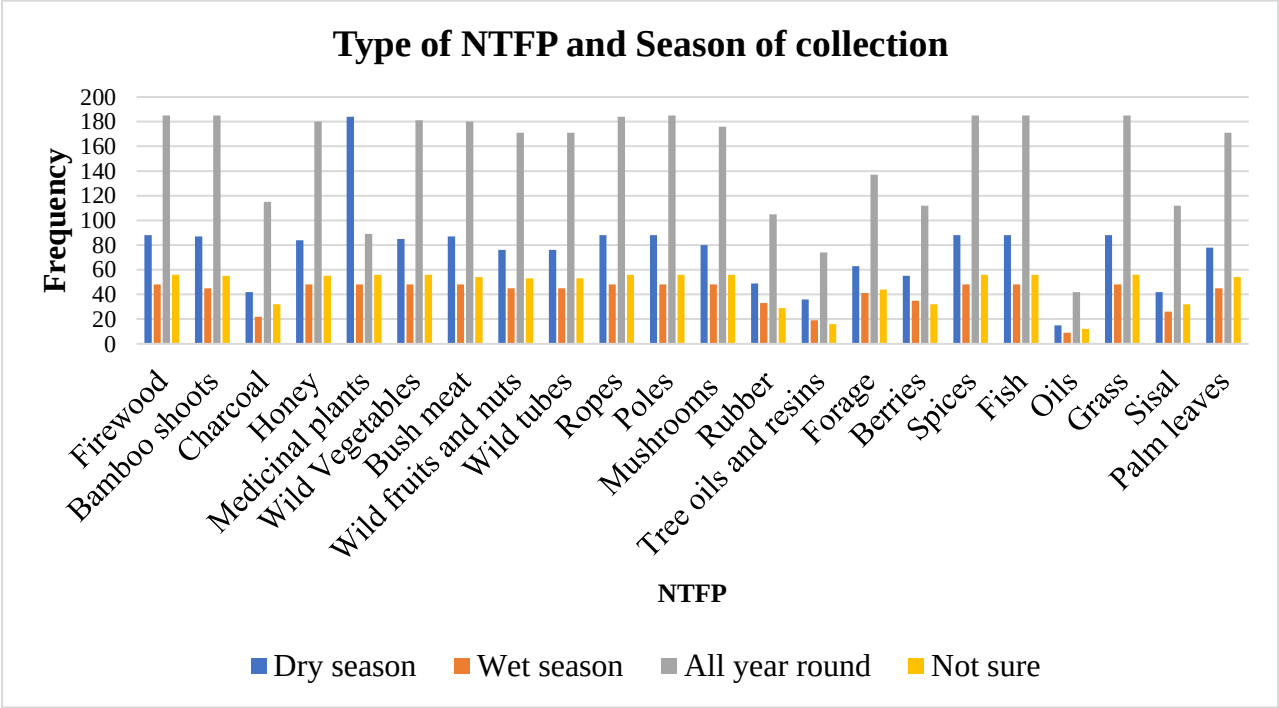

Figure 4.5: Different Types of NTFPs and seasons of collection by the different respondents in Mecula-Lugenda Corridor NSR.

In **Figure 4.5** above, the majority of people collected NTFPs all year round, this was particularly the case for firewood, bamboo shoots, poles, mushrooms, grass, palm leaves, sisal, spices, and bush meat. It is only medicinal plants that were largely collected during the dry season.

4.2.2.4: Collecting NTFPs from the catchment forest

On who collects NTFPs from the catchment forests, three categories of family members were obtained from the study and these included, women/wives, men/husband, children, and whole family. It was found that most of the NTFPs were being collected by women/wives in households constituting 47.5%. For instance, women were found to be at the forefront of collecting charcoal, sisal, oils, spices, berries, mushrooms, wild tubes, wild fruits and nuts, wild vegetables, and medicinal plants. This was supported by the majority of participants in an interview saying,

> *"It is important to understand that most of the NTFPs collected are domestically important and the majority of domestic work is done by women…this justifying the reason why consumption/ harvesting of most of NTFPs is done by women."* **Key informant 5**

In addition, 42.4% were being collected by the whole family and these included, firewood, bamboo shoots, grass, bush meat, fish, palm leaves, honey, and ropes. However, men or husbands mostly engaged in collecting huge and risky NTFPs in harvesting like tree oil and resins, rubber, ropes, poles, honey, and fish. As indicated in **Figure 4.6** below, Children were mostly engaged in collecting wild fruits and nuts, berries, and spices.

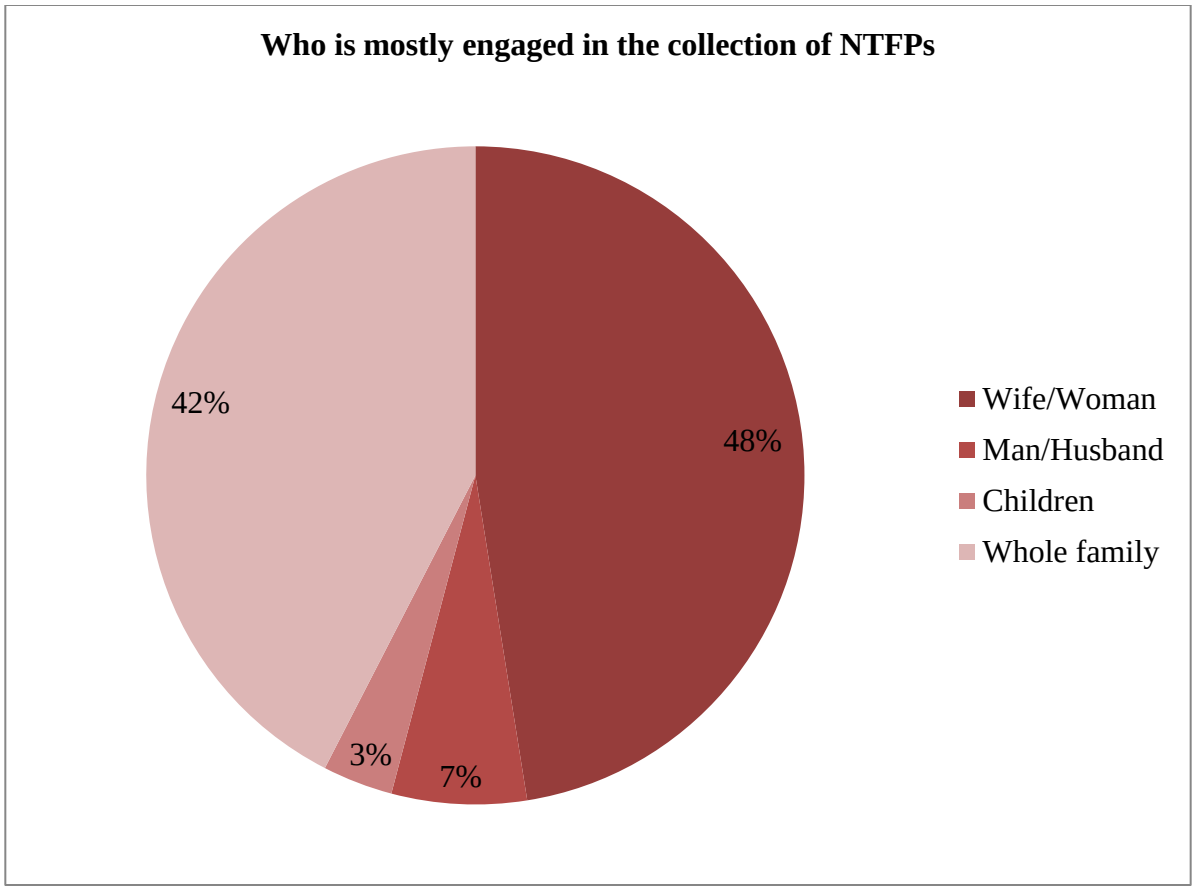

Figure 4.6 Who is mostly engaged in collecting NTFPs?

These findings were further demonstrated in a cross-tabulation done between the types of NTFPs and those who collect them as s exemplified in **Figure 4.7** below.

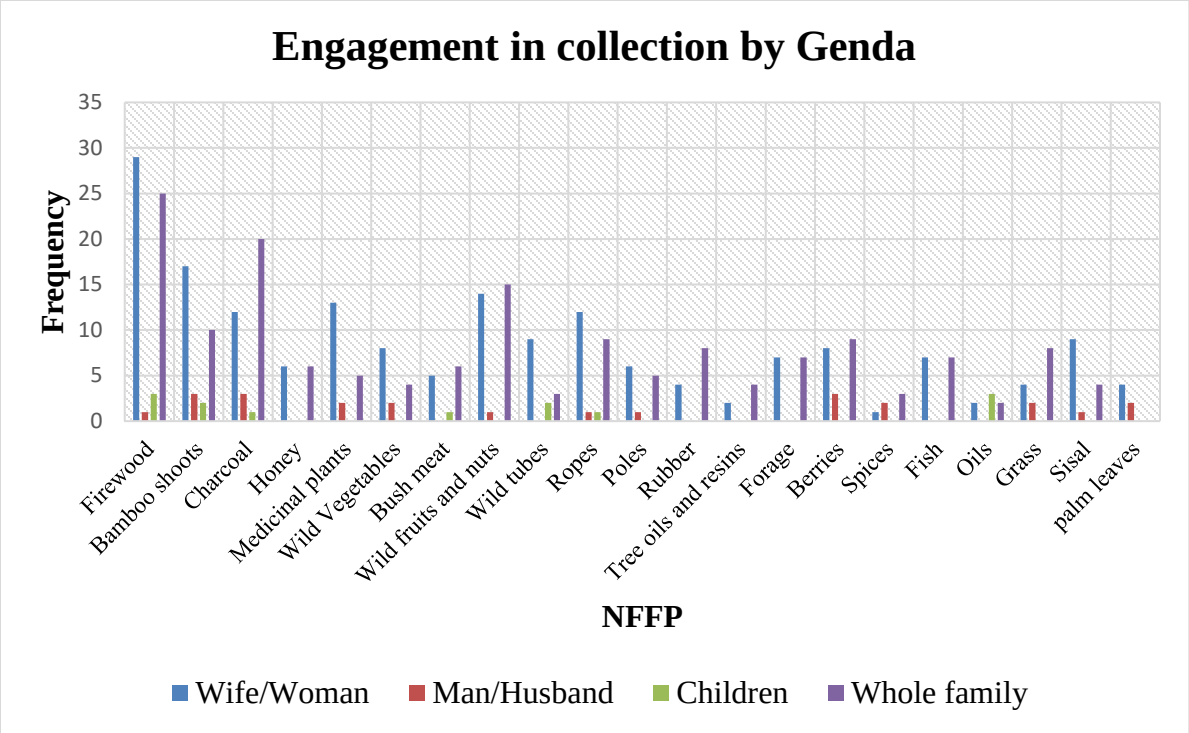

Figure 4.7 Engagement in collecting NTFPs by gender

4.2.2.5: Constraints faced in collecting NTFPs in Mecula-Lugenda Corridor

The study found specific constraints facing the collection of NTFPs. These are explained in **Figure 4.8** below.

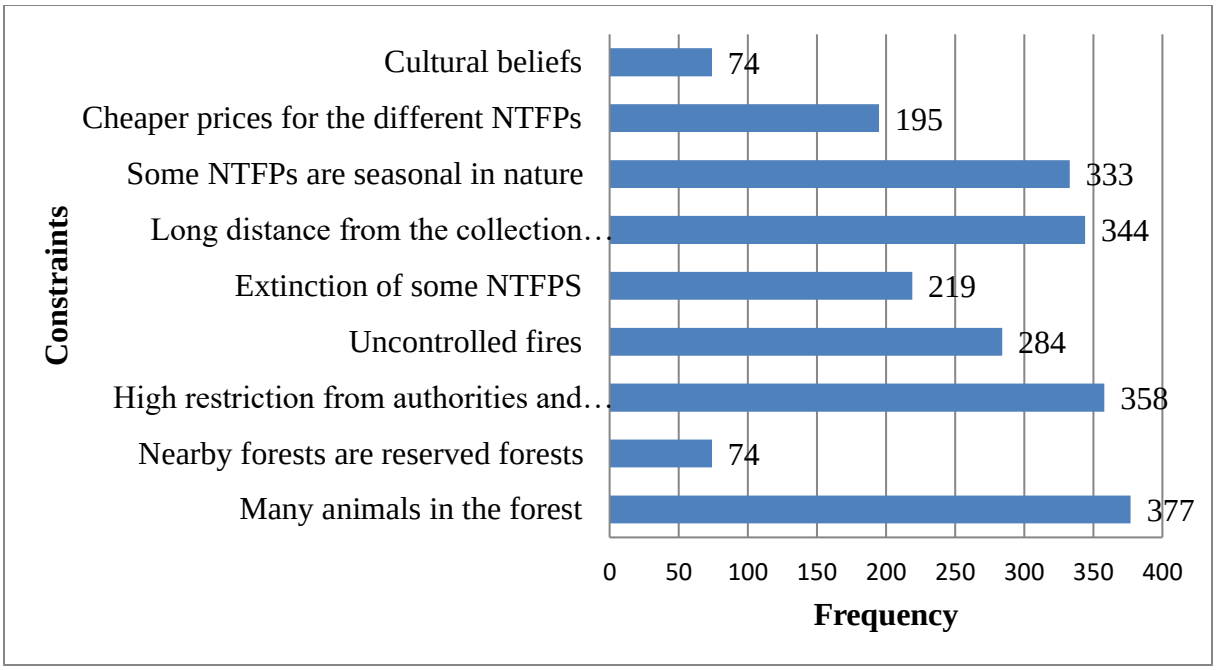

Figure 4.8 Various constraints faced by the different households in collecting NTFPs.

As exemplified above, the majority of the respondents acknowledged that they are highly constrained by many animals in the forest, and this was reported by 100%. It was also noted that some participants saying,

> *"There is a need to fence off an area where animals stay from where people stay by the government/reserve management to reduce the conflict between the people and the animals most especially in their mashambas/gardens, and homes"* **Participant 124, 96, 72 noted.**

> *"...we have got incidences of water animals eating or causing danger to people in our community during fishing, this is a very big challenge to most of our fishermen,"* **Participant 2 said.**

> *"We also have dwarfs in the bush, we have a place where we can't pass it's like a scared forest if you insist on going there your family might not see you again and many strange things are happening there.* **Participant 222**

> *Still in our village we have a forest with big trees but there is a lot of light there with strange things, I am not ready, and nobody is willing to take you there. This is where it is believed that dwarfs stay.* **Participant 222 added.**

> *"...for the case of elephants, when you find a dead elephant do not leave without someone giving you medicine otherwise you will get problems in your home."* **Participant 100**

High restrictions from authorities and cultural beliefs were reported by 95%. One of the community leaders commented,

> *"...we also have a cultural belief attached to Nzolo (to ask for the rain and blessings), in our village some people eat the buffalo, but some don't because of cultural attachment."*

> *"In this village, people do not eat the leopard; if you eat it's believed that one of your relatives will disappear."* **Participant 29 noted**.

Further, 91.2% indicated that long distance is among the constraints affecting their collection of NTFPs especially when it comes to walking within the reserves to find what they want. This was supported by some participants in an interview. For instance,

> *"Some NTFPS are scarce in our locality therefore we walk long distances to fetch them as far as Mbamba and Matondovela, for example, the fruit called MAZUKU we get it mostly from Matondovela which is quite far from where we stay."* **Participant 102**

> *"People in this community walk 7-10 km to their Mashambas which is extremely far and forces most of the community members to stay in mashambas during the rainy season until harvesting time."* **key informant 7**

The study also established that 88.8% indicated that they were constrained by NTFPs which are seasonal.

> *"…in addition, we have the issue of prolonged drought whereby we have one rainy season which has affected most of the agriculture activities and even the NTFPS that are harvested during the rainy season."* **Participant 112.**

It was evident that 75.3% reported uncontrolled fires as also indicated by one of the community members.

> *"It is a practice in most of the forests and bushes to catch fire unknowingly…there is a long-time belief among the community members that forests also undertake cleansing. They always catch fire to do away with old trees and have new greener trees rising however some uncontrolled fires are set by the community members mostly during the dry season in preparation for the rainy season…"* **Key informant 4.**

> *"Yes…some of the fires are set by humans but this is highly restricted by the authorities, however, it is hard taking a year without experiencing a natural bush or forest fire…because it is believed that for some trees to regenerate, they must first be set on fire."* **Key informant 7.**

It was found out that 51.7% reported cheaper prices for the different NTFPs. Participants also mentioned the issue of poor communication as a constraint in collecting NTFPs. Participant 203 said,

> *"We also have another issue of poor network problem for telephone even if you have clients for a certain product, you might not access them, or they might not access you when the need arises."*

4.2.3: List of Activities, rankings, source of food, and income by communities in Mecula-Lugenda Corridor, NSR.

Table 4.4: List of activities engaged in by communities in Mecula-Lugenda Corridor, NSR.

List of activities by rank	Frequency (N=377)	Percentage (%)
Ranked as first choice		
Collection of NTFPs from forests	335	88.9
Agriculture (crops)	35	9.3
Non-timber forest products production	7	1.9
Ranked as second choice		
Agriculture (crops)	290	76.9
Agricultural products selling (other than NTFPs)	55	14.6
Collection of NTFPs from forests	32	8.5
Ranked as third choice		
Agricultural products selling (other than NTFPs)	308	81.7
Agriculture (crops)	51	13.5
Livestock products selling	15	4.0
Collection of NTFPs from forests	3	.8

In the ranking, the collection of NTFPs from forests was ranked as the first choice. This exemplifies the extent to which the community is engaged in collecting NTFPs by 88.9%. Agriculture was ranked as high by 76.9% as a second-choice activity engaged in by communities. Then in the third choice, agricultural products selling (other than NTFPs) were ranked high by 81.7%. This means that communities are mostly engaged in collecting NTFPs, agriculture, and trade.

Figure 4.9 gives details on the reasons as to why the rankings above have been done as they are done. The primary reason for ranking the collection of NTFPs is because it is the source of construction material, food, medicine, and income. For the second choice, the primary reason is that agriculture is a major source of food in the reserve. Lastly, in the third choice of trading is

because it is the source of income. Therefore, sources of construction materials, food, medicine, and income are the underlying reasons for engaging in all forms of activities done.

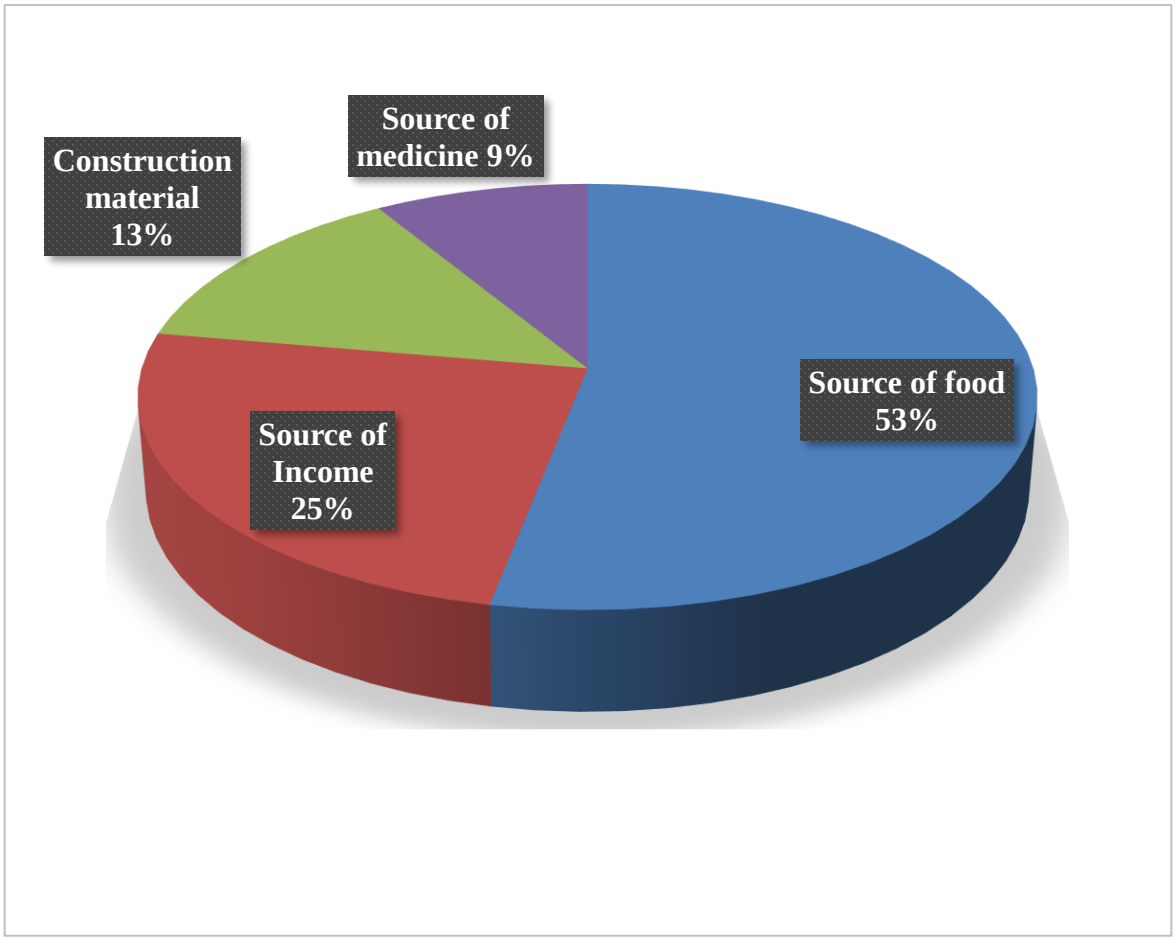

Figure 4.9: Different reasons for ranking the collection of NTFPs as the first choice

Most of the respondents obtained food from agriculture (87%), agriculture (livestock) (8%), and selling NTFPs (3.7%). Further, selling NTFPs (50.1%) was ranked in the second choice as one of the major sources of food as well as ranked first in the third choice (38.2%). This thus means that the collection and selling of NTFPs is very significant in the food security of the area. This is illustrated in **Table 4.5** below.

Table 4.5: Ranking of the different sources of food by households in Mecula-Lugenda Corridor NSR.

Source of food	Frequency (N=377)	Percentage (%)
1st choice		
Crop production	328	87.0
Livestock production	30	8.0
Selling NTFPs	14	3.7
Employment	5	1.3
2nd choice		
Selling NTFPs	189	50.1
Livestock production	151	40.1
Crop production	32	8.5
Business	5	1.3
3rd choice		
Livestock production	160	42.4
Selling NTFPs	144	38.2
Business	53	14.1
Crop production	15	4.0
Employment	5	1.3

Furthermore, most of the respondents obtained their income from trading (44.3%), livestock production (17.2%), and Selling NTFPs and crops production (13.5%). Further, crop production (42.2%), and selling NTFPs (29.4%) were ranked in the second choice as one of the major sources of income. In the third choice, livestock production (38.5%) was ranked in the second choice **(Table 4.5).**

> *"...Here in Ntimbo, we depend mostly on honey harvested from the forest, and most of the honey is got from the forest however there are some community members who have started producing it with the project from Mariri...."*

He adds that most of the honey is sold to the team from Mariri however sometimes they take a long without coming to collect and we end up selling it by the roadside" **Participant 146**

This thus means that since collection and selling NTFPs is not the primary source of income which is good in forest conservation in the reserve. One community leader elaborated that,

"…bamboo bundle costs (100.00MZN/$1.61), grass bundle costs (50.00MZN/$0.81), winnowing basket cost between 100.00MZN/1.61 - 200.00MZN/$3.23 depending on the size, charcoal a bag cost between 50.00-100.00 MZN/$0.81-1.61 also depending on the size of the bag, a roll of rope costs 200.00 meticais and a bundle of poles cost 50.00 MZN/$0.81 …all these are sold by the roadside."

This is explained in **Table 4.6** below.

Table 4.6: Ranking of the different sources of income by households in the Mecula-Lugenda corridor NSR.

Source of income	**Frequency (N=377)**	**Percentage (%)**
1st choice		
Business	167	44.3
Livestock production	65	17.2
Selling NTFPs	51	13.5
Crops production	51	13.5
Employment	43	11.4
2nd choice		
Crops production	159	42.2
Selling NTFPs	111	29.4
Livestock production	100	26.5
Business	6	1.6
Employment	1	.3
3rd choice		

Livestock production	145	38.5
Crops production	138	36.6
Selling NTFPs	70	18.6
Business	23	6.1
Employment	1	.3

4.2.4: Important materials for residence.

In another attribute to measure the extent to which the community is engaged in the collection of NTFPs, the importance of forest raw materials was studied**.** It showed that on roofing materials, most respondents indicated that they were being obtained from the collection of NTFPs. For instance, straw thatch (92.6%), mud is not used for roofing (100%), wood/plants (82.8%), and 63.7% were not using iron sheets but rather NTFPs-related products. Further, 100% were not using asbestos, tin, and cement. 98.1% were not using bricks/tiles. This means that NTFPs-related products were being used in roofing instead of mud, iron sheets, asbestos, bricks/tiles, tin, and cement. On wall materials, most respondents indicated that they were being obtained from the collection of NTFPs. For instance, straw thatch is not used (83.6%), mud is used (96.8%), wood/plants are used (83.3%), and 95.5% were not using iron sheets but rather NTFPs-related products. Further, 100% were not using asbestos and tin. Cement was being used by 67.4%. 96.3% were using bricks/tiles. This means that NTFPs-related products were not being used as wall materials like in roofing. On floor materials, straw thatch was not being used (99.7), 50.7% were using mud, wood/plants were not being used (99.7%) and 100% were not using iron sheets, asbestos, tins, and bricks. However, most of them were using cement (81.2%). Additionally, the use of NTFPs is confirmed by the number of rooms in the kitchen and bathrooms which was reported as reaching 3-4 rooms by 58.1%. Therefore, the use of NTFPs as raw materials in construction, in roofing was rated at 26.3%, 38.7% as wall materials, 17.5% as floor materials, and 17.5% as mechanisms of separating rooms in kitchen and bathrooms as exemplified in **Figure 4.10** below.

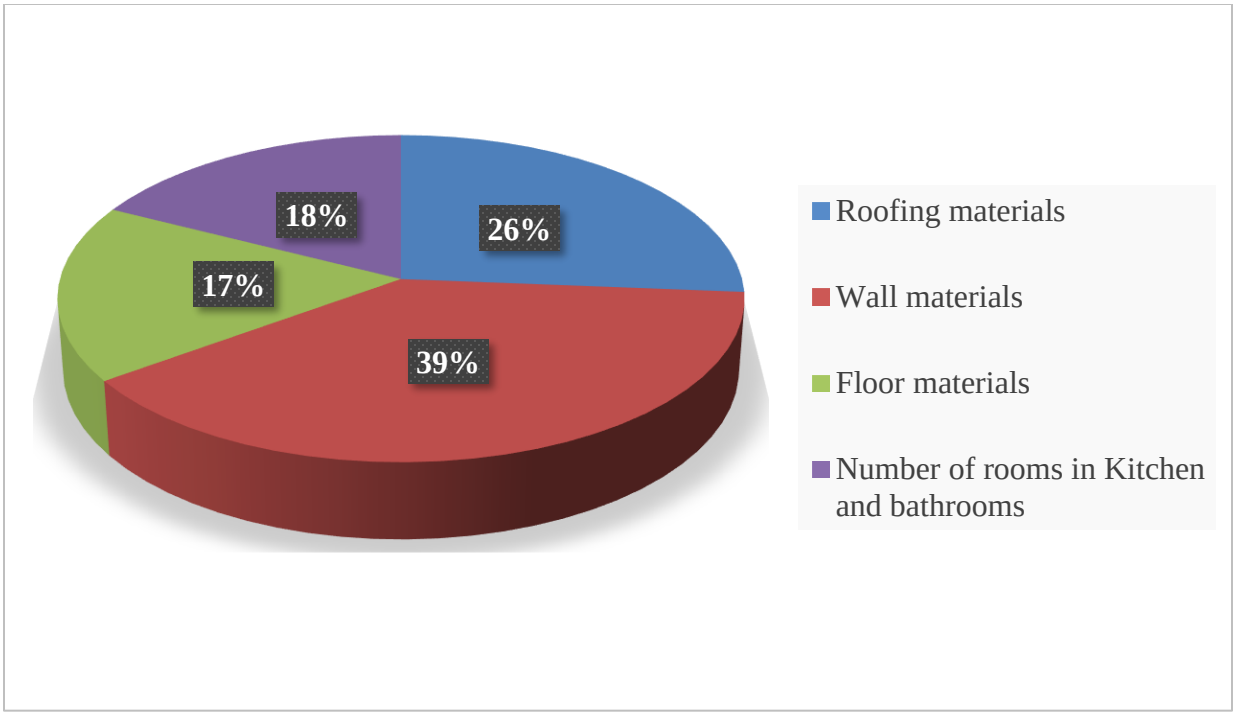

Figure 4.10: Percentage of households using NTFPs as raw materials in construction.

4.2.5: Specifying the amount obtained in activities engaged in

To assess the impact of community participation in collecting NTFPs, the researcher investigated the amount obtained in activities engaged annually. **Table 4.7** has more details.

Table 4.7: Amount obtained in activities engaged by the different households in Mecula-Lugenda corridor NSR.

Specifying the amount	**Frequency (N=377)**	**Percentage (%)**
Annual amount in selling NTFPs		
n/a	194	51.5
1000.00-5000.00MZN ($16.13-$80.65)	62	16.4
5000.00-10000.00MZN ($80.65-$161.29)	50	13.3
10000.00-15000.00MZN ($161.29-$241.94)	40	10.6
15000.00-20000.00MZN ($241.94-$322.58)	14	3.7
20000.00-25000.00MZN ($322.58-$403.23)	11	2.9

25000.00MZN_and_Above ($403.23 and above)	1	0.3
Below-1000.00MZN (Below $16.13)	5	1.3
Annual Amount in Agriculture crops		
1000.00-5000.00MZN ($16.13-$80.65)	123	32.6
5000.00-10000.00MZN ($80.65-$161.29)	116	30.8
n/a	94	24.9
10000.00-15000.00MZN ($161.29-$241.94)	19	5.0
Below-1000.00MZN (Below $16.13)	18	4.8
20000.00-25000.00MZN ($322.58-$403.23)	7	1.9
Annual Amount in Livestock		
5000.00-10000.00MZN ($80.65-$161.29)	127	33.7
1000.00-5000.00MZN ($16.13-$80.65)	125	33.2
n/a	85	22.5
Below-1000.00MZN (Below $16.13)	21	5.6
10000.00-15000.00MZN ($161.29-$241.94)	14	3.7
15000.00-20000.00MZN ($241.94-$322.58)	5	1.3
Annual Amount obtained in Business		
n/a	191	50.7
10000.00-15000.00MZN ($161.29-$241.94)	86	22.8
20000.00-25000.00MZN ($322.58-$403.23)	34	9.0
15000.00-20000.00MZN ($241.94-$322.58)	29	7.7
1000.00-5000.00MZN ($16.13-$80.65)	16	4.2
25000.00MZN_and_Above ($403.23 and above)	14	3.7
5000.00-10000.00MZN ($80.65-$161.29)	7	1.9
Annual Amount obtained in Employment		
n/a	326	86.5
20000,00-25000,00MZN ($322.58-$403.23$)	24	6.4
25000,00MZN_and_Above ($403.23 and above)	22	5.8
1000,00-5000,00MZN ($16.13-$80.65)	3	0.8
10000,00-15000,00MZN ($161.29-$241.94)	1	0.3

15000,00-20000,00MZN ($241.94-$322.58)	1	0.3

Table 4.7 shows that much of the income is generated from selling NTFPs, agriculture crops, trading, livestock, and other employment.

Figure 4.11 below clearly illustrates categories by the amount obtained in activities engaged in while showing that by the amount obtained, business is rated highest and selling agriculture crops is lowest.

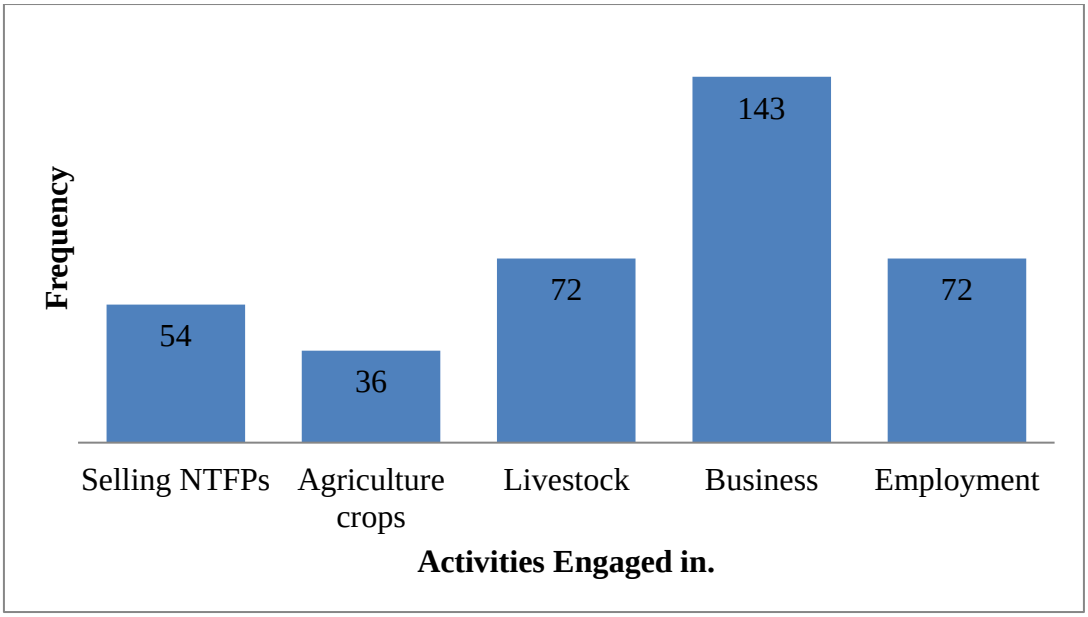

Figure 4.11: Categories by amount obtained in activities engaged in by the different households in Mecula-Lugenda corridor NSR

To further ascertain, actual bundles collected, traded, price per unit of bundle of firewood collected, and total revenue firewood**.** The annual quantity of firewood collected, traded, price per unit of bundle of firewood collected, and total revenue per household were found to be 10 monthly. This means that each household could collect 120 bundles annually. The average quantity of bamboo harvested per household per year was estimated to be 60 extracted annually. Results from this study have estimated the average amount of thatch grasses harvested in the forest per annum per household to be 180 bundles. Poles used per household in the study area per annum were estimated to be 120 poles per year. The average estimate of charcoal harvested per household per year was 60 sacks or bags. The study showed that each household can collect an average of 180

baskets of wild fruits and nuts per year during the season (Refer to objective three of the study for a detailed analysis).

4.2.6: Community as producers

To ascertain the involvement of the community as producers of NTFPs in NSR, an investigation was done based on four important areas that is, identifying the types of NTFPs produced, most Preferred NTFPs by the community, and the rate of quantity of NTFPs produced, producing NTFPs and length of producing NTFPs. The study assessed whether the respondents were engaged in producing NTFPs. **Figure 4.12** has more details.

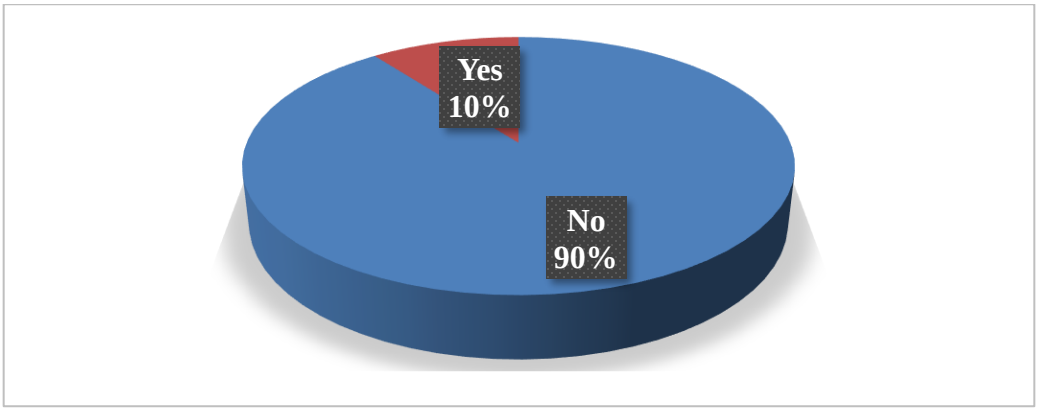

Figure 4.12: Percentage of the community participation in producing NTFPs.

It is evident in **Figure 4.12** above that 90% of the respondents were not engaged in producing NTFPs in NSR. The remaining 10% were directly engaged in producing NTFPs. These were mostly engaged in collecting NTFPs only. At this point, the study was tasked to establish how the community was participating in producing NTFPs in NSR as a way of measuring the extent of community participation.

Table 4.8: Households in the communities of Mecula-Lugenda corridor participating as producers of NTFPs.

Community as producers	Frequency (N=377)	Percentages (%)
Types of NTFPs produced		
Charcoal	14	3.7
Honey	11	2.9
Ropes	11	2.9
Length in producing NTFPs		
1960-1970	12	3.2
1970-1980	12	3.2
1980-1990	7	1.9
1990-2000	4	1.1
2000-2010	4	1.1
Who is mostly engaged in producing NTFPs?		
Woman/Wife	4	1.1
Man/Husband	19	5.0
Whole family	16	4.2

Respondents were required to state the Types of NTFPs produced. Only three NTFPs were being produced. The highest proportion of 3.7% of respondents were producing charcoal, and 2.9% were producing honey and ropes each. Further to establish the length community members had taken in producing NTFPs, the majority indicated that they have been in producing NTFPs since the 1960s. These constituted 3.2%. Man/husband was indicated as most engaged in producing NTFPs and these were ranked by 5%.

4.2.7: Community as sellers.

To ascertain the involvement of the community as sellers of NTFPs in NSR, an investigation was done in four important areas, that is, identifying the types of NTFPs sold, most sold NTFPs by the community, and length in selling NTFPs. The study assessed whether the respondents were engaged in selling NTFPs. **Figure 4.13** has more details.

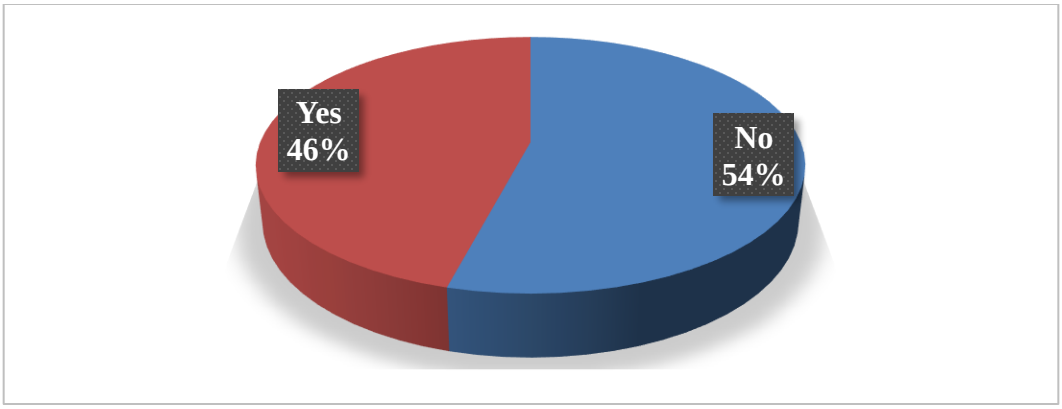

Figure 4.13: Percentage of households in communities participating in selling NTFPs.

It is evident in **Figure 4.13** above that 46% of the respondents were engaged in selling NTFPs in NSR. The remaining 54% were not directly engaged in selling NTFPs. These were mostly assumed to be engaged in collecting and producing NTFPs. At this point, the study was tasked to establish how the community was participating in selling NTFPs in NSR as a way of measuring the extent of community participation.

The results indicate that grass is the first line NTFPs sold, and this was reported by 28.1%. Fish was reported by 25.5% and Bamboo shoots (10.3%). Further, 6.9% were found selling honey and 5% firewood. Further to establish the length community members had taken in selling NTFPs, the majority indicated that they had been in selling NTFPs since 1990-2000s. These constituted 10.1%. Man/husband was indicated as most engaged in selling NTFPs and these were ranked by 22.3%**.**

> *"…For fish we sale some to the community and we take the rest to Mecula, Marrupa, Mussoma, and Tanzania… sometimes we put it on the road for the roadside buyers mostly those going as far as Marrupa and Lichinga… however if we don't preserve it through smoking it gets spoiled since the market is not readily available,"* **Participant 91 said.**

On the contrary, some of the participants admitted lack of a ready market for NTFPs collected and produced in the area. For instance, one of the community leaders said,

> *"Here in Ntimbo it's only fish with the market the rest of the products have no market. However, bamboo costs between 50.00MZN/$0.81 and 100.00MZN/$1.61 a bundle, grass costs 30.00MZ/$0.48 to 50.00MZN/$0.81*

a bundle depending on the size, and fish costs 50.00MZN/$0.81 depending on the spice of fish and the size of the bundle or basket, 5 liters of honey cost 1250.00MZN/$20.16 but this is dependent on season however we also pack in small bottle at 30.00MZN/$0.48 depending on the needs of the buyer, however, still this is mostly bought by roadside buyers and it can take you three to four days without getting any buyer."

Most of sold NTFPs is sold as unprocessed by 98.4%. The mode of selling NTFPs by the majority of households was on an individual basis and this constituted 99.2% **(Table 4.9).** As quoted from one of the community members saying,

"...we mostly sell our NTFPS along the roadside mostly honey where a liter goes up-to 200.00MZN/$3.25."

"We have one day in a year for a general market in Mussoma but in other places like Marrupa and Lichinga it's always once every week."

"We don't have stationed/gazetted markets for most of the NTFPS we just put them on the road waiting for people traveling if they don't come, we don't sell if they come, we make some money otherwise there is no market. Sometimes we even end up using what we put on the road for our own consumption most especially when they overstay by the roadside."

To some participants who were selling processed NTFPs acknowledged that,

".... here we use some fish species to extract oils." **Participant 111**. **Participant 34** added, "*Most of the bamboo that we use, and sell is cut along Incalaue river shores."*

".....some households' heads do barter trade, that's exchange livestock like chicken with clothes (Caplana)." **Participant 83.**

The buyer type of NTFPs are small traders and these were reported by 63.1%. Small traders are preferred because they are the ones available. As indicated in an interview that,

> *"What we harvest from the forest is sold on the roadside because small traders are very much available and ready to pay however little their prices may look."*

However, some preferred selling to processors. For instance, it was reported that,

> *"...we received some training from Mariri on honey production whereby they come afterwards and buy the honey from the producers at 300.00MZN/$4.82 per 150 milliliters however sometimes they also delay coming and we end up selling by the roadside market to meet our household needs."* **Participant 67.**

> *"We have also started a honey production project but moving at a very slow speed however WCS promised to buy the honey once it is readily available."* **Participant 4.**

74.8% of the respondents were not sure of the distance (KM) to this buyer, though 28.6% choose buyers because they were closer to them. In support of this, one participant was quoted saying,

> *"Our village firewood has no market but in Mussoma however there is a market for firewood, but the distance is too much."*

These are further illustrated in the summary **Table 4.9** below.

Table 4.9: Summary Table on Community as sellers.

Community as sellers	**Frequency (N=377)**	**Percentages (%)**
Types of NTFPs sold		
Grass	106	28.1
Fish	96	25.5
Bamboo shoots	39	10.3
Charcoal	28	7.4
Honey	26	6.9
Firewood	19	5

Poles	10	2.7
Medicinal plants	2	0.5
Length in selling NTFPs		
1940-50	7	1.9
1950-60	22	5.8
1960-70	15	4.0
1970-80	23	6.1
1980-90	31	8.2
1990-2000	38	10.1
2000-2010	22	5.8
2010++	15	4.0
Who is mostly engaged in selling NTFPs?		
Man/Husband	84	22.3
Woman/Wife	39	10.3
Whole family	36	9.5
Children	14	3.7
Buyer types		
Small trader	238	63.1
Broker	69	18.3
Consumer	58	15.4
Processor	12	3.2
Forms		
Unprocessed	371	98.4
Processed	6	1.6
Mode of sale		
Individually	374	99.2
Through farmer	3	.8
Reason for selling to the buyer		
Only Available	177	46.9
Better prices	111	29.4

Nearest	66	17.5
Contractual	23	6.1
Distance to selected buyer		
Not sure	216	57.3
Near (1-10KM)	108	28.6
Far (11-50KM)	36	9.5
Very Far (Above 50KM)	17	4.5

4.2.8: Bivariate analyses of community participation in the value chain as collectors, producers, and sellers of NTFPs.

Table 4.10: Socio-demographic characteristics associated with community participation in the value chain as collectors.

Variable	**Community Participation**		**Chi-square (χ^2)**	**P-value**
	No	**Yes**		
Age			3.626	0.145
Below 18	0	4		
18-27	0	64		
28-37	0	64		
38-47	1	85		
48-57	1	62		
58-67	1	39		
68++	0	56		
Sex			1.933	0.133
Male	3	227		
Female	0	147		
Level of Education			0.205	0.050**
None	2	212		
Primary	1	146		
Secondary	0	16		

Religion			1.008	0.059
Christian	0	1		
Muslims	3	373		
Marital status			0.128	0.003**
Married	1	288		
Single	1	51		
Widowed	0	12		
Divorced	1	23		
Family size			0.277	0.013**
Below 5people	2	198		
5-10	1	164		
More than 10	0	12		
Time spent in the area			0.425	0.019**
0-10	1	47		
10-20	0	72		
20-30	2	131		
30-40	0	28		
40++	0	96		

Table 4.10 above shows that; only four demographic characteristics were significantly associated with community participation in the value chain as collectors of NTFPs. Marital status was significantly associated with community participation in value chain as collectors of NTFPs (x^2 =.128; p=0.003**), family size of community members was significantly associated with community participation in value chain as collectors of non-timber forest product (x^2 =0.277; p=0.013*), time spent in the area was also significantly associated with community participation in value chain as collectors of NTFPs (x^2 =0.425; p=0.019**) and educational level was significantly associated with community participation in value chain as collectors of NTFPs(x^2 = 0.205; p= 0.050**). However, gender, age, and religion were not significantly associated with community participation in the value chain as collectors of NTFPs.

Results show that; all collection attributes were significantly associated with community participation in the value chain as collectors. Types of NTFPs collected was significantly associated with community participation in the value chain as collectors of NTFPs (x^2 =0.204; p=0.036**), length in collecting NTFPs was significantly associated with community participation in the value chain as collectors of NTFPs (x^2 = 3.228 p= 0.021**), mostly engaged in collecting NTFPs was significantly associated with community participation in the value chain as collectors of NTFPs (x^2 = 3.345; p= 0.002**) and Season of collecting NTFPs was significantly associated with community participation in value chain as collectors of NTFPs (x^2 = 1.977; p= 0.007**). The use of NTFPs as raw materials in construction (x^2 = 1.042 p= 0.023**) and the amount obtained in activities engaged in (x^2 = 0.788 p= 0.030**) were significantly associated with community participation in the value chain as collectors of NTFPs**.**

Table 4.11: Community participation in the value chain as producers.

Variable	**Community participation in value chain as producers**		**Chi-square (χ^2)**	**P-value**
	No	**Yes**		
Types of NTFPs produced			0.476	0.026**
Charcoal	0	13		
Honey	0	11		
Ropes	0	11		
Not at all	331	0		
Length in producing NTFPs			2.309	0.045**
1960-1970	1	11		
1970-1980	0	12		
1980-1990	0	7		
1990-2000	0	4		
2000-2010	0	4		
Mostly engaged in producing NTFPs			1.475	0.098
Woman/Wife	0	4		
Man/Husband	0	19		

Whole family	1	15		

Table 4.11 above shows that; only three NTFPs producing attributes were significantly associated with community participation in the value chain as producers. Types of NTFPs produced was significantly associated with community participation in the value chain as producers of NTFPs (x^2 =0.476; p=0.026**), length in producing NTFPs was significantly associated with community participation in the value chain as producers of NTFPs (x^2 = 2.309; p= 0.045**). However, categories of mostly engaged in producing NTFPs was not significantly associated with community participation in the value chain as producers of NTFPs (x^2 = 1.475; p=0.098).

Table 4.12: Community participation in the value chain as sellers.

Variable	**Community participation in value chain as sellers**		**Chi-square (χ^2)**	**P-value**
	No	**Yes**		
Types of NTFPs sold			6.94	0.075
Firewood	11	7		
Bamboo shoots	21	16		
Honey	21	15		
Medicinal plants	14	4		
Poles	21	15		
Fish	34	38		
Grass	82	78		
Length in selling NTFPs			4.937	0.041**
1940-50	3	4		
1950-60	8	14		
1960-70	9	6		
1970-80	12	11		
1980-90	13	18		
1990-2000	19	19		

2000-2010	10	12		
2010++	10	5		
Mostly engaged in selling NTFPs			0.134	0.024**
Woman/Wife	18	21		
Man/Husband	41	43		
Children	7	7		
Whole family	18	18		
Forms of selling NTFPs			0.042	0.010**
Processed	3	3		
Unprocessed	201	170		
Mode of selling NTFPs			0.192	0.023**
Through farmer	2	1		
Individually	202	172		
Buyer type of NTFPs			2.914	0.012**
Small trader	122	116		
Processor	6	6		
Broker	43	26		
Consumer	33	25		
Reason for selling to a selected buyer			6.657	0.056
Only Available	102	75		
Better prices	60	51		
Nearest	27	39		
Contractual	15	8		
Distance (KM) to this buyer			0.204	0.013*
Not sure	116	100		
Near (1-10KM)	59	49		
Far (11-50KM)	19	17		
Very Far (Above 50KM)	10	7		

Table 4.12 above shows that; seven NTFPs selling attributes were significantly associated with community participation in the value chain as sellers. Length in selling NTFPs was significantly associated with community participation in the value chain as sellers of NTFPs(x^2 =4.937; p=0.041**), categories of mostly engaged in selling NTFPs was significantly associated with community participation in the value chain as sellers of NTFPs (x^2 = 0.134; p= 0.024**), forms of selling NTFPs was significantly associated with community participation in the value chain as sellers of NTFPs (x^2 =0.042; p=0.010**), Mode of selling NTFPs was significantly associated with community participation in value chain as sellers of NTFPs (x^2 =0.192; p=0.023**), buyer type of NTFPs was significantly associated with community participation in value chain as sellers of NTFPs (x^2 = 2.914; p= 0.012**), distance (KM) to this buyer was significantly associated with community participation in value chain as sellers of NTFPs (x^2 =0.204; p=0.013*). However, the Reason for selling to a selected buyer was not significantly associated with community participation in the value chain as sellers of NTFPs (x^2 = 6.657; p=0.056).

4.2.9: Multivariate analysis of determinants of community participation as collectors, producers, and sellers of NTFPs.

A multivariate analysis of the extent of community participation as collectors, producers, and sellers of NTFPs**.** Four demographic factors, that is, education, family size, marital status, and time spent in the area were significantly associated with community participation in the collection, production, and selling of NTFPs. The probability of community participation as collectors, producers, and sellers of NTFPs was 2.5 times higher than with those non-educated members when compared with those who were educated (95%CI (0.410-4.86) (p-0.004). This means that the lesser the education, the higher the likelihood of involving as collectors, producers, and sellers of NTFPs. Secondly, the probability of community participation as collectors, producers, and sellers of NTFPs was 4.5 times higher when married compared to other marital statuses at (95%CI (3.30-8.29) (p-0.004). This means that marriage comes with more demands for involving in the collection, production, and selling of NTFPs. Further, the likelihood of community participation as collectors, producers, and sellers of NTFPs went high with the increase in family size. This means that larger family sizes were associated with higher participation in the collection, production, and selling NTFPs. The last significant demographic factor was time spent in the area. The more years households stayed in the area, the more likelihood to participate as collectors,

producers, and sellers of NTFPs. For instance, those who had lived for 20-30 years were associated with 2.1 likelihood at (95%CI (0.723-7.08) (p-0.00). Furthermore, the probability of community participation in the collection of NTFPs was 6.3 times higher depending on the types of NTFPs collected at (95% CI (4.30-10.5) (p-0.00). This means that the need to collect firewood spurred many to engage in the collection, production, and selling of NTFPs. In addition, the probability of community participation as collectors, producers, and sellers of NTFPs was 7.6 times higher with the length in collecting NTFPs at (95% CI (5.22-9.50) (p-0.00). This means that the longer the community members are engaged in collecting NTFPS, the longer they participate as collectors, producers, and sellers of NTFPs. The presence of women or wives in a household was also associated with a higher probability of community participation as collectors, producers, and sellers of NTFPs by 5.11 times at (95% CI (3.870-8.21) (p-0.00). Season of collecting NTFPs was 2.7 times associated with community participation as collectors, producers, and sellers of NTFPs at (95% CI (1.20-3.56) (p-0.00). This meant that community participation increased since collection could be done all year round. The use of NTFPs as raw materials in construction was found to have 2.3 times associated with the likelihood of community participation as collectors of NTFPs at (95% CI (0.623-3.48) (p-0.140). This meant that since NTFPs was playing a significant role in providing wall materials of constructions, the participation of the community increased. However, since the majority obtained much of the money in business related to NTFPs, this was associated with 4.86 times likelihood to engage in the collection of NTFPs. The probability of community participation as producers reduced with the types of NTFPs produced. Length in producing NTFPs was found to have 4.4 times associated with the likelihood of community participation as collectors, producers, and sellers of NTFPs at (95% CI (1.87-7.27) (p-0.00). Length in selling NTFPs was found to have 2.8 times association with the likelihood of community participation as sellers of NTFPs at (95% CI (2.01-6.32) (p-0.01). The selling of NTFPs was much associated with the generation of 1990-2000. The presence of men/husband was found to have 7.2 times associated with the likelihood of community participation as sellers of NTFPs at (95% CI (2.62-9.09) (p-0.01). In addition, selling of unprocessed NTFPs also was one times more likely to increase the probability of increasing community participation as sellers of NTFPs at (95% CI (.003-1.89) (p-0.047). The individual mode of selling NTFPs had likelihood of 1 times contribution towards community participation as sellers of NTFPs at (95% CI (0.001-2.55) (p-0.010). The presence of small trade as the major buyer type of NTFPs was found to have 8.22 higher likelihood

of increasing the probability of increasing community participation as sellers of NTFPs at (95% CI (1.56-2.59) (p-0.03). Those who were found not sure about the distance (Km) to the buyer was found to have 4.1 times high likely to contribute to community participation as sellers of NTFPs at (95% CI (2.62-9.19) (p-0.059). This means that distance is not a major factor in community participation as sellers of NTFPs.

In summary, community participation as collectors, producers and sellers of NTFPs was evaluated as increasing and this was dependent on the education, marital status, family size and time spent in the area by community members, types of NTFPs collected, length in collecting, producing and selling NTFPs, presence of women or wives in a households, season of collecting, producing and selling NTFPs, produced and sold, the presence of men/husband, forms of producing and selling NTFPs, mode of collecting, producing and selling NTFPs, the buyer type of NTFPs and distance (KM) to the buyer.

4.3: Discussion of results.

The study findings established that the collection of NTFPs generally contributes 38.6% to food security in NSR. Shackleton, *et al.*, (2017) and Lopes *et al.*, (2018) supported the above study since they had earlier ascertained that NTFPs contributed over and above 40% on food security in South Africa and Zambia respectively. Specifically, the study also showed that spices contributed much to securing daily food at home. They found out that they not only use spices for food but also income generation. The natural flavors found in these spices influence a good number of consumers to use these spices. In Kano, Nigeria, many NTFPs collectors add value on spices which makes them marketable (Suleiman *et al.*, 2017). This is done through processing, packaging, and other forms of branding to make spice powders, oils, and oleoresins. In the context of NSR conservation action and rural development, the harvesting of spices is central in continued preservation of the woodland. In addition, forage was also found to have a significant influence on food security ß=0.666 (p=0.034). This suggested that community members who collected forage increased their food security through looking after their domestic animals. This tallied with the findings of Suleiman *et al.*, (2017) who had earlier ascertained the role of forage collected as NTFPs on food security from Tropical Rain forests in Wudi in Nigeria. The collection of forage is essential in the preservation of Niassa Special Reserve because they act as a good substitute for

community members to look after their animals without tampering with forests. This can also improve rural developments in form of increased ability to rear animals needed on national markets. Furthermore, study findings established that the collection of wild fruits and nuts contributed 59.8% on food security of collectors.

The above is congruent with Mahonya, *et al.,* (2019) who found out that wild fruits and nuts provide daily food consumption to children and youths. This was found as a great contribution of NTFPs towards food security. This also serves as a way of respect to NSR by the community since it is a breeding ground for fruits. It was also established that the collection of mushrooms was found to contribute close to a margin of 45.6% to food security. This has the potential to improve rural development by acting as a good source of sauce for most of the families who would go for important wild animals. The collection of wild vegetables was found to contribute close to a margin of 63.2%. Shackleton, *et al.,* (2017) confirmed these findings in their study done in non-timber forest products in the Eastern Arc Mountains in Tanzania. These found that the collection of wild vegetables, medicinal plants, and grass had a positive and significant influence on food security. These can act as harbors for environmental degradation because the rural households collectively benefit from them.

The study found out that NTFPs explained 24.5% of the variation in income generation. This means that NTFPs have a likelihood of providing an indirect income by a margin of 24.5%. This finding is congruent with Munanura *et al.,* (2014) who had conducted a study in woody vegetation in Lesotho. They had also established a contribution of 33% of NTFPs on income generated by farmers indirectly from rain forests since they would save the money, they would use to buy firewood to do something else, in either way, it is a contribution to income generation. This study found out that firewood had greatly contributed to savings among households with ß=0.762 (p=0.017). This implied that community members who collected firewood were highly likely to have growth in income by a margin of 76.2%. These findings concur with earlier studies done by Shaankerbc, *et al*., (2015) They found out that firewood took priority among the NTFPs consumed in Ecuador and Peru. These were consumed both at household or subsistence and commercial levels by the majority of rural dwellers. These contributed to 70% of the income generated by a significant number of community members who relied on forests for a living.

In addition, in line with the above study, Zaku *et al.,* (2013) conducted a study in Kaduna State, Nigeria. These had also found that wild vegetables constituted a frontline position in generating incomes just like how this current study established. For instance, this study found out a significant influence of wild vegetables on income generation ß=0.701 (p=0.013). This suggests that community members who collected wild vegetables like greens, pepper, eggplants etc. increased their income by a margin of 70.1%. Further, the collection of mushrooms was found to contribute 77.7% on income. Further, the collection of medicinal plants contributed 57.6% on income generation. This tallied exactly with what Schaafsma *et al.,* (2014b) and Newton, *et al.,* (2016) established that medicinal plants like garlic, gingers, feverfew, ginseng etc. contributed 51.2% on the incomes generated by neighboring communities in Eastern Arc Mountains in Tanzania. Wood *et al.,* (2015) also found out that charcoal contributed 35% on the incomes generated from NTFPs which is not far different from this current study which found a significant relation of 52.1% and spices contributed 55.9% (p=0.020). This tallies with Munanura *et al.,* (2014) who had done a study in Rwanda on forest dependence at Volcanoes National Park. These found out that the number of people selling spices collected from the volcano forest was higher and this had contributed on the employment and incomes generated. The acquisition of income and food security from the above NTFPs is central to NSR conservation action and rural development.

The implication of the above is that in the Mecula-Lugenda Corridor, NTFPs can be self-consumed, given as gifts to people, or exchanged for other goods or products like cassava flour, using the same measurement unit. When NTFPs are not eaten they enter in the value chain of NTFPs. In the Mecula-Lugenda Corridor, the NTFP value chain is complex with multiple actors involved. At the bottom of the chain, we have the collectors who are the main actors in the value chain. During the period of gathering collectors generally move from the village to the forest and stay there during the whole period of gathering; living in the forest to collect and sell the products. In the forest collectors gather, crush, and dry products manually. NTFPs are generally collected in the rainy season and dried under the sun or by exposing products on fire bands when there is no sufficient sun to dry products in the forest. Concerning processing, for all the main NTFPs in the Mecula-Lugenda Corridor, only kernels are transformed into oil before commercialization or use. In the Mecula-Lugenda Corridor crushing, drying, processing, and conservation of NTFP are not well developed due to the lack of skills and equipment. This accounts for the low development of the NTFP sector. This thus means that for NTFP profit to increase significantly, semi-processing

and grading need to be introduced. In addition, adding value by simple equipment can boost production, and reduce losses, and then packaging can make a major difference to price and quality. Other actors in the NTFP value chain are local traders. They generally buy and sell to urban semi-wholesalers or wholesalers settled in the villages. However urban semi-wholesalers generally sell directly in the urban markets. One of the most powerful actors in the value chain are intermediaries who have a strong influence in NTFP marketing because they are mandated by the wholesalers who give them money and most of the time some materials and they go to the forest to get products from the collectors. The presence of intermediaries weakens the power of collectors in NTFP price negotiation, but they contribute to the sales of products collected. The most powerful actors in the NTFP value chain in the Mecula-Lugenda Corridor are the wholesalers. They influence NTFP marketing because they generally have the main financial power and can buy large quantities, store, and sell in urban markets. One of the reasons for the weakness power of collectors in the value chain is that they generally take credits as food, and alcohol from the local traders, wholesalers, or from intermediaries against their NTFPs. This weakens their power in the value chain because they don't receive the real incomes of their activities. In Mecula-Lugenda Corridor, the NTFP value chain is complex, with several stages involved in the process of getting products from the forest to the market. There were at least four levels of commercialization between the collectors and the urban market. This contributed to the poor income of collectors. NTFP gathering usually requires much labor, but collectors do not generally receive the main part of the income, all other actors generally have more power in the marketing process in Mecula-Lugenda Corridor.

4.4 Summary

The study found that communities largely participated in the collection of NTFPs. Particularly 100% were collecting firewood, medicinal plants, fish, species, grass, and ropes. The communities rarely participated in the collection of oil and bush meat. On the most preferred NTFPs by the community, it was evident that 80% of the community members preferred firewood, poles, ropes, wild fruits and nuts, grass, bamboo shoots, wild tubes, medicinal plants, and fish. These NTFPs that are most preferred were associated with the value they play in relation to food security, health security, economic security, and overall survival and economic growth of the area. It was established that since the 1940s, the existing households have been engaged in collecting a series

of NTFPs. It was noticed that seasons for collecting several NTFPs was largely done all year round. However, some NTFPs could be largely collected during dry or wet seasons. Three categories of family members including women/wives, men/husbands, children, and the whole family in that order engaged in collecting NTFPs from catchment forests. Collection of Non-Timber Forest Product from forests was ranked in the first choice (88.9%) in the major activities engaged by community members, followed by trade (87.1) and agriculture (76.9%). The primary reason for ranking the collection of Non-Timber Forest Products is because it is the source of construction material, food, medicine, and income. For the second choice, the primary reason is that agriculture is a major source of food in the reserve. Lastly, in the third choice of trading is because it is the source of income. Therefore, source of construction materials, food, medicine, and income are the underlying reasons for engaging in all forms of activities done in the forest areas. In community participation as producers, only 10.3% of the communities were engaged in producing NTFPs in NSR which is far below the number of people engaged in collection. The small number that is engaged in producing is largely in three NTFPs. The highest proportion of 3.7% were producing charcoal, 2.9% were producing honey and ropes each. The majority had been in producing NTFPs since the 1960s. These constituted 3.2%. Men/husbands were indicated as most engaged in producing NTFPs and these were ranked by 5%. In community participation as sellers, 45.9% of the respondents were engaged in selling NTFPs in NSR. Grass is the first line NTFPs sold by 28.1%. Fish was reported by 25.5% and bamboo shoots (10.3%). Further, 6.9% was found selling honey and 5% firewood. The majority have been selling NTFPs since 1990-2000s. These constituted 10.1%. Man/husband were indicated as most engaged in selling NTFPs. Majority of NTFPs sold were sold unprocessed (89.1%) and lacked a ready market. In summary, community participation as collectors, producers, and sellers of NTFPs was evaluated as increasing and this was dependent on the education, marital status, family size and time spent in the area by community members, types of NTFPs collected, length in collecting, producing and selling NTFPs, presence of women or wives in households, season of collecting, producing and selling NTFPs, produced and sold, the presence of men/husband, forms of producing and selling NTFPs, mode of collecting, producing and selling NTFPs, the buyer type of NTFPs and distance (KM) to the buyer.

CHAPTER FIVE: DIVERSITY AND IMPORTANCE VALUE INDEX (IVI) OF TREE SPECIES WITH NTFPS NON-TIMBER FOREST PRODUCTS ATTACHMENT.

5.0: Introduction

Understanding tree composition and structure of a forest is a vital instrument in assessing the sustainability of the forest, species conservation, and management of forest ecosystems (Chamberlain, *et al.*, 2020). In the study area, a few unpublished inventories have been recorded mostly with the tree species with NTFPs attachment. This research determined the composition, structure, harvested parts, seasons of harvesting, diversity and Importance Value Index (IVI) of tree species with NTFPs Attachment in the Mecula-Lugenda Corridor.

5.1.1: Methodology.

Data on anatomy, botany, physiology, and flowering/fruiting phenology of the various tree species used as a source of NTFPs in the selected area was collected. Our focus was basically on tree species simply because they have the majority of the NTFPs attached than any plant ranging from ropes, poles, fishing, medicinal, traditional/cultural attachment, honey production, making crafts, glue, hoe handles, shade, the door for poultry cages, killing termites, ornamental, wooden sandals, hats, bee hives, dancing costumes, making canoe, silos (for seed storage), cooking sticks/spoon, used for making mortar, books/paper, rituals for women (circumcision), and toothbrush. To collect all this information transects were purposively established in different communities/sites along the Mecula-Lugenda corridor. This data was collected from November to December 2019. Two transects of 500m each were constructed in each of the communities/sites (Cuchiranga, Lisongole, Ntimbo 1, Ntimbo 2, Mussoma/Lugenda, and Lichegue) and a total of twelve (12) transects were established. Along each transect five (5) plots of 50m×50m were established using machetes, ranging poles, compass, and red flagging tape making a total of sixty (60) plots established in the entire study area. The distance between transacts was dependent on the various sites where community members found most of the species harvested however care was taken that these transacts are established with the boundaries of a specific community. From each plot, tree species with NTFP attachment were counted, recorded (name, DBH, parts harvested, NTFP attached, damage just in case of any, and the cause of the damage), and separated into different families. Identification of different tree species with NTFPs attachment along each transect was based on a

visual assessment of physiognomic and ecological characteristics. A total inventory of the different NTFPs tree species was done from all the plots within each transect. After collecting that information, it was used to guide sustainable resource use (for both environmental, social, and economic reasons).

5.1.2: Recording and Analysis

Recording of tree species was done by listing those tree species with their type of NTFP harvested, family name, botanical names, use, and many others. A botanist from the agriculture research institute assisted in tree identification. Diameters at Breast Height (DBH) was also measured using a caliper for all trees with NTFPs attachment in each plot. Trees identified were listed and classified. Diameters at breast and other data generated from this study was used to calculate the Basal Area, Tree Species Diversity, Relative Frequency, Relative Abundance, Relative Dominance, and Importance Value Index using formulas 1, 2, 3, 4 5 and 6 below (Barbour, M. G., *et al.*, 1987; Koontz, M., *et al*., 2016).

$$\text{Relative Frequency(RF)} = \frac{\text{Individuals of a species}}{\text{Total individuals of all species}} \text{ X100} \quad \text{..... (1)}$$

$$\text{Relative Dominance(RD)} = \frac{\text{Total basal area of a species}}{\text{Total basal area of all species}} \text{ X100} \quad \text{..... (2)}$$

$$\text{Relative Abundance (RA)} = \frac{\text{Number of individuals per hectare of a specie}}{\text{Total number of Individuals per hectare}} \text{ X100} \quad \text{..... (3)}$$

$$\text{Basal Area} = ((3.14(\text{DBH})^2)/4)/\text{Sampling area} \quad \text{..... (4)}$$

$$\text{Importance Value Index (IVI)} = \text{RA} + \text{RF} + \text{RD} \quad \text{..... (5)}$$

Tree Species Diversity was determined using the Shannon diversity Index ($H^/$) following (Roswell, M., *et al.*, 2021). This is determined by

$$H = -\text{å } Pi(\ln Pi) \quad \text{..... (6)}$$

where P_i is the proportion of each species in the sample.

5.2.0 Results.

5.2.1: Tree species, NTFPs Harvested, and season harvested in Mecula-Lugenda corridor NSR.

Results showed that 8 parts are harvested on the tree species in Mecula-Lugenda Corridor, NSR. 16 families were harvested for leaves and roots. For instance, those that provide leaves for the different NTFPs included Annonaceae, Apocynaceae, Capparidaceae, Combretaceae, Ebenaceae, Fabaceae, Lauraceae, Leguminosae, Linaceae, Malvaceae, Phyllanthaceae, Polygalaceae, Rhamnaceae, Rubiaceae, Salicaceae, and Strychnaceae. Those that provide roots for the different NTFPs included Annonaceae, Apocynaceae, Capparidaceae, Combretaceae, Connaraceae, Fabaceae, Leguminosae, Linaceae, Myrtaceae, Ochnaceae, Olacaceae, Phyllanthaceae, Polygalaceae, Rubiaceae, Salicaceae, and Strychnaceae as showed in **Table 5.1.** 14 families were harvested for branches and these included; Annonaceae, Apocynaceae, Bignoniaceae, Burseraceae, Capparidaceae, Combretaceae, Connaraceae, Dipterocarpaceae, Ebenaceae, Fabaceae, Lamiaceae, Malvaceae, Phyllanthaceae, and Strychnaceae. 13 families were harvested for bark which included Annonaceae, Apocynaceae, Bignoniaceae, Combretaceae, Connaraceae, Fabaceae, Lauraceae, Linaceae, Malvaceae, Myrtaceae, Ochnaceae, Phyllanthaceae, and Polygalaceae. 13 member trees were harvested for trunk and these are Annonaceae, Apocynaceae, Bignoniaceae, Combretaceae, Connaraceae, Dipterocarpaceae, Ebenaceae, Fabaceae, Lamiaceae, Leguminosae, Malvaceae, Phyllanthaceae and Strychnaceae. 12 families were harvested for fruits and these are these included; Annonaceae, Fabaceae, Lamiaceae, Lauraceae, Leguminosae, Olacaceae, Phyllanthaceae, Rhamnaceae, Rubiaceae, Salicaceae, Strychnaceae, and Verbenaceae. Two (2) families provided flowers including Burseraceae and Fabaceae. The last category was seeds harvested for the different NTFPs and this was provided by two tree family species, that is, Leguminosae and Salicaceae.

Table 5.1: Tree species, NTFPs harvested, and Season harvested in Mecula-Lugenda corridor NSR.

Species	Family name	Part harvested	Season harvested	NTFPs Attachment
Diplorhynchus condylocarpon	Apocynaceae	Back, Leaves, Trunk, Branches, and Roots	All Year	Medicinal, firewood, traditional/cultural attachment, forage, rubber.
Julbernadia globiflora	Fabaceae	Trunk, Branches, and Bark	All year	Firewood, medicinal, making canoes, ropes, poles, wooden sandals, beehives, dancing costumes, silos (for seed storage)
Burkea africana	Fabaceae	Trunk, Branches, Roots, and Bark	All year	Firewood, medicinal, charcoal, poles, traditional/cultural attachment
Terminalia sericea	Combretaceae	Root, leaves, Trunk, and Branches	All year	Traditional/cultural attachment, poles, firewood
Combretum apiculantum	Combretaceae	Root, Leaves, Bark, Trunk, and Branches	All year	Medicinal, firewood.
Pseudolachnostylis maprouneifolia	Phyllanthaceae	Roots, Leaves, Branches, Bark, and trunk	All year	Medicinal, traditional/cultural attachment, firewood, poles, ropes.
Flacourtia indica	Salicaceae	Fruit, Leaves, Roots, and the Whole tree	All year	Fruit is used as food, medicinal, firewood, and traditional/cultural attachment.
Pterocarpus angolensis	Fabaceae	Bark, leaves, roots, trunk, Bark, and Branches	All year	Traditional/cultural attachment, medicinal, used for fishing, ropes, firewood, and forage.

Species	Family name	Part harvested	Season harvested	NTFPs Attachment
Brachystegia boehmii	Fabaceae	Bark, Trunk, and Branches	All year	Firewood, poles, wooden sandals, doors for poultry cages, hats, beehives, dancing costumes, ropes, medicinal.
Bridelia cathartica	Phyllanthaceae	Fruit and trunk	All year	Fruit is used as food and construction.
Commiphora africana	Burseraceae	Branches, flowers	All year	Used as shade, used for making mortar/cooking spoon/sticks
Diospyros kirkii	Ebenaceae	Branch, trunk	All Year	Firewood, construction, charcoal
Sansevieria sp.	Leguminosae	fruit, seeds, trunk, Root	All year	Fruit is used as food, seasoning food, Furniture for specialized leaders, medicinal, firewood, and forage.
Combretum collinum	Combretaceae	Root, Trunk, Branch	All year	Medicinal, firewood, used for making mortar/cooking spoons/sticks, charcoal.
Gardenia ternifolia	Rubiaceae	Trunk, Branches, flowers, bark	All year	Crafts, firewood, charcoal, honey production.
Catunaregam spinosa	Rubiaceae	Root, fruit, and leaves	All year	Rituals for women(circumcision), used for fishing, fruit used as a food
Ochna mossambicensis	Ochnaceae	Trunk, branch	All year	Firewood
Brachystegia Manga	Leguminosae	Leaves.	All year	Traditional/cultural attachment
Melhania forbesii	Malvaceae	Leaves	All year	Medicinal
Hugonia orientalis	Linaceae	Roots and leaves	All year	Medicinal

Species	Family name	Part harvested	Season harvested	NTFPs Attachment
Annona senegalensis	Annonaceae	Leaves, roots, fruit, Bark, Trunk/branches	All year	Medicinal, fruits used for food, crafts, Glue, hoe handles
Swartzia madagascariensis	Fabaceae	Leaves, Flowers, Fruit	All year	Medicinal, used for fishing.
Tamarindus indica	Fabaceae	Fruit, trunk, branch, leaves, roots	All year	Fruit is used as food, firewood, and medicinal.
Baphia massaensis	Fabaceae	bark, leaves, roots	All year	Traditional/cultural attachments
Philenoptera bussei	Fabaceae	Bark, trunk	All year	Medicinal, firewood, charcoal, forage.
Pteleopsis myrtifolia	Combretaceae	Trunk, branches, leaves, and Bark	All year	Firewood, traditional/cultural attachment, medicinal.
Bauhiniaa petersiana	Fabaceae	Trunk/branches	All Year	Firewood, construction, charcoal
Combretum molle	Combretaceae	Roots	All year	Traditional/cultural attachments
Dalbergiella nyasae	Fabaceae	Roots and leaves	All year	Medicinal
Vitex doniana	Verbenaceae	Fruit	wet season	Fruit used as a food
Rourea orientalis	Connaraceae	bark and roots, trunk and branches	All year	Used for making mortar/cooking spoons/sticks, medicinal.
Monotes engleri	Dipterocarpaceae	Trunk and branches	All year	Firewood
Cassia abbreviate	Connaraceae	Bark, Roots	All year	Medicinal, and ornamental
Markhamia obtusifolia	Bignoniaceae	Bark, trunk/ branches	All Year	Ropes, and firewood

Species	**Family name**	**Part harvested**	**Season harvested**	**NTFPs Attachment**
Strychnos madagascariensis	Strychnaceae	Roots, leaves, and Branches		Medicinal
Bauhinia galpinii	Fabaceae	Bark, Leaves, and roots	All year	Medicinal
Vitex payos	Lamiaceae	Leaves, Roots,	All year	Medicinal, used for fishing, used to kill termites.
Olax dissitiflora	Olacaceae	Fruit, Roots	All year	Medicinal, fruit used as food.
Vachellia sp.	Fabaceae	Fruit, trunk, branch	All Year	Medicinal, firewood, crafts.
Syzygium guineense	Myrtaceae	Bark, roots	All Year	Medicinal, used for fishing.
Cordiamyxa	Boraginaceae	Trunk, Branches, Fruit	All year	Medicinal, fruits are used for food, firewood, and charcoal.
Dombeya Shupangae	Malvaceae	Trunk, branch, bark	All year	Books/paper, firewood, making canoe
Albizia amara	Fabaceae	Roots and leaves	All year	Medicinal
Cassytha filoformis	Lauraceae	Bark, leaves	All year	Traditional/cultural attachment, used for fishing, and firewood.
Diospyros	Ebenaceae	Leaves	All year	Medicinal
Eriosema sp.	Fabaceae	Leaves.	All year	Medicinal,
Mundulea sericea	Fabaceae	Trunk, Branches, and leaves	All year	Firewood, medicinal
Breonadia salicina	Rubiaceae	Root	All year	Medicinal
Monanthotaxis buchananii	Annonaceae	Fruit, Bark, and leaves	All year	Medicinal, fruit used as food.

Species	**Family name**	**Part harvested**	**Season harvested**	**NTFPs Attachment**
Hymenocardia acida	Phyllanthaceae	Bark	All year	Traditional/cultural attachment
Acacia nigrescens	Fabaceae	Bark	All year	Medicinal
Terminalia stenostachya	Combretaceae	Roots	All year	Traditional/cultural attachment
Dalbergia nitidula	Fabaceae	Trunk, branches.	All year	Firewood
Securidaca longipedunculata	Polygalaceae	Bark, roots, and leaves	All year	Medicinal, traditional/cultural attachment.

Tree species are largely harvested for medicinal, and these are from Eighteen (18) families. Thirteen (13) families are harvested throughout the year for firewood purposes, twelve (12) families are harvested throughout the year purposely for cultural attachments, ten (10) families are for construction, eight (8) families were for crafts, seven (7) families for food and food crafting. There are 34 NTFPs attached to the trees throughout the year, and these include glue, hoe handles, shade, door for poultry cages, fishing, killing termites, traditional/cultural attachment, ornamental, poles, wooden sandals, hats, bee hives, dancing costumes, honey production, making canoe, ropes, silos (for seed storage), cooking sticks, spoon, used for making mortar, books/paper, rituals for women (circumcision), and toothbrush. It has been noted that the season of harvesting is largely all year accounting for 98.21% and the wet season is only 1.79%.

5.2.2.0: Importance Value Index

5.2.2.1: Basal area

Out of the entire tree species encountered *Julbernadia globiflora* dominates with a total basal area of 5.73m^2 per hectare closely to this is followed by *Diplorhynchus condylocarpon* with a basal area of 5.52m^2 per hectare Further, *Burkea africana* (4.71m^2 per hectare), *Terminalia sericea,* had 2.40m^2 per hectare, *Combretum apiculatum (*2.38m^2 per hectare), *Brachystegia Boehmii* had 1.34m^2 per hectare and *Pseudolachnostylis maprouneifolia (*1.055m^2 per hectare).

5.2.2.2: Relative Frequency.

Diplorhynchus condylocarpon had the highest Relative Frequency (14.96%), followed by *Terminalia sericea* (10.13%), *Julbernadia globiflora* 9.60%, *Burkea africana* 6.97%, *Combretum apiculatum* 6.38%, *Pseudolachnostylis maprouneifolia* 5.62% and *Flacourtia indica* 5.36%.

5.2.2.3: Relative Abundance

Diplorhynchus condylocarpon had the highest percentage of individuals relative to the total number of individuals of all species in a community or sample with 14.96%. this was followed by *Terminalia sericea* (10.12%), *Julbernadia globiflora* at 9.60%, *Burkea Africana* at 6.37% and *Combretum apiculatum* 5.62%%, and *Pseudolachnostylis maprouneifolia* at 5.36%

5.2.2.4: Relative Dominance

The study revealed that *Julbernadia globiflora* is the most dominant in all tree species encountered in the study with 19.37% Relative dominance. This is followed by *Diplorhynchus condylocarpon* at 18.68%, *Burkea africana* with 15.91%, *Terminalia sericea* with 8.13%, *Combretum apiculantum* with 8.01%, *Brachystegia Boehmii* with 4.51% and *Pseudolachnostylis maprouneifolia* with 3.53%.

Figure 5.1 below indicates that *Diplorhynchus condylocarpon* has the most rated important value index (IVI) in all tree species encountered in the study with an index of 48.6058. This was followed by *Julbernadia globiflora* with an index of 38.5819, *Burkea africana* with an index of 29.8507,

Terminalia sericea with an index of 28.3802, *Combretum apiculatum* with a 20.8248, *Pseudolachnostylis maprouneifolia* with 14.7806, *Flacourtia indica*, *Pterocarpus angolensis*, *Brachystegia boehmii*, *Bridelia cathartica and Commiphora africana* followed respectively.

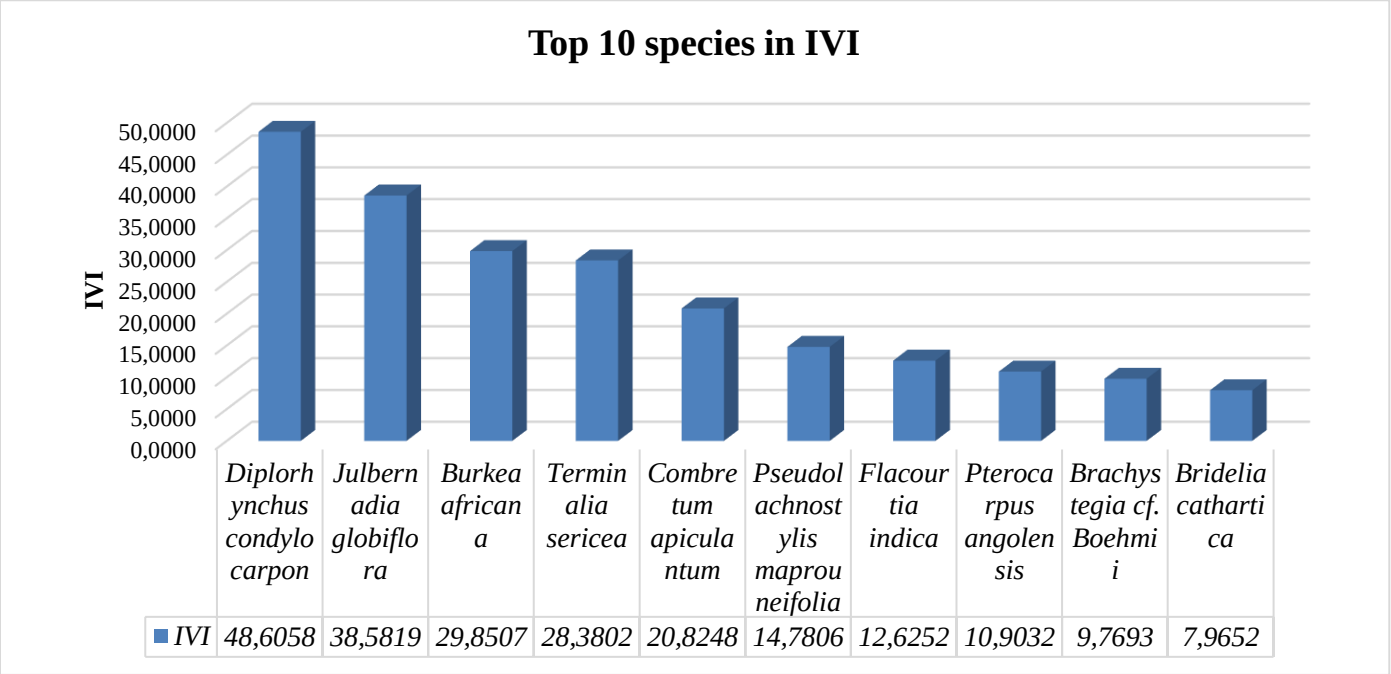

Figure 5.1: IVI of the different Tree species supplying NTFPs.

5.2.3: Species Diversity

Shannon Diversity Index (H) was calculated for the six sites (Cuchiranga, Lisongole, Ntimbo 1, Ntimbo 2, Mussoma, and Lichegue) and established that Ntimbo 2 had the highest species diversity of 2.973 followed by Lichegue (2.953), Mussoma (2.891), Cuchiranga (2.845), Ntimbo 1 (2.771) and the site with the lowest diversity was Lisongole (2.617) (**Figure 5.2 below**).

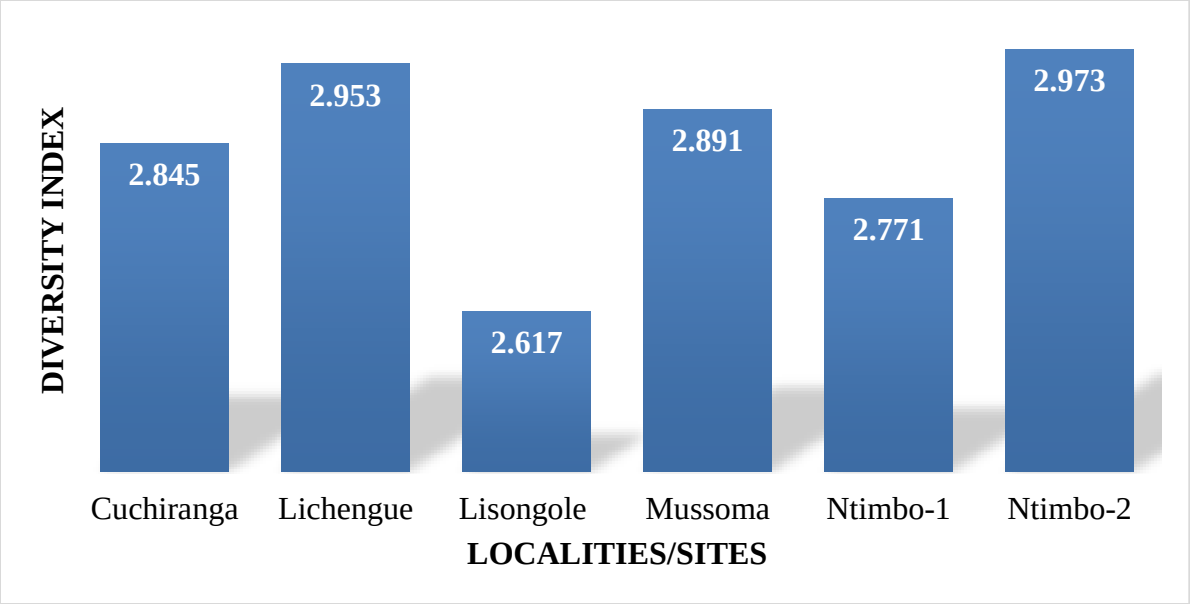

Figure 5.1: Diversity Index of the different species with NTFPs at different sites.

5.3: Result Discussion.

The study revealed a total of fifty-six different tree species with NTFP attachment distributed among twenty-five botanical families. This was dominated by Fabaceae, Combretaceae, Phyllanthaceae, Annonaceae, Bignoniaceae, Ebenaceae, Leguminosae, Malvaceae, and Rubiaceae, in that order. This presents a similarity with a study conducted by Buramuge, V. A et al., (2023) about tree species composition and diversity in fire-affected areas of miombo woodlands, Central Mozambique they established the dominance of Fabaceae and Phyllanthaceae families. This is relevant because each type of forest system has its dominance of species by families, or some species of some families have more use value than species of other families.

The study further established that 8 parts are harvested on the tree species in the Mecula-Lugenda Corridor with the commonest part being leaves and roots obtained from 16 families due to association with the love for medicine in the area due to inaccessibility of healthcare services in the area (Borah *et al.*, 2020). Ifeoma, *et al*., (2021) indicate that there is a high association between parts (NTFPs) obtained from tree species and their existence. Firewood, research/education, medicine, and cultural attachment are primary in determining the parts harvested. The implication thus is that this defines the forest cover changes existing or that will exist in the area. The more people consume leaves and roots, this can have a bearing on the intensity of forest growth. The

parts that are highly consumed can be a basis for forest management to recommend afforestation in different forest communities.

The commonest NTFP harvested from the different tree species was largely for medicinal use and obtained from Eighteen (18) families, harvested throughout the year, thirteen (13) families are harvested throughout the year for firewood purposes, twelve (12) families are harvested throughout the year purposely for cultural attachments, ten (10) families are harvested for construction, and eight families NTFP collected for craft, and seven tree families are harvested for food and food crafting. Borah *et al.,* (2020) noted that catchment rain forests tend to possess several products harvested throughout the year. This is integral to the above study where it was noted that the season of harvesting is largely all year accounting for 98.21% and the wet season is only 1.79%. This is further confirmed by Mipun, *et al*., (2019) who ascertained that since people need medicine, firewood, cultural ornaments, construction, food, and crafts throughout the year, it becomes inevitable for them to avoid resorting to selected tree species that they find extremely important and dominant. The above findings imply that there is a deep and integral relationship between the lives of people and the forests around them since they see them as a source of life-saving medicines. This predicts that forest conservation becomes easy and predictable due to the role it plays in the lives of community members. The forest management therefore needs to maintain the forest cover, it is important that dominant tree species are safeguarded through recommending artificial plantation of dominant tree species and gazzetting of communities per the need established.

Out of the entire tree species encountered *Julbernadia globiflora* dominates total basal area, followed by *Diplorhynchus condylocarpon, Burkea africana, Terminalia sericea, Combretum apiculantum, Brachystegia boehmii, Pseudolachnostylis maprouneifolia*. In support of the above findings, João De Sousa, Pires, *et al* (2021) established that trees at a breast height of one feet and above are less associated with harvesting than those below. Given the fact that there is a low regeneration possibility. To preserve biodiversity, forest management must be diversified in its approaches. For instance, there is a need to abandon traditional tree removal. This is because broadleaved woodlands (including the Mecula-Lugenda Corridor) showed that most canopy tree species are strongly light-demanding. To stimulate regeneration and fast growth of sprouting shoots on cut stumps, relatively large gaps are required. For instance, gap diameter should be 3-5

times the height of the mature canopy (Chidumayo, 2019). This is because mature miombo woodland has very few to zero small stems of canopy trees in the understory.

The former is based on the influence of the structure and composition of the ecosystem on disturbances as provided by Chidumayo (2019). The latter, on the other hand, is measured through the influence of disturbances on the structure and composition of an ecosystem. Hence, structural and species diversity should be maintained or increased.

The study further revealed the Relative abundance of each tree species supplying NTFPs encountered in the study sites. *Diplorhynchus condylocarpon* had the highest density, followed by *Terminalia sericea, Julbernadia globiflora, Burkea Africana, Combretum apiculantum and Pseudolachnostylis maprouneifolia*, the relative abundance of these species justifies why the local communities were particularly highly involved in the collection of firewood and medical NTFPs. Epanda *et al.*, (2020b) were in line with the study findings since they had earlier established that *Diplorhynchus condylocarpon*, *Terminalia sericea,* and *Julbernadia globiflora* species are great sources of firewood and play significant roles all year around. This was also found true by Bruschi, Mancini, Mattioli *et al.*, (2014) who found out that *Diplorhynchus condylocarpon, Terminalia sericea,* and *Julbernadia globiflora* species are great sources of firewood for the whole year in Miombo woodland, Mozambique. The relative abundance thus depicts that the biological resources of the area are used by local people in various ways. The loss of biodiversity and degradation of forests in many places (especially near villages) can be attributed to medicinal herb collection and unregulated grazing. This is also confirmed by Ribeiro, *et al.,* (2020) that the resilience of NTFPs in Miombo Woodlands relies on medical herbs and unregulated grazing. Many resident species are expected to be endangered or threatened. The important species need protection, because of their scientific interest and rarity. It is imperative therefore that forest management authorities invest in preventing deforestation while introducing alternative sources of fuel and timber. This can be in the form of the mobilization of communities to adopt climate-smart technologies, agroforestry practices, and afforestation. Furthermore, programs that provide conservation education, initiate the sustainable use of the forests and propagate multipurpose indigenous trees should be initiated. It is recommended that biological inventories with comprehensive flora and fauna biological databases should be prepared. A detailed ecological study of vegetation is needed for the development of conservation and management programs

within the study area. The study suggests conservation strategies to protect woody species against anthropogenic pressures (for example, protection from or reducing the frequency and/or intensity of disturbance, especially woodcutting and bushfires).

Further, *Julbernadia globiflora* was found to be the most dominant of all tree species. This justifies the reason why most of the community members are highly involved in the collection of firewood, medicinal, charcoal, and poles and undertaking cultural ceremonies since it was discovered that this specie is central in these uses. This concurs with Sitoe, *et al.*, (2010) who in their study in dry forests and miombo woodlands in Mozambique established *Julbernadia globiflora* is primary in facilitating the collection of firewood and construction materials. The *Julbernadia globiflora* was followed by *Diplorhynchus condylocarpon, Burkea Africana, Terminalia sericea, Combretum apiculantum, Brachystegia boehmii* and *Pseudolachnostylis maprouneifolia*. The dominance of these tree species is associated with their provision of medicinal, firewood, cultural attachment, forage, and rubber, and poles. About forest management, different forest management practices have a direct impact on species dominance, thereby having varying effects on forest species. The species' responses to management vary as they depend on their ecological niches. Thus, no single management practice can benefit all species. The conservation or promotion of a particular species (or species group) requires therefore a fit-to-purpose management strategy considering the species' ecological requirements. To conserve a diverse forest community, it is necessary to manage forests in a way to promotes diversity in habitat structure, such as by mimicking natural forest disturbances and dynamics, and promoting the development of trees that could serve as habitat. *Burkea africana* was found with high standing volumes, any management that is applied simultaneously on the entire landscape will tend to decrease the standing volume and increase vertical structures, resulting in a general decline in forest species occurrences. This was also confirmed by Ribeiro *et al.*, (2020) in Miombo Woodland, it is necessary to spatially optimize the management practices in the landscape to promote the overall forest species diversity. This approach may allow creation of the necessary diversity of habitats through time for different bird species.

The study findings also revealed that *Diplorhynchus condylocarpon* has the most rated important value index (IVI) in all tree species encountered in the study. This justifies the reason why most of the community members are highly involved in the collection of medicine, firewood, cultural attachment, forage, and rubber since it was discovered that this species is central in these NTFPs.

This concurs with Mbanze, *et al.,* (2019) who did a study on vegetation structure and the effects of human use of the dambos ecosystem in northern Mozambique and established that *Diplorhynchus condylocarpon* is primary in the collection of herbal medicines, research, and cultural ritual performances. This was followed by *Julbernadia globiflora* which is also associated with providing a range of NTFPs including firewood, medicine, making canoes, making ropes, poles, wooden sandals, beehives, dancing costumes, and silos (for seed storage). *Burkea Africana*, *Terminalia sericea*, *Combretum apiculantum,* and *Pseudolachnostylis maprouneifolia* also recorded a higher IVI compared to the rest of the species in the study area. The importance value index of these trees confirms the relationship the community has with the above trees in obtaining firewood, poles, medicinal, and charcoal as well as the cultural attachment. Ameja, *et al.,* (2022) in their study about regeneration and restoration status of Miombo Woodland concurs with the above findings in their study about NTFPs and their contribution to healthcare and livelihood security. They ascertained that those trees with a stronger relationship with communities are highly safeguarded and replanted because they cannot live without them, and these tend to score a high IVI in relation to others. They added that each community has its highly dominant and important species because of the cultural, food security, health, ecotourism, and agricultural roles they play. Ryan, *et al.,* (2016) on their study on ecosystem services from miombo woodlands in Mozambique qualifies the above viewpoint in their study about distribution and importance value index of woody species under different successional stages while indicating that the primary indicator preservation of timber species that is important in firewood, medicine, and construction is being dominant and valued (higher IVI). The roles attached to all these trees with leading IVI are highly pronounced in relation to those with low IVI especially when it comes to performing cultural rituals. This is congruent with what Chirwa, *et al.,* (2008) in their study about ecology and management of the Miombo woodlands found out found out that trees that have cultural significance are more pronounced, valued, and dominant when compared with those without. This thus implies that to preserve biodiversity, forest management must be diversified, and the traditional way in which trees are selected for removal that prevails today must be abandoned. The management objectives must include maintaining the resistance (ability to stay unchanged despite the presence of disturbances) and resilience (ability to absorb change and disturbance and persist). Specific guidelines for assessing resistance and resilience have been proposed by Haddad, *et al.,* (2022). The former is based on the influence of structure and composition of the ecosystem on

disturbances. The latter, on the other hand, is measured through the influence of disturbances on the structure and composition of an ecosystem. Hence, structural and species diversity should be maintained or increased.

Shannon diversity Index (H) was calculated for the six cites and established that Ntimbo 2 had the highest species diversity followed by Lichegue, Mussoma, Cuchiranga, Ntimbo 1 and the site with the lowest diversity was Lisongole. This indicated that the communities have more than one species. This thus informs the study that there have been efforts to conserve different tree species in the area given the fact that they offer differing importance. Secondly, these statistics imply that the reserve management and other forest authorities need to continuously sustain the prevailing measures to ensure that the abundance is retained. Thirdly, the existing diversity of species offers a lot of access to different NTFPs. This is supported by Bruschi, *et al*., (2014) who acknowledged the role of the abundance of tree species in generating NTFPs. Hence, the area understudy remains rich as far as the collection of NTFPs is concerned. It also depicts efforts made by the reserve management and the community to conserve the existing forests and trees.

5.4 Summary

A total of 56 different tree species and 25 families were identified. The family of Fabaceae had the highest number of species. *Burkea africana* was the most dominant (13.49 %.). *Diplorhynchus condylocarpon* (29.03) had the most Importance Value Index. The tree species composition and structure in this study will serve as a management tool for managers of the Mecula-Lugenda Corridor, NSR in terms of determining appropriate silvicultural treatments. It will also help the operators of the Mecula-Lugenda corridor, NSR to identify possible uses to which the trees can be put now or in the future. Reliable information on the status and trends of forest resources helps to give decision-makers the prospect necessary for the orientation of forest policies and programs. Thus, tree assessment and structure in the Mecula-Lugenda corridor, NSR serves as a valuable tool that will enable conservators and managers of the Corridor to quantify tree species composition as well as provide information on a structure that is essential for forest management and tree utilization.

CHAPTER SIX: KEY FACTORS THAT INFLUENCE THE DECISION OF THE HOUSEHOLD'S PARTICIPATION IN SELECTED NON-TIMBER FOREST PRODUCTS MARKET.

6.0: Introduction.

This chapter presents the established key factors that influence the decisions of the household's participation in selected non-timber forest products markets. Several key factors from physical, social, and economic were found. The first section handles the Univariate analysis of each, and every factor investigated, the second section brings forth the bivariate analysis and the last section handles the multivariate binary logistic regression analysis of all significant factors and how they influence household participation decision in collection, selling, and producing NTFPs.

6.1.0: Methodology.

6.1.1: Study Population

The study population consisted of households from selected villages in the Mecula-Lugenda corridor using NSR Forests, local leaders, traditional healers, and officials managing NSR. The sampling frame in this study is the household. A multistage sampling procedure was used to sample households in selected villages. Random sampling was preferred because it allowed statistical inferences. The localities were chosen to ensure a representation of NTFP collectors from the forest and producers on the farm. Secondly, villages were purposively selected in the Mecula-Lugenda corridor between the Lugenda river bridge and the Mecula district headquarters. Finally, the lists of households in each village were provided by the head of each village. Simple random sampling was used to select households from the twelve selected villages. The names of the household heads in each locality were numbered and the table of random numbers was used to select those that appeared in the sample.

Table 6.1: Target population.

Target population	Sampling techniques
Household Heads	Simple random sampling
Village Leaders	Purposive
Market Vendors	Purposive
Wildlife Conservation Society staff.	Purposive
Traditional Healers	purposive

6.1.2: Determination of the Sample Size

The sample size was determined by using Yamane's formula (1967)

$$n = \frac{N}{(1+Ne^2)} \text{..... (6)}$$

Where

n= sample size,

N = population size, and

e = Margin of error (MoE), e = 0.05.

In this study, the population size (N) is 3537.

e= 0.05 or 5%

Previous studies have shown a good response rate of over 98% (Melo and Alegre, 2008; Wood, E.., *et al.*, 2015), therefore, only a non-response rate of 5% was considered to cater for non-response, which brought the sample size to 377 respondents. Therefore, the sample size was 377 households.

6.1.3.0: Data collection methods.

The researcher utilized the following data collection methods: Household Survey Method, Market Survey, village interviews, Observation, and document reviews.

6.1.3.1: Community meetings/ focus group discussions.

Community meetings, with an average of between 7-12 attendants in each village, were held through regular and repetitive village visits. In the meetings, the researcher presented his research purpose, assessed local interest, asked for villagers' participation, then later validated his findings. Meetings were held in a suitable area/ spot close to the forest from where the whole forest and village is visible; the researcher with his team of research assistants explained the purpose and process of participatory mapping to the community members. This was followed by gathering the materials (e.g., sticks, stones, wood ash, flowers, leaves, and other materials that are available locally) to develop the participatory resource map.

Community meetings/ Focus Group Discussions were used for interactive explanation of the NTFPs Marketing concepts and need for conservation. During the community meetings, we tried to keep a gender balance, so that women, who played a major role in NTFP harvesting and trade, could express their concerns and wishes. To do so, we used the ''talking stick'' method (Sari, *et al.,* 2019). The speakers passed a small bamboo stick to each other to use like a microphone. We used men and women assisting in the meetings, especially with the people who were usually quiet. Attendance for these meetings varied among villages and according to the season and villagers' free time.

During the meetings, the researcher facilitated the preparation of a sketch map showing the forest resources, topographic features (river, terrain structures), community household locations, and physical infrastructure including road and foot trails. Support the sketching of the potential habitat of commercially important NTFP species and discuss with community members the prominent features of forest NTFP distribution, differences in topography, and other physical features and how that would help in the promotion of their markets and distributions.

6.1.3.2: Village-level interviews and household surveys.

Once the NTFPs collected and produced in the study were identified, household surveys were conducted to attach value to the different NTFPs, locate the main area where each household collects NTFPs, the amount collected per year, and the income they generate from the sale of NTFPs. A representation of households was surveyed in each village. Resource persons (e.g.,

hunters or specialists in the collection of one specific product) were also interviewed on harvesting/hunting techniques.

6.1.3.3: Direct observation.

Observation is a determined, orderly, and particular way of watching, listening, and recording an event as it occurred (Bharath, *et al.*, 2011). This method was used to learn about interactions in a group, ascertain the contribution of different individuals in the communities in the NTFPs value chain, study behavior and personality traits, and allow the collection of information where there is a lack of will or inability to respond by the respondents. The researcher intended to use a non-participant observation technique (Ryan *et al.*, 2016). This technique involved collecting data by observing the presence or absence of community participation in NTFP market in NSR to confirm or fill gaps found when using questionnaires and interview guides. The researcher used an observation schedule to document his assessment of community participation in the NTFP market in NSR. This technique involved the researcher ticking against a list of expected items on the checklists to indicate their presence or absence in the study area. Other observations included socio-cultural, economic, and psychical factors affecting community participation in the NTFPs market in NSR.

6.1.3.4: Key informants' interview.

Interview refers to the method of collecting data by asking people questions and following up or probing and prompting their answers (Kothari, 2004). An interview is a verbal communication, often face to face, though the telephone may sometimes be used, in which an interviewer tries to elicit information, beliefs, or opinions from another person Burns 1997 cited (Bharath, *et al.*, 2011). This allowed an in-depth understanding of factors impeding community participation in the NTFP market in NSR, strategies put in place to conserve the mostly harvested NTFP species, and reasons for findings expressed in the questionnaires. The interview guides were used to conduct face-to-face interviews with open-ended questions. The obtained responses were noted down to get data through probing and clarifying the questions which helped the researcher get relevant responses and meet study objectives (Mugenda, and Mugenda, 2003). Structured key informant interviews were also conducted with staff of WCS and village leaders in the study area because of the key information they hold surrounding the management of the reserve.

6.1.3.5: Market survey

During the market survey, information on market price, how prices change across seasons, market capacity, and quantities of different NTFPs that reach the market were collected. Types, prices, and amounts of NTFPs supplied and sold at the market for the last year were recorded. Total sales per year were also determined to obtain the total income. This was done at Markets (Mecula, Mussoma, Marrupa municipality, and Lichinga municipality) and households located in the study area where NTFPs from the Mecula-Lugenda corridor are traded. Sellers and buyers of NTFPs were interviewed to give the average amount of the products sold/purchased per day. The amount of these products was determined by converting the local measuring units to conventional units like kilograms. The market chain information was also collected linked to markets, and actors in the trade, this information was extracted from the questionnaire.

6.1.4: Data analysis.

Data collected from semi-structured questionnaires was summarized, edited, coded, and analyzed using the Statistical Package for Social Sciences (SPSS) computer program to generate quantitative statistics. Descriptive statistics for example frequencies, percentages, and means were computed. Inferential analyses were conducted to show the relationship between NTFPs collected and social-cultural, economic, and physical factors which include age, education level, household size, residence duration, distance from the forest, and occupation. Multiple regression models below were used to determine the relationship between dependencies of social-cultural, economic, and physical factors on NTFP collection and production within this specific area.

$$Y = A + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + \cdots + B_nX_n + \varepsilon i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8),$$

Where: Y= Dependent variable, (Quantity of NTFPs collected and produced)

X_s= independent variables (Social-cultural, economic, and physical factors),

A= Constant,

B_s= Regression Coefficients,

εi= Random Error.

Correlational analysis was carried out to establish a relationship between variables based on the Pearson Product Moment Correlation Coefficient given by;

$$\rho_{xy} = \frac{\{E(xy)-E(x)E(y)\}}{\sqrt{\{E(x^2)-(E(x))^2\}}\sqrt{\{E(y^2)-(E(Y))^2\}}} \quad \text{…….. ……...(9)}$$

Through the Pearson Product Moment Correlation, the researcher was able to establish a pattern which indicates the social-cultural, economic, and psychical factors affecting community participation in NTFPs Market in NSR. The hypotheses were tested at a 5% upper level of statistical significance from which the research hypothesis for the three research objectives were tested against the null hypothesis and the statistical significance of the relationships determined (Oso, and Onen, 2008).

Qualitative data analysis involved both thematic and content analysis and was based on how the findings related to the research questions. Content analysis was used to edit qualitative data and reorganize it into meaningful shorter sentences. Thematic analysis was used to organize data into themes and codes were identified (Sekaran, 2003). After data collection, information of the same category was assembled, and their similarity with the quantitative data was created after which a report was written. Qualitative data was interpreted by composing explanations or descriptions from the information. The qualitative data was illustrated and substantiated by quotations or descriptions.

6.2.0: Results.

This section presents the established key factors that influence the decisions of the household's participation in selected NTFP markets. Several key factors from physical, social, and economic were found. The first section handles the Univariate analysis of each, and every factor investigated, the second section brings forth the bivariate analysis and the last section handles the multivariate binary logistic regression analysis of all significant factors and how they influence household participation decision in collection, selling, and producing NTFPs.

6.2.1: Univariate Analysis of physical factors that influence the decisions of the household's participation in selected NTFPs markets.

This provides a univariate analysis of the factors that influence decision-making on the participation of households in the non-timber forest products market.

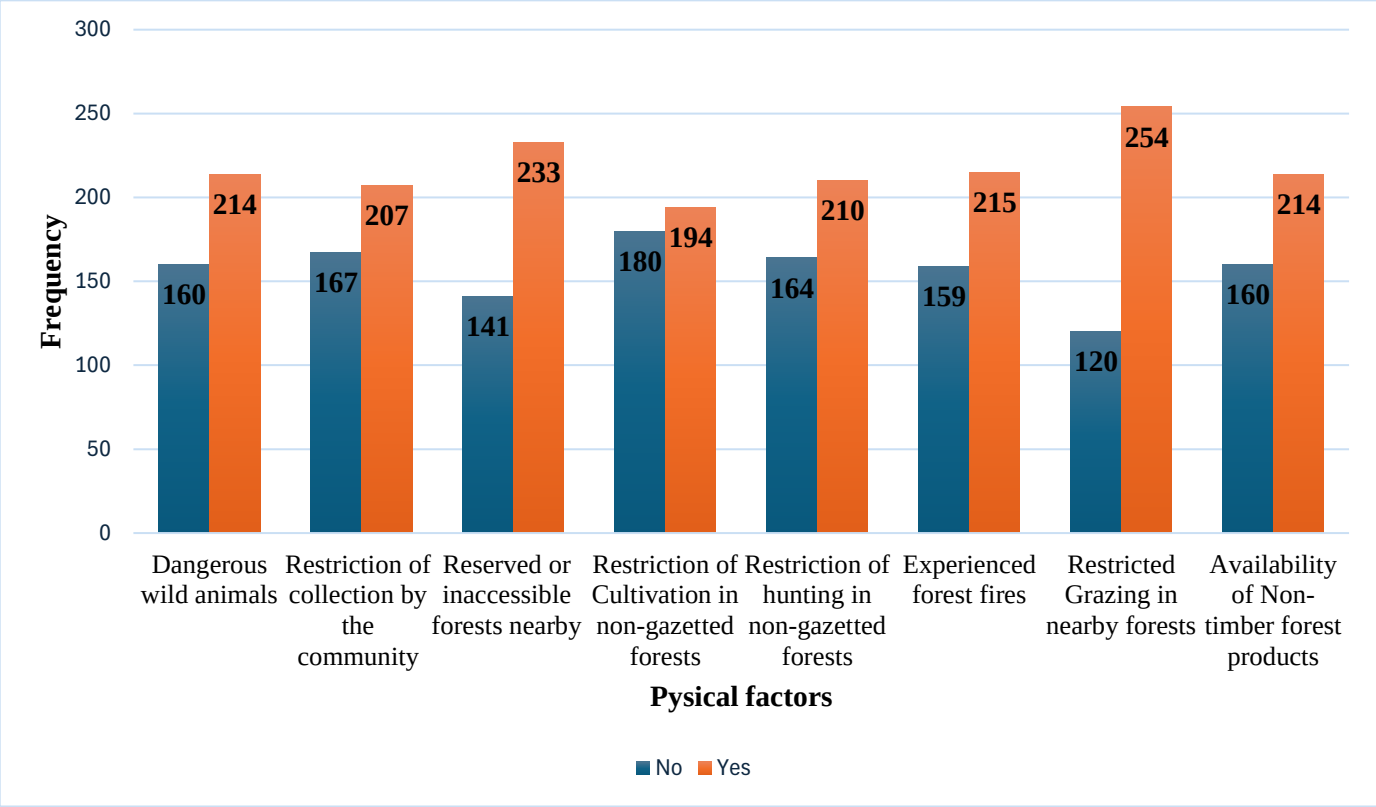

Figure 6.1. Physical factors that influence the decision of the household's participation in selected non-timber forest products market

Respondents were required to state whether they are scared by dangerous wild animals in collecting NTFPs sold. The highest proportion 57.2% of respondents agreed. 55.3% also agreed that there are restrictions on collection by the community. On whether the nearby forests are reserved or inaccessible, 62.3% agreed. Furthermore, on whether cultivation is restricted in non-gazetted forests, 51.9% said yes. 56.1% added that they are restricted from hunting in non-gazetted forests. In addition, 57.5% agreed that they have ever experienced forest fires. 67.9% agreed that they are frequently restricted from grazing in nearby forests whereas the availability of NTFPs was agreed on by 57.2%.

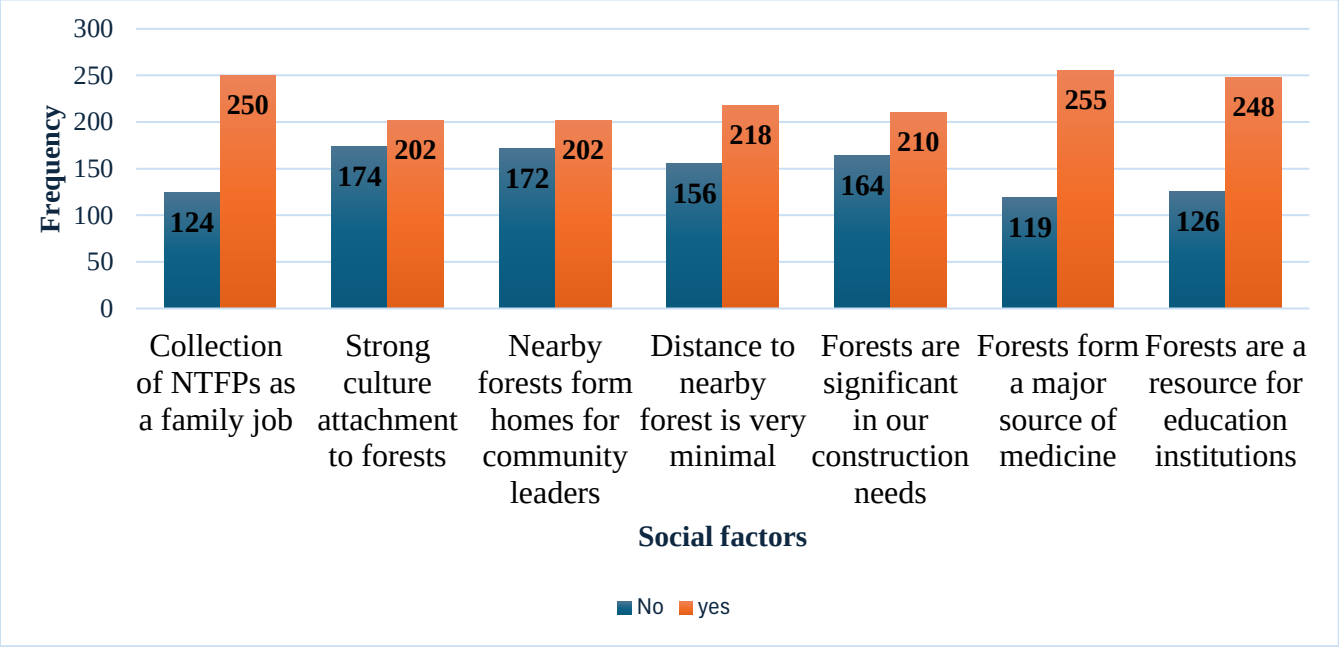

Figure 6.2: Social factors that influence the decision of the household's participation in selected NTFPs market.

Respondents were required to state whether collecting NTFPs is a family job. The highest proportion 66.8% of respondents agreed. 55.1% also agreed that there is a strong cultural attachment to forests. On whether the engagement in collection depends on the season, 54% agreed. Furthermore, on whether nearby forests form homes for community leaders, 54% said yes. In addition, 58.3% agreed that the distance to nearby forests is very minimal. 56.1% agreed that forests are significant in our construction needs, 68.2% admitted that forests form a major source of medicine and lastly, 66.3% reported that forests are a resource for education institutions.

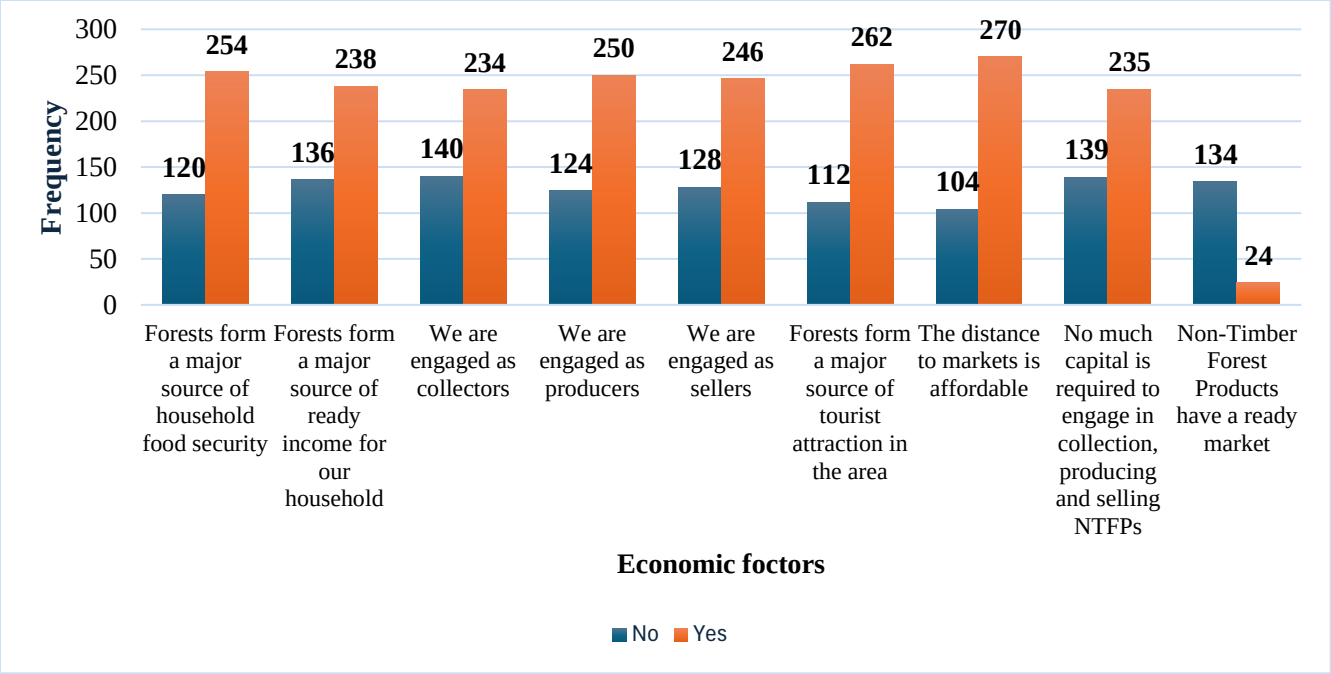

Figure 6.3: Economic factors that influence the decision of the household's participation in selected

Respondents were required to state whether forests form a major source of household food security. The highest proportion 67.9% of respondents agreed. 63.6% also agreed that forests form a major source of ready income for our household. On whether forests form a major source of tourist attraction in the area, 70.1% agreed. Furthermore, on whether the distance to markets is affordable, 72.2% said yes. 62.8% admitted that not much capital is required to engage in the collection, production, and selling of NTFPs. Lastly, 64.2% agreed that Non-Timber Forest Products have a ready market.

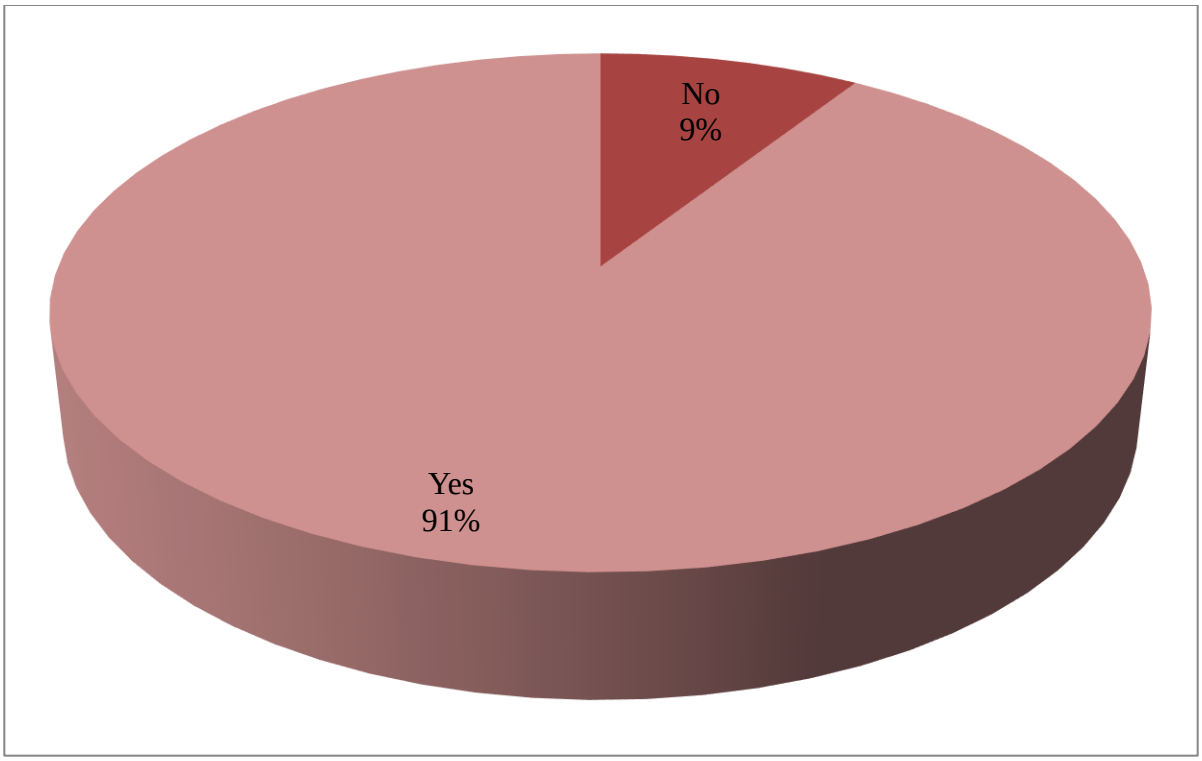

Figure 6.4: Percentage of households' participation in selected NTFPs market.

It is evident in **Figure 6.4** above that 91% of the households participate in selected non-timber forest products market in NSR. The remaining 9% were not directly participating in the selected NTFP market in NSR.

6.2.2: Bivariate analyses of key factors that influence the decision of the household's participation in selected NTFPs market.

Table 6.1: Physical factors that influence the decision of the household's participation in selected NTFPs market.

Variable	**Household Participation decision making in NTFPS**		**Chi-square (χ^2)**	**P-value**
	No	**Yes**		
Dangerous wild animals			0.392	0.032**

No	10	150		
Yes	17	197		
Restriction of collection by the community			2.65	0.084
No	8	159		
Yes	19	188		
Reserved or inaccessible forests nearby			1.718	0.068
No	7	134		
Yes	20	213		
Restriction of cultivation in non-gazetted forests			0.162	0.021**
No	14	166		
Yes	13	181		
Restriction of hunting in non-gazetted forests			0.549	0.038**
No	10	154		
Yes	17	193		
Experienced forest fires			1.977	0.013**
No	8	151		
Yes	19	196		
Restricted grazing in nearby forests			1.299	0.59
No	6	114		
Yes	21	233		
Availability of non-timber forest products			0.049	0.12**
No	11	149		
Yes	16	198		

Note: *The stars are only intended to flag levels of significance for 3 of the most used levels. *P < 0.05, **P < 0.01, and ***P < 0.001.*

Table 6.1 above shows that five of the physical factors were significantly influencing the decision of the household's participation in the selected NTFP market. Dangerous wild animals was significantly associated with the decision of the household's participation in selected NTFPs market (x^2 =0.392; p=0.032**), restriction of cultivation in non-gazetted forests was significantly associated with the decision of the household's participation in selected NTFPs market (x^2 =0.162; p=0.021**), restriction of hunting in non-gazetted forests was significantly associated with the decision of the household's participation in selected NTFPs market (x^2 =0.549; p= 0.038**), experienced forest fires was significantly associated with the decision of the household's participation in selected NTFPs market (x^2 =1.977; p=0.013**), availability of NTFPs was significantly associated with community participation in the value chain as sellers of NTFPs (x^2 =0.049; p=0.12**). However, restricted grazing in nearby forests, reserved or inaccessible forests nearby, and restriction of collection by the community were not significantly associated with the decision of the household's participation in selected NTFPs market.

Table 6.2: Social factors that influence the decision of the household's participation in selected NTFPs market.

Variable	**Household participation decision making in NTFPS**		**Chi-square (χ^2)**	**P-value**
	No	**Yes**		
Collection of NTFPs as a family job			1.569	0.015**
No	6	118		
Yes	21	229		
Strong cultural attachment to forests			1.579	0.008**
No	9	159		
Yes	18	188		
engagement in collection depends on the season			0.939	0.050**
No	10	162		
Yes	17	185		

Nearby forests form homes for community leaders			0.323	0.029**
No	11	161		
Yes	16	186		
Distance to the nearby forest is very minimal			0.262	0.026**
No	10	146		
Yes	17	201		
Forests are significant in our construction needs			0.114	0.17**
No	11	153		
Yes	16	194		
Forests form a major source of medicine			1.235	0.50**
No	6	113		
Yes	21	234		
Forests are a resource for education institutions			0.785	0.046**
No	7	119		
Yes	20	228		

***Note**: The stars are only intended to flag levels of significance for 3 of the most commonly used levels. *P < 0.05, **P < 0.01, and ***P < 0.001.*

Table 6.2 above shows that: all social factors were significantly influencing decision of the household's participation in selected NTFPs market. Taking collection of NTFPs as a family job was significantly associated with decision of the household's participation in selected NTFPs market (x^2 =1.569; p=0.015**), strong culture attachment on forests was significantly associated with decision of the household's participation in selected NTFPs market (x^2 =1.579; p=0.008**), seasonal engagement in collection was significantly associated with decision of the household's participation in selected NTFPs market (x^2 =0.939; p= 0.050**), nearby forests being a homes for community leaders was significantly associated with decision of the household's participation in

selected NTFPs market (x^2 =0.323; p=0.029**), distance to nearby forest was significantly associated with community participation in value chain as sellers of NTFPs (x^2 =0.262; p=0.026**). Further, the construction needs of forests was significantly associated with decision of the household's participation in selected NTFPs market (x^2 =0.114; p=0.17**), forests being a major source of medicine was significantly associated with decision of the household's participation in selected NTFPs market (x^2 =1.235; p=0.50**), forests being a resource for education institutions was significantly associated with community participation in value chain as sellers of NTFPs (x^2 =0.785; p=0.046**).

Table 6.3: Economic factors that influence the decision of the household's participation in selected NTFPs market.

Variable	**Household Participation decision making in NTFPs**		**Chi-square (χ^2)**	**P-value**
	No	**Yes**		
Forests form a major source of household food security			1.299	0.019**
No	6	114		
Yes	21	233		
Forests form a major source of ready income for our household			2.515	0.032**
No	6	130		
Yes	21	217		
We are engaged as collectors			2.875	0.088
No	6	134		
Yes	21	213		
We are engaged as producers			1.569	0.065
No	6	118		
Yes	21	229		
We are engaged as sellers			1.862	0.071
No	6	122		

Yes	21	225		
Forests form a major source of tourist attraction in the area			1.182	0.040**
No	5	107		
Yes	22	240		
The distance to markets is affordable			0.452	0.035**
No	6	98		
Yes	21	249		
Not **much capital is required to engage in the collection, production, and selling of Non-Timber Forest Products**			1.574	0.065
No	7	132		
Yes	20	215		
Non-Timber Forest Products have a ready market			2.343	0.079
No	6	128		
Yes	21	219		

Note: *The stars are only intended to flag levels of significance for 3 of the most used levels. *P < 0.05, **P < 0.01, and ***P < 0.001.*

Table 6.3 above shows that; many of the economic factors significantly influence the decision of the household's participation in selected NTFPs market. Forests being a major source of household food security was significantly associated with decision of the household's participation in selected NTFPs market (x^2 =1.299; p=0.019**), forests being a major source of ready income for households was significantly associated with decision of the household's participation in selected NTFPs market (x^2 =2.515; p=0.032**), forests being a major source of tourist attraction in the area was significantly associated with decision of the household's participation in selected NTFPs market (x^2 =1.182; p=0.040**), the affordability of distance to markets was significantly associated with decision of the household's participation in selected NTFPs market (x^2 =0.452; p=0.035**).

6.2.3: Multivariate analysis of key factors that influence the decision of the household's participation in selected NTFPs market.

A multivariate analysis was done to assess the key factors that influence the decision of the household's participation in the selected NTFPs market.

Table 6.4: Multivariate Analysis of key factors that influence the decision of the household's participation in selected NTFPs market.

Key factors that influence the decision of the household's participation in selected* NTFPs *market	***B***	***S.E.***	***Wald***	***df***	***Sig.***	***Exp(B)***	***95% C.I.for EXP(B)***	
							Lower	***Upper***
Sex (2)	.024	.515	.002	1	0.012	1.025	0.377	2.811
Age (6)	-.133	.149	.800	1	0.371	0.876	0.654	1.172
Education level (2)	-.168	.343	.240	1	0.024	0.845	0.432	1.655
Family size (2)	.481	.598	.647	1	0.021	1.618	0.501	5.228
Time spent in the area (4)	.099	.214	.212	1	0.045	1.104	0.725	1.680
Dangerous wild animals (1)	-.263	.868	.092	1	0.762	0.769	0.140	4.211
Restriction of Cultivation in non-gazetted forests (1)	-.870	.680	1.640	1	0.000	0.419	0.111	1.587
Restriction of hunting in non-gazetted forests (1)	.280	1.001	.078	1	0.008	1.32	0.186	9.420
Experienced forest fires (1)	.468	1.3377	3.129	1	0.007	11.8	0.766	18.566
Availability of NTFPs (1)	-.238	.899	1.8377	1	0.009	0.290	0.050	1.690
Collection of NTFPs as a family job (1)	-.827	1.019	.658	1	0.017	0.437	0.059	3.224
Strong cultural attachment to forests (1)	.068	.794	1.805	1	0.019	2.91	0.613	13.800
Engagement in collection depends on the season (1)	.189	.839	.051	1	0.022	1.21	0.233	6.252
Nearby forests form homes for community leaders (1)	-.156	.715	.048	1	0.027	0.855	0.211	3.473
Distance to nearby forest is very minimal (1)	.487	1.287	1.335	1	0.048	0.226	0.018	2.815
Forests are significant in our construction needs (1)	-.288	1.020	.080	1	0.007	0.749	0.101	5.535

Forests form a major source of medicine (1)	.566	1.197	.224	1	0.036	1.76	0.169	18.387
Forests are a resource for educational institutions (1)	-.981	1.077	.830	1	0.062	0.375	0.045	3.096
Forests form a major source of household food security (1)	.409	8.37	.000	1	0.008	5.32	4.21	11.53
Forests form a major source of ready income for our household (1)	.282	1.913	.000	1	0.007	7.00	3.06	13.143
Forests form a major source of tourist attraction in the area (1)	.832	.928	.804	1	0.000	2.3	0.373	14.181
The distance to markets is affordable (1)	.847	6.767	.000	1	0.008	4.00	1.45	3.096

Key factors: *Gender (1: male; 2: female); Age (1: below 18 years; 2: 18–27 years; 3: 28–37 years; 4:38–47 years; 5: 48–57 years; 6: 58–67 years; 7: 68 C years); Family size (1: below 5 people; 2: 5–10 people; 3: more than 10 people); Time spent in the area (1: 0–10 years; 2: 10–20 years; 3: 20–30 years; 4: 30–40 years; 5: 40 C years); Education level (1: none; 2: primary; 3: secondary); and Others (0: no; 1: yes).*

Three demographic factors, that is, sex, age, education, family size, and time spent in the area were significantly associated with the decision of the household's participation in selected NTFPs market. The decision of the household's participation in selected non-timber forest products market was 1.03 times depending on sexes in the households at (95% CI (0.377-2.811) (p-0.012). This means that the more females in the households, the more decisions of the household's participation in selected NTFPs market. Secondly, age was found to have a non-significant influence on the decision of the household's participation in selected NTFPs market. This was indicated with a 0.9-time likelihood (95% CI (0.654-1.172) (p-0.371). This means that the higher the age of household members, the higher the likelihood of undertaking a decision of the household to participate in selected NTFPs market. The education level of household members was 0.8 times more likely to determine the decision of the household's participation in the selected NTFPs market at (95% CI (0.432-1.655) (p-0.024). This means that the less educated the higher the likelihood of undertaking the decision of the households to participate in the selected NTFP market.

Family size was also 1.6 times likely to influence the decision of the households to participate in the selected NTFPs market (95% CI (0.501-5.228) (p-0.021). This means that the larger the family size, the higher the likelihood of influencing significantly towards decision of the households to participate in the selected NTFP market. Time spent in the area was also found to have a 1.1 times likelihood to influence the decision of the households to participate in the selected NTFP market (95% CI (0.725-1.680) (p-0.045). This means that the longer the households have lived in the area, the higher the likelihood of influencing significantly towards the decision of the households to participate in the selected NTFP market.

Dangerous wild animals are 0.8 times more likely to influence the decision of the households to participate in the selected NTFP market (95% CI (0.140-4.211) (p-0.762). This means that the scary dangerous wild animals, a high likelihood to significantly influencing the decision of the households to participate in the selected NTFPs market. Restriction of cultivation in non-gazetted forests was further found to have a 0.42 times likelihood to influence the decision of the households to participate in the selected NTFPs market (95% CI (0.111-1.587) (p-0.00). This means that the more restrictions made on cultivation in non-gazetted forests, the higher the likelihood of significantly influencing the decision of the households to participate in the selected NTFP market. Restriction of hunting in non-gazetted forests was further found to have been 1.32 times more likely to influence the decision of the households to participate in the selected NTFP market (95% CI (0.186-9.420) (p-0.008). This means that the more restrictions made on hunting in non-gazetted forests, the less likelihood to participate in the selected NTFP market.

Those who had experienced forest fires was further found to have 11.8 times more likely to influence the decision of the households to participate in the selected NTFP market (95% CI (.766-18.566) (p-0.007). This means that the more forest fires, the less likelihood to participate in the selected NTFPs market. Availability of NTFPs was also found to be 0.3 times likely to influence the decision of the households to participate in the selected NTFPs market (95% CI (0.050-1.690) (p-0.009). This means that the availability of NTFPs, the higher the likelihood to participate in the selected NTFPs market. In addition, the collection of NTFPs as a family job was contributing 0.44 times likely to influence the decision of the households to participate in the selected NTFPs market (95% CI (0.059-3.224) (p-0.017).

Strong culture attachment to forests was further found to be 2.9 times more likely to influence the decision of the households to participate in the selected NTFP market (95% CI (0.613-13.800) (p-0.019). This means that the stronger the cultural attachment to forests, the less likelihood to participate in the selected NTFP market. Seasonal engagement in the collection was also found to be 1.2 times more likely to influence the decision of the households to participate in the selected NTFPs market (95% CI (0.233-6.252) (p-0.022). This means that the change in seasonal engagement in the collection, the higher the likelihood to participate in the selected NTFP market. In addition, nearby forests being homes for community leaders was also found to contribute 0.9 times likely to influence the decision of the households to participate in the selected NTFPs market (95% CI (0.211-3.473) (p-0.027). This means that the nearer the homes of community leaders to the forest, the less likelihood to participate in the selected NTFPs market.

Distance to nearby forests was found to have a 0.2 times likelihood to influence the decision of the households to participate in the selected NTFPs market (95% CI (0.018-2.815) (p-0.048). This means that the change in the distance to nearby forests, the higher the likelihood of participating in selected NTFPs market. Forests being significant in construction needs was found to have a 0.7 times likelihood to influence the decision of the households to participate in selected NTFPs market (95% CI (0.101-5.535) (p-0.007). This means that the perception of forests as offering construction needs, the higher the likelihood to participate in selected NTFPs market. Forests being a major source of medicine was found to be 1.8 times likely to influence the decision of the households to participate in selected NTFPs market (95% CI (0.169-18.387) (p-0.036). This means that the perception of forests as offering medicine, the higher the likelihood to participate in selected NTFPs market.

Forests being a resource for education institutions was found to be 0.4 times more likely to influence the decision of the households to participate in the selected NTFP market (95% CI (0.045-3.096) (p-0.062). This means that the higher forests are seen as educational institutions, the higher the likelihood to participate in selected NTFPs market. A forest being a major source of household food security was found to be 5.3 times more likely to influence the decision of the households to participate in the selected NTFPs market (95% CI (4.21-11.53) (p-0.008). This means that the higher the household takes forests as a major source of household food security, the higher the likelihood of participating in the selected NTFP market.

A forest being a major source of ready income for households was found to be 7 times likely to influence the decision of the households to participate in the selected NTFP market (95% CI (3.06-13.143) (p-0.007). This means that the perception of forests as a major source of ready income for households, the likelihood of participating in selected NTFPs market. Forests being a major source of tourist attraction in the area was further found to be 2.3 times likely to influence the decision of the households to participate in selected NTFPs market (95% CI (0.373-14.181) (p-0.000). This means that the perception of forests as a major source of tourist attraction, the higher the likelihood to participate in selected NTFP markets. Lastly, affordability of a distance to markets was found to have a significant influence on the decision of the households to participate in selected NTFPs market by 4 times at (95% CI (1.453-3.096) (p-0.008).

6.3: Discussion of results.

The study revealed that dependence on NTFPs was more explained by the sex of household members. It was discovered that the more females in the households, the more dependence on NTFPs. Hutauruk *et al.*, (2018) had earlier conducted a study in Kenya, Malinau District regarding the effect of socio-demographic factors on the dependence on NTFPs. It was established that females depend on NTFPs more than males. The education level of household members was highly likely to determine the dependence on NTFPs. This means that the less educated, the higher the likelihood of depending on NTFPs. Hutauruk *et al.*, (2018) also had earlier conducted a study in Kenya, Malinau District regarding the effect of socio-demographic factors on the dependence on NTFPs. It was established that the education level of a household to depend on NTFPs is far higher than the dependence emerging from gender.

Family size was also found to characterize dependence on NTFPs. It was discovered that the larger the family size, the higher the likelihood of depending on NTFPs. This concurred with a study done on Carvalho Ribeiro *et al.*, (2018) had earlier conducted a study in Amazon, Brazil regarding socio-demographic factors and dependence on NTFPs. It was established that dependence on NTFPs increases with the increase in family size. Time spent in the area was also found to characterize dependence on NTFPs. It was discovered that the longer the households have lived in the area, the higher the likelihood of depending on NTFPs. This concurs with Endamana, *et al.*,

(2016) who had earlier found a significant relationship between Times spent in the area and dependence on NTFPs.

The availability of NTFPs was also found to have increased dependence on non-timber forest resources. This means that the availability of NTFPs increases the dependence on NTFPs. These findings tally with the earlier studies done by Muhammad Zakaria and Yousuf Hassan I, (2002) who had earlier found out that the availability of NTFPs significantly affects dependence on non-timber forest resources. In addition, the collection of NTFPs as a family job was contributing to increased dependence on NTFPs. This was further confirmed by Penjani, *et al*., (2009) in Chiradzulu District, Malawi about income and dependence on NTFPs. Strong cultural value attachment to forests was further found to have increased dependence on NTFPs. This means that the stronger the cultural attachment to forests, the higher the likelihood to depend on NTFPs. The study findings were found in line with Sundriyal, (2020a) who had undertaken a study in Himalayan communities and found a strong cultural attachment between households and dependence on NTFPs.

Seasonal engagement in the collection was also found to increase dependence on NTFPs. This means that the change in seasonal engagement in the collection, the higher the likelihood of depending on NTFPs. The findings are congruent with the study done by Mutenje, *et al*., (2011) in Southern Zimbabwe who had earlier confirmed that seasonal engagement in collection increases dependence on NTFPs. Distance to the nearby forest was found to have increased dependence on NTFPs. This means that the smaller the distance to the nearby forest, the higher the likelihood to depend on the nearby forest. Daniel, *et al.,* (2016b) in line with the above study found a strong relationship between distance to nearby forest and dependence on NTFPs.

A forest that has abundant construction material contributes to increasing dependency on NTFPs. This means that forests being a source of construction needs increases dependence on NTFPs. This finding concurred with what Hutauruk *et al.*, (2018) had earlier established that the dependence of households on NTFPs is primarily because many of the households obtain construction materials for their use or for selling to other builders in the Malinau district. A forest being a major source of medicine was found to increase dependence on NTFPs. This means that forests being a major source of medicine increases dependence on NTFPs. This finding was congruent with what Mahonya, *et al.,* (2019) established that forests are a source of medicine, and this explains the

increasing number of households depending on them. Forests being a resource for educational institutions was also found to increase the likelihood of depending on NTFPs. This means that dependence on NTFPs increases with an increase in the need for education. This is confirmed by Mujawamariya and Karimov, (2014a) who also found out that since many studies are ongoing about forests, this has increased the number of people depending on them.

A forest being a major source of household food security was found to increase the likelihood to depend on NTFPs. This means that the higher the household takes forests as being a major source of household food security, the higher the dependence on NTFPs. Matias *et al.*, (2018) concurred with the above findings indicating that a good number of families are relying on NTFPs as a source of food. This has increased the dependence on forests. A forest being a major source of ready income for a household was found to have increased dependence on NTFPs. This means that the perception of forests as a major source of ready income for a household, the likelihood of participating in NTFPs. Mau, *et al*., (2018) concurred with the above findings indicating that a significant number of families are relying on NTFPs as a source of income. This has increased the dependence on forests.

A forest being a major source of tourist attraction in the area was further found to increase dependence on NTFPs. Nabaloum *et al.*, (2019) in support of the above findings confirmed that many households want to live close to forests because they benefit from selling merchandise to tourists or students who always come to witness these forests. Lastly, the affordability of a distance to markets was found to have a significant influence on increased dependence on NTFPs. Kar, 2010; Chou, (2018) further confirmed that people find forest resources important since NTFPs have a ready and accessible market.

The central idea obtained from the above factors which characterize dependence on NTFPs is to design appropriate programs that can steer the capacity of communities living near forested areas to look far within themselves and outside the forests for survival. This will enable sustainable forest conservation or overreliance on forests for almost everything. This can be achieved in two major ways. First, designing appropriate capacity development programs where rural dwellers are trained and sensitized about forests, imparted with other important skills that can be employable elsewhere, away from forested zones. In this case, entrepreneurial skills, free academic education programs introduced in the area, and other vocational skills. This can subsequently change the

destiny of these populations and stop looking at forests as the last resort. Secondly, budget allocation to the process of economic empowerment of communities living near forested areas need to be prioritized if the forests are to remain productive and sustainable. This budget can be spent on training and provision of small credit to communities living near forested areas to begin engaging in other businesses in line of agriculture, processing, extensive services, storage, transportation, distribution, retail sale/trading, and innovation.

6.4 Summary

The study revealed that dependence on NTFPs was more explained by the gender of household members. It was discovered that the more females in the households, the more dependence on NTFPs. Family size was also found to characterize dependence on NTFPs. It was discovered that the larger the family size, the higher the likelihood of depending on NTFPs. Availability of NTFPs was also found to have increased dependence on NTFPs. This means that the availability of NTFPs increases the dependence on NTFPs. Seasonal engagement in the collection was also found to increase dependence on NTFPs. This means that the change in seasonal engagement in the collection, the higher the likelihood of depending on NTFPs. Forests being significant in construction needs was found to highly characterize dependence on NTFPs. This means that forests being a source of construction materials increase dependence on NTFPs. Forests being a major source of medicine were found to increase dependence on NTFPs. This means that forests being a major source of medicine increases dependence on NTFPs. A forest being a major source of household food security was found to increase the likelihood to depend on NTFPs. This means that the higher the household takes forests as being a major source of household food security, the higher the dependence on NTFPs. Forests being a major source of ready income for a household was found to have increased dependence on NTFPs. This means that the perception of forests as a major source of ready income for a household, the likelihood of participating in NTFPs. Forests being a major source of tourist attraction in the area was further found to increase dependence on NTFPs. This means that forests being the major source of tourist attraction increase the level of dependence on NTFPs. Lastly, the affordability of a distance to markets was found to have a significant influence on increased dependence on NTFPs.

CHAPTER SEVEN: ECONOMIC VALUE OF SELECTED NON-TIMBER FOREST PRODUCTS TOWARDS HOUSEHOLD FOOD SECURITY AND INCOME.

7.0 Introduction.

To understand the economic value of selected NTFPs towards food security and income, it was important to understand the economic activities in which households are engaged and find their relationship with NTFPs, the category of valuable NTFPs, the quantity of key NTFPs collected, the amount obtained in selected NTFPs and their economic value about food security and income. The results have been obtained through a market survey and key informant interviews conducted in the Mecula-Lugenda Corridor, NSR.

7.1.0: Methodology.

7.1.1: Study population and sample size.

The study population consisted of households from selected villages in the Mecula-Lugenda corridor using NSR Forests, local leaders, traditional healers, and officials managing NSR. The sampling frame in this study was the household. A multistage sampling procedure was used to sample households in selected villages. Random sampling was preferred because it allowed statistical inferences. The localities were chosen to ensure a representation of NTFP collectors from the forest and producers on the farm. Secondly, villages were purposively selected in the Mecula-Lugenda corridor between the Lugenda River Bridge and the Mecula district headquarters. Finally, the lists of households in each village were provided by the head of each village. Simple random sampling was used to select households from the twelve selected villages. The names of the household heads in each locality were numbered and the table of random numbers was used to select those that appeared in the sample.

Table 7.1: Target population.

Target population	Sampling techniques
Household Heads	Simple random sampling
Village Leaders	Purposive
Market Vendors	Purposive
Wildlife Conservation Society staff.	Purposive
Traditional Healers	purposive

The sample size was determined by using the Yamane's formula (1967)

$$n = \frac{N}{(1+Ne^2)} \text{.....(6)}$$

Where

n= sample size,

N = population size, and

e = Margin of error (MoE), e = 0.05.

In this study, the population size (N) is 3537.

e= 0.05 or 5%

Previous studies have shown a good response rate of over 98% (Mundoli *et al.*, 2021), therefore, only a non-response rate of 5% was considered to cater for non-response, which brought the sample size to 377 respondents. Therefore, the sample size was 377 households.

7.1.2: Data collection

The researcher utilized the following data collection methods: Household Survey Method and Market Survey. Once the NTFPs collected and produced in the study were identified, household surveys were conducted to attach value to the different NTFPs, locate the main area where each household collects NTFPs, the amount collected per year, and what income they generate from the sale of NTFPs. A representation of households was surveyed in each village. Resource persons

(e.g., hunters or specialists in the collection of one specific product) were also interviewed on harvesting/hunting techniques.

During the market survey, information on market price, how prices change across seasons, market capacity, and quantities of different NTFPs that reach the market were collected. Types, prices, and amounts of NTFPs supplied and sold at the market were recorded. Total sales per year were also determined to obtain the total income. This was done in the Markets of Mecula, Mussoma, Marrupa municipality, and Lichinga municipality and households located in the study area where NTFPs from the Mecula-Lugenda corridor are traded. Sellers and buyers of NTFPs were interviewed to give the average amount of the products sold/purchased per day. The amount of these products was determined by converting the local measuring units to conventional units like kilograms. The market chain information was also collected linked to markets, and actors in the trade, this information was extracted from the questionnaire.

7.1.3: Economic Valuation of NTFPs/Data analysis

Data on quantities (Q) of each NTFP collected through market survey was converted to conventional units (e.g., kilogram). The economic value of each NTFP was obtained based on the Shackleton and Shackleton model (Dovie *et al.*, 2002), where:

Annual value extracted per household = Annual Quantities Extracted (either for domestic use or trade) × Mean Farm gate Price.

$V = QP$……..……..... (**7)**

Where;

V= Gross Value,

Q= Quantity of NTFPs,

P= Price of the product.

7.2.0: Results

7.2.1: Economic activities contributing to food security and household income of villagers in Mecula-Lugenda Corridor, NSR.

In the context of this study, agriculture as the main economic activity contributes about 70% of household income annually; NTFPs contribute about 12% of household income per year. Business and trading of other items contribute about 10% and livestock keeping contributes about 8% to household income per annum **(Figure. 7.1).** The above implies that NTFPs collection and trading is done to supplement agriculture income as NTFPs are common pool resources which can be accessed by everyone in the village.

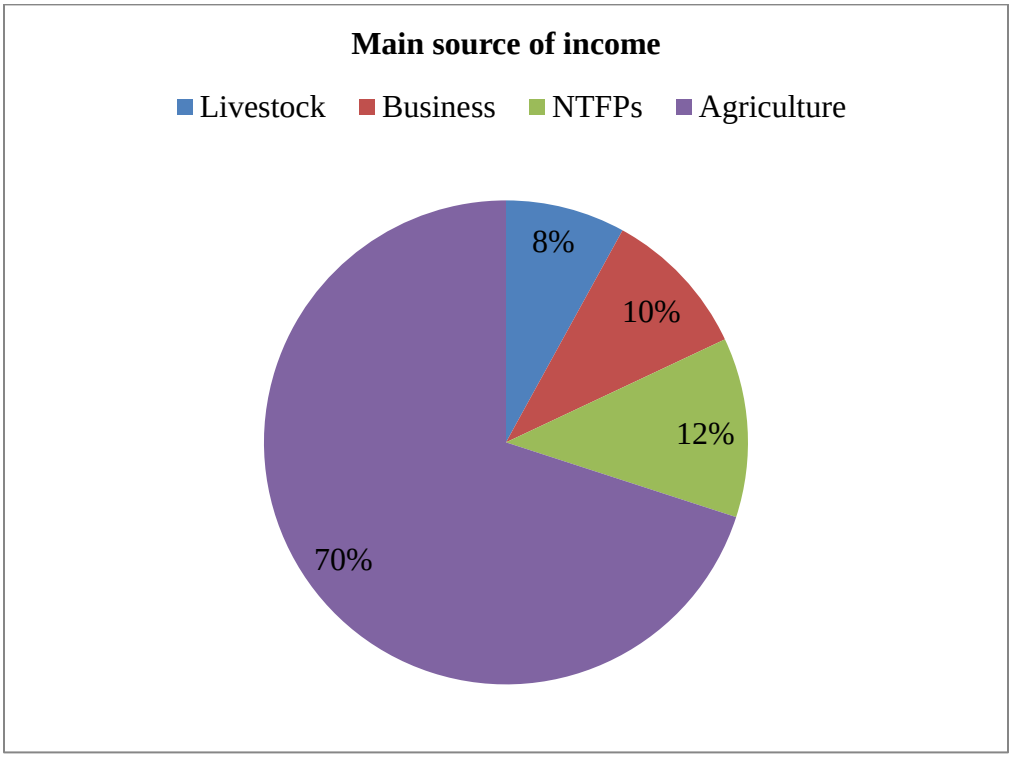

Figure 7.1: Percentage share of main income sources of respondents in villages around the Mecula-Lugenda Corridor.

The collection of NTFPs from forests was ranked as the first choice contributing to income and food security. This exemplifies the extent to which the community is engaged in collecting NTFPs by 88.9%. Agriculture was ranked as high by 76.9% as a second-choice activity engaged in by communities. Then in the third choice, agricultural products selling (other than NTFPs) was ranked

high by 81.7% **(Table 7.2 below).** This means that communities are mostly engaged in collecting NTFPs, agriculture, and trade.

Table 7.2: Activities engaged in by communities in the Mecula-Lugenda Corridor.

List of activities	**Percentage (%)**
Ranked as first choice	
Collection of NTFPs from forests	88.9
Agriculture (crops)	9.3
Non-timber forest products production (i.e. fruits, fishing, afforestation, honey harvesting, etc.)	1.9
Ranked as second choice	
Agriculture (crops)	76.9
Agricultural products selling (other than NTFPs)	14.6
Collection of NTFPs from forests	8.5
Ranked as third choice	
Agricultural products selling (other than NTFPs)	81.7
Agriculture (crops)	13.5
Collection of NTFPs from forests	.8
Livestock products selling	4.0

Figure 7.2 below gives details on the reasons for rankings. The primary reason for ranking the collection of NTFPs is because it is the source of construction material, food, medicine, and income. For the second choice, the primary reason is that agriculture is a major source of food in the reserve. Lastly, the third choice of trading is because it is the source of income. Therefore, sources of construction materials, food, medicine, and income are the underlying reasons for engaging in all forms of activities. In summary, most of the respondents reported engaging in all forms of activities mentioned above as a way of obtaining food (53%**)**, income (25%**)**, construction materials (13%**),** and source of medicine (9%**)**. This thus means that since the collection of NTFPs can provide all of the above, this qualifies it to be ranked as the first choice.

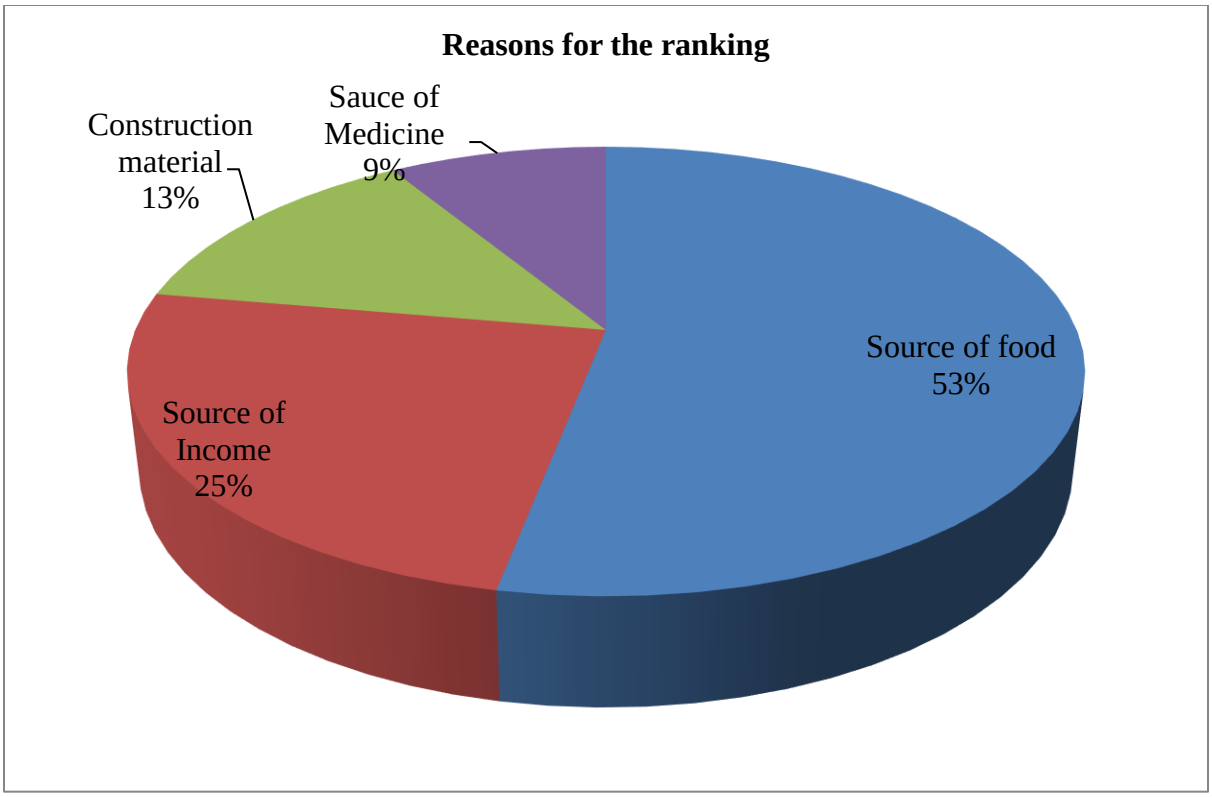

Figure 7.2: Different reasons for ranking activities as they are.

Further, most of the respondents obtained food from crop production (87%), livestock (8%), and selling NTFPs (3.7%). Further, selling NTFPs (50.1%) was ranked in the second choice as one of the major sources of food as well as ranked first in the third choice (38.2%). This thus means that collection and selling of NTFPs is very significant in the food security of the area. This is illustrated in **Table 7.3** below.

Table 7.3: Different Sources of Food in Mecula-Lugenda Corridor NSR.

Source of food	Percentage (%)
1st choice	
Crops	87.0
Livestock	8.0
Selling NTFPs	3.7
Employment	1.3
2nd choice	
Selling NTFPs	50.1
Livestock	40.1
Crops	8.5
Business	1.3
3rd choice	
Livestock	42.4
Selling NTFPs	38.2
Business	14.1
Employment	1.3
Crops	4.0

Furthermore, most of the respondents obtained their income from business in the form of trading (44.3%), agriculture (livestock) (17.2%), and Selling NTFPs (13.5%). Further, Crops (42.2%), and selling NTFPs (29.4%) were ranked as the second choice as one of the major sources of income. In the third choice, Livestock (38.5%) was ranked the third choice. This thus means that NTFP collected in a sustainable manner can benefit the individual gaining income from conservation, and the latter from enhancement of ecosystem maintenance including biodiversity. This is illustrated in **Table 7.4** below.

Table 7.4: Different sources of income in Mecula-Lugenda Corridor NSR.

Source of income	**Percentage (%)**
1st choice	
Business	44.3
Livestock production	17.2
Selling NTFPs	13.5
Crop production	13.5
Employment	11.4
2nd choice	
Crop production	42.2
Selling NTFPs	29.4
Livestock production	26.5
Business	1.6
Employment	0.3
3rd choice	
Livestock production	38.5
Crop production	36.6
Selling NTFPs	18.6
Business	6.1
Employment	0.3

7.2.2: Amount in the form of income obtained in activities engaged in.

To assess the impact of community participation in collecting NTFPs, the researcher investigated the amount obtained in activities engaged. **Table 7.5** has more details.

Table 7.5: Different amount obtained in activities engaged.

Specifying the Amount	Percentage (%)
Annual Amount in Selling NTFPs	
n/a	51.5
1000.00-5000.00MZN ($16.13-$80.65)	16.4
5000.00-10000.00MZN ($80.65-$161.29)	13.3
10000.00-15000.00MZN ($161.29-$241.94)	10.6
20000.00-25000.00MZN ($322.58-$403.23)	2.9
15000.00-20000.00MZN ($241.94-$322.58)	3.7
Below-1000.00MZN (Below $16.13)	1.3
25000,00MZN_and_Above ($403 and above)	0.3
Annual Amount in crop production	
5000.00-10000.00MZN ($80.65-$161.29)	30.8
1000.00-5000.00MZN ($16.13-$80.65)	32.6
n/a	24.9
Below-1000.00MZN (Below $16.13)	4.8
20000.00-25000.00MZN ($322.58-$403.23)	1.9
10000.00-15000.00MZN ($161.29-$24.94)	5.0
Annual Amount in livestock production	
5000.00-10000.00MZN ($80.65-$16129)	33.7
1000.00-5000.00MZN ($16.13-$80.65)	33.2
n/a	22.5
Below-1000.00MZN (Below $16.13)	5.6
10000.00-15000.00MZN (161.29-$241.94)	3.7
15000.00-20000.00MZN ($241.94-$322.58)	1.3
Annual Amount obtained in Business	
n/a	50.7
1000.00-5000.00MZN (16.13-$80.65)	4.2
5000.00-10000.00MZN (80.65-$16129)	1.9
10000.00-15000.00MZN (161.29-$241.94)	22.8

15000.00-20000.00MZN ($241.94-$322.58)	7.7
20000.00-25000.00MZN ($322.58-$403.23)	9.0
25000.00MZN_and_Above ($403 and above)	3.7

Note: 1$ is equivalent to 62MZN

Table 7.5 above shows that much of the money was obtained in selling NTFPs, agricultural produce, livestock rearing, and lastly business dealings.

7.2.3: Classification of valuable NTFPs collected from Mecula-Lugenda corridor, NSR.

Communities around the Mecula-Lugenda a Corridor extract variety of NTFPs throughout the year for their daily subsistence and income generation. These products are collected from the general land forests, farmlands, and woodlands as provided in the Land Act (1997), the Forest and Wildlife Act (1999), and the Forest and Wildlife Regulation (2002). The researcher classified the NTFPs to understand them better. These were edibles and non-edibles. The edible NTFPs included animals, honey, oils, fish, spices, and many others. Non-edible products include grasses, medicinal plants, oil for cosmetic use, etc. These two classes were further divided into four general categories as indicated in **Table 7.6** below.

Table 7.6: Different classes of NTFPs collected.

Classification of NTFPs collected				
	Edibles	**Medicinal, cultural, and dietary supplements**	**Floral products**	**Specialty woods and associated products**
	Mushrooms	Medicinal plants	Honey	Firewood
	Wild vegetables	Tree oils and resins	Wild tubes	Bamboo shoots
	Bush meat	Oils	Ropes	Charcoal
	Wild fruits and nuts		Grass	Poles
	Fish		Sisal	Pará rubber tree/ Rubber
	Forage		Berries	
	Species			
Total	**7**	**3**	**6**	**5**

By classification, edibles were the primary NTFP products collected, produced, and sold by households in Mecula-Lugenda Corridor, and these constituted 7 NTFPs, 6 of NTFPs were floral products, 5 were specialty woods or timber and 3 were medicinal, cultural, and dietary supplements.

7.2.4.0: Quantity of key NTFPs collected from Mecula-Lugenda Corridor, NSR.

The annual quantity of firewood collected per household was found to be 120 bundles annually. The average quantity of bamboo harvested per household per year was estimated to be 60 extracted annually. Results from this study have estimated the average amount of thatch grasses harvested in the forest per annum per household to be 180 bundles. Poles used per household in the study area per annum were estimated to be 120 poles per year. The average estimate of charcoal harvested per household per year was 60 sacks or bags. The study showed that each household can collect an average of 180 baskets of wild fruits and nuts per year during the season. The quantity of key NTFPs harvested is shown in **Table 7.7** below.

Table 7.7: Quantity of key NTFPs collected, produced, and traded from Mecula-Lugenda Corridor per year.

	% of using NTFPs	% of consumption purpose (food security)	% of selling potion (Income generation)	Average quantities (mean)
Firewood	100	95	5	120 bundles
Bamboo shoots	98.7	90.5	8.2	60 bundles
Charcoal	56	18	38	60 sacks
Honey	97.3	29.2	68.1	60 Liters
Medicinal plants	100	64.6	35.4	60 kilograms
Wild Vegetables	98.1	84.3	13.8	120 baskets
Bush meat	15.1	7.0	8.1	180 kilograms
Wild fruits and nuts	97.9	67.5	30.4	180 baskets

	% of using NTFPs	% of consumption purpose (food security)	% of selling potion (Income generation)	Average quantities (mean)
Wild tubers	91.5	50.8	40.7	180 baskets
Ropes	100	12.9	87.1	120 bundles
Poles	99.7	17.7	82	120 pieces
Mushrooms	95.5	45.2	50.3	120 baskets
Rubber	57.3	-	57.3	60 bundles
Tree oils and resins	38.5	14.5	24	60 liters
Forage	75.6	56.4	19.2	120 bundles
Berries	62.1	49.8	13.3	120 baskets
Spices	100	85.4	14.6	120 baskets
Fish	100	74.3	25.7	240 baskets
Oil	20.7	6.7	4	2400 liters
Grass	100	59	31	180 bundles
Sisal	56.2	12.9	43.3	120 bundles
Palm leaves	92.3	33.1	59.2	180 bundles

7.2.4.1: Firewood.

Firewood is the major source of energy in most rural areas of the Mecula-Lugenda Corridor used for cooking and heating**.** In this study, 100% of respondents are involved in firewood collection (These consist of dead branches, dead woods, and cuttings) which is the main source of energy. Bricks are usually dried using firewood and thus, this increases firewood consumption in the study area. Out of the 100% collected firewood, only 5% is sold and 95% is used for home consumption. This could probably be due to the reasons that firewood is the only cheaper, available, and affordable primary source of energy in this area.

7.2.4.2: Bamboo.

Bamboo poles were found to be the most used materials for house construction and artisanal activities in the surveyed villages. About 98.7% of the respondents in the study area are engaged in the bamboo collection. The results show a larger average use of bamboo probably since bamboo poles are cheaper, available, and can be used to produce a wide range of artisans' items like woven baskets, mats, large carrying baskets, and storing agricultural produce. Also, bamboo is used by rural communities in the study area for house construction, roofing, and fencing. The diversity of products obtained from bamboo as NTFP has attracted most communities in the study area to engage in the collection and use of bamboo. Close to 90.5% of collected bamboo is used at the household level and 8.2% is sold off.

7.2.4.3: Poles.

Building poles were found not to be mostly used as construction materials under the study perhaps due to most of the houses in the study area were being built using bricks and bamboo used for roofing and fencing. About 99.7% of the respondents in the study area collect and use poles for building purposes. The results are synonymous with those reported by key informants who observed that 91% of respondents were involved in pole collection. It was, therefore, established that most of the poles collected are sold by 82%, and 17.7% is used for home needs. The variation in poles utilization could probably be due to the difference in the number of poles consumed domestically. In the study area, it was found that 120 poles are extracted per household per year.

7.2.4.4: Grasses.

Thatch grass was found to be among the most used materials for roofing, fencing, traditional rural construction, and animal pens. 100% of the respondents in the study area are engaged in thatch grass collection. Key informants observed that 734 bundles of thatch grass are harvested in the area per annum. Results of the study demonstrate that demand for thatch grass in the study area is high probably because they are cheaper, available, and affordable resources that can be accessed by even poor community members and are mainly collected for consumption purposes and contribute to non-cash household income. Out of the 100% collected grass, 69% is used for domestic use and 31% are traded**.**

7.2.4.5: Wild fruits and nuts.

In the study area fruits were observed to be collected on a seasonal basis by children or both male and female especially during food shortage periods**.** Results from this study observed that 67.5% of respondents in the study area utilize wild fruits and nuts to sustain their main food specifically during starvation otherwise are collected in small quantities by both families normally for home consumption. Only 30.4% sell these fruits and nuts. The results indicate fewer families are involved in wild fruit and nuts collection different from those reported by other researchers. From interviews, 83.4% of respondents reported collecting and utilizing wild fruits as the main food during famine. One of the key informants noted that almost all (99%) of the respondents utilize wild fruits and nuts as a bite. The difference can probably be caused by the wild fruit species richness in the study area and inadequate knowledge of the edibility of wild fruits.

7.2.4.6: Charcoal.

Results from this study observed that 56% of respondents are involved in charcoal making. Key informants observed that at least 45 bags of charcoal leave the forest daily, which suggests a huge percentage of charcoal produced in the area. For instance, 38% of the respondents sell out charcoal, and 18% burn charcoal for home consumption. In the study area results demonstrate that few respondents are involved in charcoal production perhaps due to that 100% of the residences in the study area use firewood as the main source of fuel for cooking and heating. Few respondents were involved in charcoal collection specifically during land clearing for agriculture where charcoal is produced from logs remaining on the farm. Commercial charcoal production is discouraged by bad market conditions in the study area as civil workers are the main clients for charcoal in the study areas and being a reserve charcoal production is entirely discouraged by the reserve management.

7.2.4.7: Medicinal plants.

In the study area, the respondents interviewed were fully engaged in collecting and trading medicinal plants (100%), adding to the fact that the product was mentioned to be among the potential NTFPs for income generation and treating various ailments. This means that most of the populations in the study area are using local herbs more than modern medicines for their health care. 64.6% of the respondents showed that they collected NTFPs for home use and 35.4%

collected them for selling. Results from key informants showed that they utilize medicinal plants like *Diospyros trucatifolia, Combretum apiculatum, Julbernardia globiflora, Pterocarpus angolensis, Annona senegalensis, Olax dissitiflora, Diplorhynchus condylocarpon, Securidaca longepedunculata, Pseudolachnostylis maprouneifolia, Terminalia sericea, Rourea orientalis, Dalbergiella nyasae, Commiphora africana, Flacourtia indica, Brachystegia boehmii, Strychnos madagascariensis, Gardenia ternifolia, Catunaregam spinosa, Cassia abbreviata,* and *Monanthotaxis buchananii* collected from roots, leaves, flowers, bark or a mixture of different parts and a mixture of different species. Identified medicinal plant species are used to treat various diseases like stomach pain, headache, hernia, heart diseases, eye diseases, loss of appetite, stroke, chest pain, pneumonia, Asthma, Breast pain, Pimples, fungal infections, bilharzia, leprosy, diarrhoea, and craziness**.** Herbalists were observed to collect an average of 60 kilograms of medicinal plants annually, the collection is done frequently within a week depending on the availability of people attending treatment.

7.2.4.8: Wild meat.

The range of products consumed includes birds and their eggs, insects, rodents and other larger animals. The finding from this study is that few residents from the study area are involved in wildlife hunting as a source of protein for their families and this was found among 15.1%. On this, 7% hunt for home consumption, and 8.1% hunt for selling. This could be attributed to the fact that the forest is surrounded or located near reserves where hunting is illegal. Results observed from focus group discussions mentioned a few species hunted including wild pigs and rats. The main hunters of wild animals were men.

Table 7.8: Mean differences of average production of NTFPs towards food security and income.

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Firewood	3.500	14	.004	.467	.18	.75
Bamboo shoots	3.500	14	.004	.467	.18	.75
Charcoal	2.646	14	.019	.333	.06	.60
Honey	2.256	14	.041	.267	.01	.52
Medicinal plants	1.000	14	.334	.067	-.08	.21
Wild Vegetables	1.468	14	.164	.133	-.06	.33
Bush meat	4.000	14	.001	.533	.25	.82
Wild fruits and nuts	3.500	14	.004	.467	.18	.75
Wild tubes	1.000	14	.334	.067	-.08	.21
Ropes	3.055	14	.009	.400	.12	.68
Poles	3.055	14	.009	.400	.12	.68
Mushrooms	3.500	14	.004	.467	.18	.75
Rubber	3.500	14	.004	.467	.18	.75
Tree oils and resins	2.646	14	.019	.333	.06	.60
Forage	2.256	14	.041	.267	.01	.52
Berries	1.000	14	.334	.067	-.08	.21
Spices	1.468	14	.164	.133	-.06	.33
Fish	4.000	14	.001	.533	.25	.82
Oil	3.500	14	.004	.467	.18	.75
Grass	1.000	14	.334	.067	-.08	.21
Sisal	3.055	14	.009	.400	.12	.68
Palm leaves	3.055	14	.009	.400	.12	.68

Since the Test value is 0, NTFPs collected, produced, and traded are moving in the right direction towards improving food security and household incomes of community members. However, firewood (0.467) 95% CI (0.18-0.75), bush meat (0.533) 95% CI (0.25-0.82), wild fruits (0.467) 95% CI (0.18-0.75), and fish (0.533) 95% CI (0.25-0.82) showed a high probability compared to others.

7.2.5: NTFP value chains.

The value chain for NTFPS was conducted to understand the coordination amongst the actors, projected relationships between the processes, and how the participating households benefited. A stylized description of the value chains **(Figure 7.4)** highlights that there were more similarities than differences between the chains for the 21 NTFPs, many of which have short value chains. The first step in the value chain is the harvesting. The products are then transported home before selling.

Edibles like mushrooms, sisal, oils, honey, medicinal plants, and wild fruits are cleaned and graded according to size. These are cleaned and further processed. Processing edibles like spices involved pounding in a mortar and cooking them. The mixture is poured into a winnowing basket to cool and solidify, before being cut into pieces of different sizes for sale in the village, neighboring villages, and local, and town markets. Some products are packaged in plastic bags of different sizes to attract buyers by making it easier for them to carry the product home. The prices were determined by the size of the units sold. Grass was the only one of the four products that was stored, often being kept until the rainy season when it fetched better prices due to high demand. The shortest chain ended with the products being sold within the village directly to end users or through intermediaries. All products were sold directly to users and/or intermediaries. However, the grass was largely sold within the village. Mushrooms and wild fruits entered the value chain and ended with consumers within the village, local, and/or town markets.

Differences in cash income generated were revealed for all the products. There was a reduction in cash income received by the traders if the products were sold to intermediaries. This was because they offered wholesale prices to the intermediaries. Traders who took wild fruits to town to sell directly to consumers received a higher price. However, this may not translate into an increase in income because there were transportation costs and associated risks taking the product to town

markets which may later reduce actual income. The intermediaries who bought the products in local markets covered transportation costs and took the risk of transport losses.

Pricing of the products was based on the quantity, the unit of measurement, the size of the products after grading (especially for ropes, oils, wild fruits, and mushrooms), and the types of buyers. The buyers included final consumers within the villages, in neighboring villages, at the market, and vendors who acted as intermediary buyers. In most cases, final consumers paid more than intermediaries for the same products. However, intermediaries could sometimes pay consumer prices and then still make a profit by reducing the quantities when re-selling the products for the same price. In some situations, the unit price was lowered if all the product was bought at once (wholesale prices were offered) and sometimes the price depended on the prevailing needs of the seller and the amount of time the product has spent on display. Demand and supply played a role in price determination for all the products though this was situational. During high supply and low demand, market prices tended to decline; consequently, traders were compelled to reduce their prices further, especially for perishable products such as mushrooms and wild fruits. Seasonality and scarcity of the products had an influence on the prices, for example, grass, berries, honey, fetched higher prices during dry season resulting in prices almost doubling for the same product and quantity. The length of time to collect the products and distance to the market had no influence on the prices as the products were regarded as free resources by most buyers with no capital investment while at the same time excluding labor costs.

There was not much age or gender differentiation of roles along the chains, other than for edibles. However, involvement at each stage was influenced by the distance to be covered to get the resource and the type of product. Thus, only women and children were involved in harvesting mushrooms because of the long distances traveled to get the resource (5–14 km). Grass selling was done by men and women. Firewood was mostly collected by women and children. Poles and Ropes were mainly collected by women and men. Medicinal plants were mostly collected by women. Exceptionally, in all three administrative posts only women involved who carried out all the activities such as collecting, transporting, and selling NTFPs to final consumers. The value chain of edibles was the exclusive domain of women and children/girls. The value chain of edibles begins largely from women and children/girls who collect the product, transport, process, selling to intermediaries, and direct to consumers. Wild vegetables, berries, tubes, and fruits attracted the

involvement of all groups (men, women, boys, and girls). However, in Mecula, only men and women participated in the collection, transportation, cleaning, and selling with most participation by men. On the contrary, respondents indicated that there were few men participating in the wild fruits trade in all three administrative posts. NTFP traders also enjoyed non-monetary benefits. For all NTFPs, the traders mentioned their self-employed status; the trade had taught them business skills, using part of the product without purchasing, flexibility to undertake the trade, the ability to work with family members and to multitask with other productive works, or household chores. For mushrooms, wild fruit and other edibles, traders also saw their involvement in the trade as a way of keeping traditional products and knowledge alive for passing on to future generations.

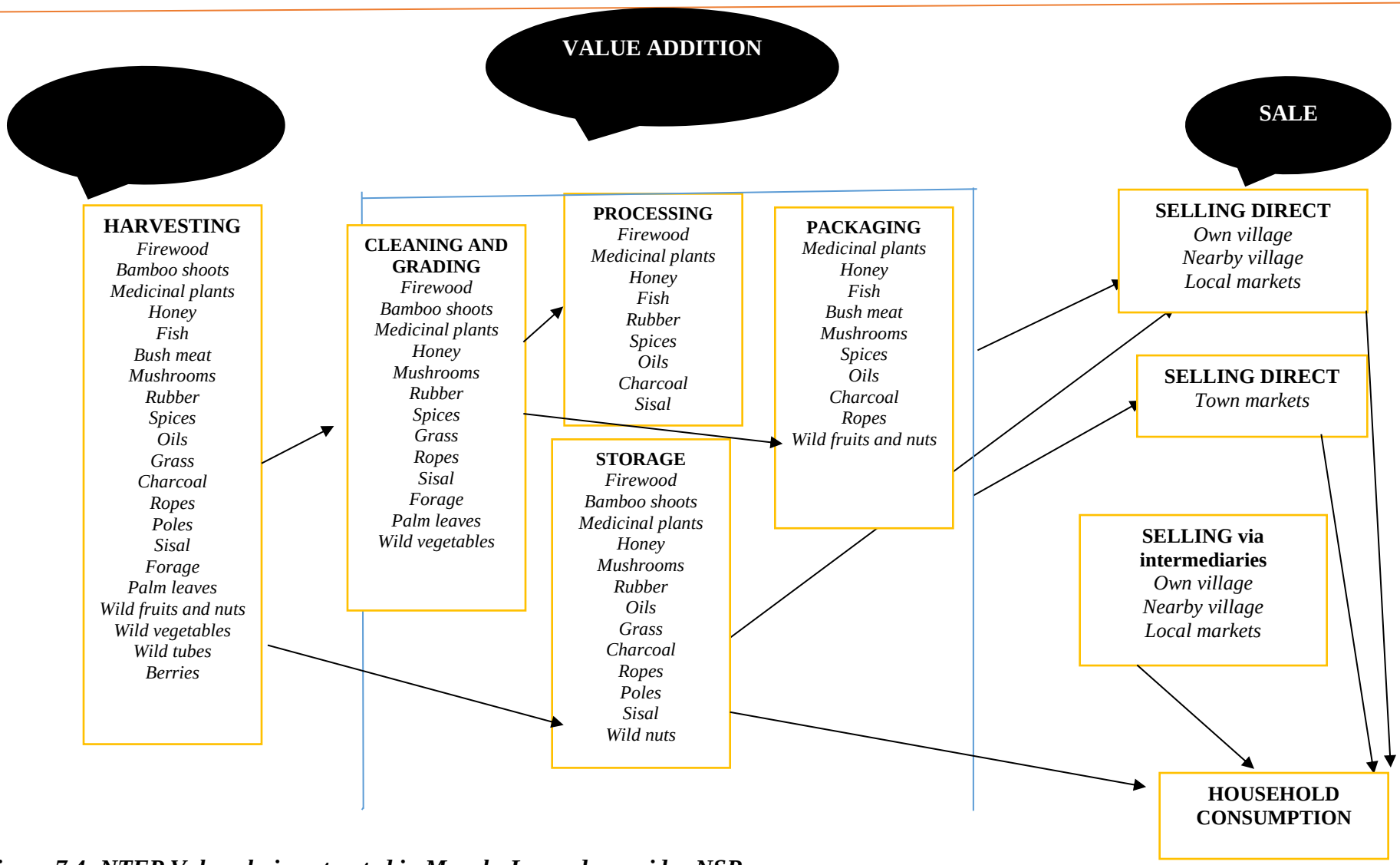

Figure 7.4: NTFP Value chain extracted in Mecula-Lugenda corridor NSR.

7.2.6: Economic valuing of NTFPs collected, produced, and sold in the Mecula-Lugenda corridor, NSR.

In a market survey conducted to evaluate the flow of Non-Timber Forest Products in the Mecula-Lugenda Corridor, NSR where NTFPs were collected, produced, and sold aimed at preparing an inventory of the NTFPs extracted in the three administrative posts, estimate the quantity of NTFP gathered by locals and finally estimate the financial income derived from NTFPs extracted. The markets were classified into three i.e., large, medium, and small dealers. In each class, if the number was less than 5, 100% sampling was done; otherwise, 25% of dealers were randomly selected for the survey. The result indicated that 21 NTFPs were available in the three administrative posts, and they were qualified based on the kind of products extracted e.g., firewood measured in bundles/year i.e., bundles of firewood fetched on an annual basis. Honey, mushrooms, wild tubes, etc. collected was measured in liters/ baskets annually. The financial valuation of NTFPs which indicate the income of the farming household was carried out irrespective of the gathering household. That is, the total population of all the administrative posts in the study was considered wholly. The financial valuation of the quantities of NTFPs gathered was estimated by using the current market price trends and measured in bundles/baskets/pieces/kg/ha/yr. There were variations in the estimated value realized per household as well as differences in their financial value across the administrative post considered. The author was able to value NTFPs by directly using the current market price to estimate the income of the communities with the quantities of NTFPs gathered.

Data on quantities (Q) of each NTFP collected through a market survey was converted to conventional units. The economic value of each NTFP was obtained based on the Shackleton and Shackleton model (Dovie, *et al.,* 2002), where: Annual value extracted per household = Annual Quantities Extracted (either for domestic use or trade) × Mean Farm gate Price/farm price.

$$V = QP \quad \ldots\ldots (7)$$

Where;

V= Gross Value,

Q= Quantity of NTFPs,

P= Price of the product.

Table 7.9: Economic valuation of NTFPs towards food security and income.

NTFPs	**Average Quantity (Annual)**	**Average Price (MZN)**	**Gross value (MZN)**
Firewood	120 bundles	25.00($0.49)	3,000.00($48.39)
Bamboo shoots	60 bundles	10.00($0.16)	600.00($9.68)
Charcoal	60 sacks	10.00($0.16)	600.00($9.68)
Honey	60 litres	20.00($0.32)	1,200.00($19.36)
Medicinal plants	60 kilograms	20.00($0.32)	1,200.00($19.36)
Wild vegetables	120 baskets	5.00($0.08)	600.00($9.68)
Bush meat	180 kilograms	4.00($0.06)	720.00($11.61)
Wild fruits and nuts	180 baskets	5.00($0.08)	720.00($11.61)
Wild tubes	180 baskets	5.00($0.08)	720.00($11.61)
Ropes	120 bundles	20.00($0.32)	2,400.00($38.71)
Poles	120 pieces	50.00($0.81)	6,000.00($96.77)
Mushrooms	120 baskets	7.50($0.11])	900.00($14.52)
Rubber	60 bundles	10.00($0.16)	600.00($9.68)
Tree oils and resins	60 litres	20.00($0.32)	1,200.00($19.36)
Forage	120 baskets	5.00($0.08)	600.00($9.68)
Berries	120 baskets	5.00($0.08)	600.00($9.68)
Spices	120 baskets	5.00($0.08)	600.00($9.68)
Fish	240 baskets	25.00($0.49)	6,000.00($9.68)
Oils	2400 litres	1.50($0.02)	3600.00($58.07)
Grass	180 baskets	5.00($0.08)	720.00($11.61)
Sisal	120 bundles	25.00($0.49)	3,000.00($48.39)
Palm leaves	180 baskets	5.00($0.08)	900.00($14.52)
Economic value			**37,920.00 ($611.61)**

***NOTE**: The economic values are expressed in terms of gross benefits to NTFP-producing households, based on a mean farm gate price (1$ is equivalent to 62MZN)*

Results showed that 21 NTFPs ranging between food products, firewood, and construction materials were collected, produced, and traded by households living adjacent to Mecula-Lugenda Corridor, NSR. The identified and quantified NTFPs in the study area were firewood, honey, bush meat, wild mushrooms, medicinal plants, honey, poles, thatch grass, ropes, wild vegetables, palm leaves, wild fruits, berries, forage, rubber, tree oils and resins, sisal, and wild tubes **(Table 7.9 above).** The mean annual value of the identified NTFPs ranged from 600.00MZN to 6,000.00MZN ($9.68-$96.77). Fish and poles had the highest mean annual value followed by others (Table 5.10 above). The NTFPs were collected mainly from farmlands and village forests and illegally from reserve forests for some NTFPs like dried firewood, mushrooms, wild vegetables, and medicinal plants. The most dominant NTFPs in terms of mean annual value per household were firewood, mushrooms, medicinal plants, and honey. All respondents collected firewood for subsistence and 5% collected for trade **(Table 7.9 above).**

7.3: Result Discussion.

The study established that the annual quantity of firewood collected per household came close to 120 bundles annually. This made firewood to be a major source of energy in most rural areas of the Mecula-Lugenda Corridor, NSR used for cooking and heating bricks. It was evident that 5% of collected firewood is sold and 95% is used for home consumption. This is due to the reasons that firewood is the only cheaper, available, and affordable primary source of energy in this area. This is further qualified by national statistics on energy in Mozambique, where it is indicated that around 40% of people have access to electricity, through the grid or mini/off-grid systems. The government has promoted solar PV solutions in rural areas, reporting that 700 schools and 800 other public buildings now have electricity from solar. It is also worth noting that the energy mix is formed by 0.1% from coal, 16.2% from oil, 6.8% from natural gas and 11.6% from hydro. This leaves about 60% of communities, especially in rural areas relying on firewood energy. Similarly, Mushi, *et al.*, (2020) reported that Tanzanian energy balance is dominated by biomass-based fuels, the same applies to Namibia, Malawi, Zambia, and Mozambique.

By economic value, therefore, the implication is that characteristically, forest-based activities form only part of a household's income-earning enterprises. The income earned in forest-based activities contributes to a household's food supply situation in several ways: most directly, it provides cash for food purchases. It may also provide savings for investment in agricultural assets (e.g., livestock) or inputs (e.g., seeds), and as outlets for savings accrued in agriculture. In the Mecula-Lugenda Corridor, for example, 64% of those enterprises operated by persons previously in farming are run in conjunction with farming, and 30% of them with one or more other small enterprise activities. Of those where enterprise activity predominates, 56% also farm, and 65% have other activities in addition to the forest-based one. This close integration with other household activities makes it very difficult to separate income earned in forest-based activities, and even more difficult to define how it contributes to household food security. However, based on economic modeling, the collection of firewood remains a major income-generating activity directly and indirectly. Furthermore, the prominent role played by women in many forest-based enterprises may be of particular importance for household food security. This mirrors that women are the main and key managers to sustain the woodlands. They can apply selective stem thinning (removing suppressed stems) and pruning branches of remaining good stems. This can be used for firewood, cheaply, and close to home. This stimulates growth to enable stands to develop faster from stage 1 to stage 3 and men can then harvest the more mature stems in stages 3 and 4 (mature woodland). This implies that there may be a direct link between women's income and child nutrition. Some studies suggest that there are differences between women's and men's spending patterns. Women characteristically spend money on food supply and thus, nutritional status is more directly dependent on women's income than men's (Lufuke *et al.*, 2023).

In the Mecula-Lugenda Corridor, farmers cannot produce enough to be food self-sufficient year-round. Households earn cash income to buy food through apportioning wage labor in the collection of firewood. There are seasonal income and emergency income generated from the collection, production, and selling of firewood. By season, although fuel wood is collected year-round, there are often seasonal peaks to its collection. The seasonality of fuelwood collections closely relates to the fluctuations in labor requirements for agricultural production. Thus, when on-farm labor is at its lowest, fuelwood collection is at its peak. This period is often when food supplies are at their lowest, consequently, the income from fuelwood trading helps lessen the negative impact of fluctuating food supplies. Similarly, Wood *et al.*, (2015) found that in the Philippines, many fuel

wood sellers sold fuel wood for less than three months a year. This was due in part to the labor required in other activities and transportation difficulties during the rainy season. Another example of the seasonal nature of forest-based activities comes from northeastern Brazil, where the collection and processing of babassu palm kernels occurs in the off-peak agricultural period. Income from babassu kernels makes a significant contribution to the household's overall income, representing 39% of the cash income and 34% of the total household income during this period (Cardozo *et al.*, 2015). Many of the poorer farmers rely on this income to tide them through the lean period; in addition, many are dependent on this cash income for purchasing seeds and other inputs needed for the following season's planting. By emergency, perhaps the most renowned role for forest gathering enterprises is the buffer they provide during emergency periods. In the Mecula-Lugenda Corridor, during a drought year, an additional 13% of the villagers collect firewood to supplement income lost due to drought. In addition, better-off village members engage in the collection when income is needed for emergency medical, funeral, or wedding expenses. This was the same case in Botswana; the fuel wood trade provides employment for rural Botswana in periods when there were few alternatives. Kgathi (2014) found that 60% of the traders interviewed had resorted to fuelwood trading because they could find no alternatives. More than 80% of the traders were regularly arable farmers and substituted (or supplemented) fuelwood trade for farming during drought years. This thus informs the study that the ways in which the income generated from these enterprises is spent affects the contribution it makes to household food security. Often money from these enterprises is not reinvested in the enterprise itself, but rather is invested in agricultural assets.

The study revealed that bamboo poles are the most used materials for house construction and artisanal activities in the surveyed villages because it was cheaper, available and can be used to produce a wide range of artisan items like woven baskets, mats, harvesting, drying, winnowing basket, large carrying baskets and storing agricultural produce. Research on the direct-use values of NTFPs harvested from communal savannas in Bushbuckridge, South Africa found the total annual value per hectare was R810 ($129), whilst the total per household was as high as R6630 ($1052): R2218 ($352) for home consumption and R4412 ($700) traded. The values of NTFPs (per household per year) included fuel wood (R465/$74), construction wood (R218/$35) and wild fruits and herbs (R525/$83 and R2625/$417 respectively). Other NTFPs valued included, thatch grass, carving timber, medicinal plants, reeds for construction and so forth (Dash, *et al.*, 2016).

This thus informs us that bamboo poles are major income generating activities for forest communities which subsequently brings food for many families. However, this cannot be sustainable in near future especially if stringent restrictions are brought up to safeguard bamboo poles. Secondly, it will not be sustainable as communities change from using such bamboo poles but rather the kind of houses constructed can change in design. This thus should inform forest management authorities to ensure that afforestation of such poles is highly recommended to protect the ecosystem and forest cover change. Furthermore, a friendlier alternative can be thought of in construction of houses to protect forests as also communities remain. For instance, the use of bricks can provide a better alternative since several bricks are made with coal fly ash, cement and clay without being burnt. This will generate a sustainable income for the communities as well as widening food security by selling bricks.

It was further revealed that building poles were found not to be mostly used as construction materials under the study perhaps due to most of the houses in the study area were built by using bricks and bamboo used for roofing and fencing. The variation in poles utilization could probably be due to the difference in number of poles consumed domestically. In the study area it was found that 120 poles are extracted per household per year. This differs from other researchers who observed that 500 poles can be used to construct a three rooms house in Nyanganje forest reserve Morogoro (Caspa, *et al*., 2020). Rovero, (2007), observed that 600 poles can be used to construct a two rooms house in Mazumbai, Tanga, Tanzania. The difference might be due to availability of alternative construction materials (bricks and bamboo), size and design houses constructed. This thus should inform us that the sustainable collection of building poles for trade is expected to increase the adaptive capacity of households to climate change by majority of people. This means that local people can bear economic loss if they are denied of collection of construction poles. Similarly, the demand for building poles was increasing by forest dependent households more than it used to be 30 years ago, due to modern housing standards which limits the number of poles used and instead use iron bars, iron sheets, cement, and others. These were not being used before and instead use only poles. This is also the case for the households where demand of building poles by households to increase resilience to adverse effects of changing climatic conditions is significantly eminent. However, even though there is increasing demand of construction poles, and information on its economic value for subsistence use and trade in terms of benefits and its importance to livelihoods of households under the changing climate is inadequate. Also, most of the building

poles collected, traded, and consumed outside the cash economy and therefore are not adequately captured in national economy statistics. There is a growing need at national and international policy levels for projections at large spatial scales of the economic values that households derive from forests, including the collection of construction poles.

Thatch grass was found to be among the most used materials for roofing, fencing, traditional rural construction, and animal pens. It was revealed that demand for thatch grass in the study area is high probably because they are cheaper, available, and affordable resource that can be accessed by even poor community members and mainly collected for consumption purposes and contributes to non-cash household income. In Zimbabwe, it was found out that environmental income constituted 35.4% of the average total income per person for 1993 - 1994 and, 36.9% for 1996–1997 (Matias *et al.*, 2018). This includes income from gold panning, however even if this is excluded, the environmental income is considerable. Comparing values across countries becomes complicated in terms of how the value was derived, how many resources were considered and whether the value is gross or net, however, despite these complications; the values still indicate an important contribution made by thatch grass to rural households. Considering the percentage of the total income gives a better indication of the contribution made by NTFPs relative to other livelihood strategies (Chamberlain, *et al*., 2020). The implication of the above is that collection and selling of thatch grass is largely for poor rural communities, especially in this remote area who lack of access for social support and infrastructure were majorly dependent on forests to generate thatch grass to build their houses. This should inform that the forest management authorities that efforts must be made to transform these communities while investing in poverty eradication Programme. This will save the reliance on thatch grass to building their houses and generating income for subsequent obtaining of food.

The study also found out that fruits are collected on seasonal bases by children or both male and female especially during food shortage periods even though few families are involved in wild fruit and nuts collection different from those reported by other researchers. The difference can probably be caused by few wild fruit species richness in the study area and inadequate knowledge on the edibility of wild fruits. Presence of variety of cultivated fruits discourage collection of wild fruits was realized. Dash, *et al*., (2016) considered the value of fruits across various countries and found in Nicaragua the average annual net value of fruits per person was $411 whilst the contribution

made to individual households was approximately 40% of the total annual income. In Sri Lanka, the annual net value per family was between $32 and $820 with 63% of the total income coming from forest products. Generally, fruits as NTFPs have often been undervalued because studies failed to examine the range utilized by communities and only considered them in terms of their direct-use values, not their existence and option values, their role in establishing social ties, local exchanges for goods and services, sacred areas, and ecological services (Soe and Yeo-Chang, 2019). According to Shanley *et al.*, (2015) ‘‘Activities that deplete biodiversity for short-term gain appear economically rational because many of the values of biodiversity are not recognized and accounted for in decision-making.’’ Although the literature highlights the important role of NTFPs in rural livelihoods, this information is yet to be effectively translated into policy. In relation to food security and income thus, fruits have a direct provision of nutritious food, such as nuts, oils, vegetables (leaves, flowers, and roots), fruits, bush meat, fish, herbs, saps, mushrooms, tubers and insects, and feed for livestock. Secondly, they provide wood fuel for cooking food and boiling water, which is critical in developing countries for preparing many nutrient-rich foods (such as legumes and meats) facilitating nutrient assimilation. Third, they improve food safety and reducing the risks of diarrhea; formal and informal employment and income generation in the forestry sector and through sales of wood and non-wood-forest products (NWFPs) with significant differences by gender and social groups. Lastly, non-provisioning ecosystem services that sustain all food production and agriculture activities now and in the future.

Charcoal is the single largest source of household energy in urban areas, as it is considered cheap and easy to transport, distribute, and store (Weyer, *et al.*, 2018). It is estimated that as many as 120,000 earth kilns are used each year, or 335 per day to meet such demand (Weyer, *et al*., 2018). In the study area results demonstrate that few respondents are involved in charcoal production perhaps because 100% of the residences in the study area use firewood as the main source of fuel for cooking and heating. Few respondents were involved in charcoal collection specifically during land clearing for agriculture where charcoal is produced from logs remaining in the farm. Commercial charcoal production is discouraged by limited market opportunities in the study area as public servants are the main client for charcoal in the study areas. It is however understood that 56% of the charcoal-producing households in our sample use charcoal to fill seasonal income gaps. Most low-income households use charcoal to fill seasonal income gaps, because they do not have access to alternative sources of income at certain times of the year, especially the off-agricultural

season. This coincides with the findings of Weyer, *et al*., (2018) that poorer households that lack alternative cash income sell NTFPs to cope with shocks. On the other hand, high-income households have alternative sources of income but produce charcoal seasonally to supplement their household income. Mugido and Shackleton, (2019) have reported that wealthy households predominantly respond to opportunities in higher-return environmental products, while poorer households diversify in response to vulnerability. Statistically, we did not find evidence to support the claim that income from charcoal production serves as a primary seasonal gap-filler for rural households, especially during off-agricultural seasons. Angelsen *et al.*, (2014a) made a similar observation in their global comparative assessment of the role of environmental products on gap-filling. This is explained by the high contribution of charcoal to household cash income and supports the assertion by Angelsen *et al.,* (2014a) that forest income contributes more to regular household income than is often recognized. Furthermore, 48% of the sampled households experienced at least one form of shock in the year 2016. A comparable figure provided by Pouliot and Treue, (2013) from households sampled in Ghana and Burkina Faso was somewhat lower (67%). Our results on the use of charcoal to mitigate economic shocks from farm raiding by cattle, crop failure, and illness do not support the assertion by Angelsen *et al.*, (2014a) that the frequency and/or amount of environmental resource use as safety-net increases with shocks' severity. We attribute the non-proportionate increase in income from coping strategies to the multiple strategies adopted by households to cope with economic shocks. It could also be explained by the inability of households to clearly differentiate between usage of charcoal income as regular household income or emergency income (Angelsen *et al.*, 2014b). Similar observations have been made by McSweeney, (2004) and Pouliot and Treue, (2013). In this case thus, the forest management authorities need to be informed that charcoal production is used both as an *ex ante* and *ex post* coping strategy against cattle invasion. Some households whose fields had been raided by cattle in the past indicated that the incident forced them to enter charcoal production (*ex post),* while others indicated that the frequent destruction of their fields by cattle forced them to produce more charcoal to ensure a stable source of income (*ex-ante*). Our results also corroborate the findings of Wood, *et al.*, (2008) that households produce charcoal in bulk to respond to one-off shock events, or they turn to charcoal production as a longer-term response to deprivation.

The study further revealed that forest communities are fully engaged in collecting and trading medicinal plants including *Diospyros trucatifolia, Combretum apiculatum, Julbernadia*

globiflora, Pterocarpus angolensis, Annona senegalensis, Olax dissitiflora, Diplorhynchus condylocarpon, Securidaca longepedunculata, Pseudolachnostylis maprouneifolia, Terminalia sericea, Rourea orientalis, Combretum apiculantum, Dalbergiella nyasae, Commiphora africana, Flacourtia indica, Brachystegia boehmii, Strychnos madagascariensis, Gardenia ternifolia, Catunaregam spinosa, Cassia abbreviate, and Monanthotaxis buchananii collected from roots, leaves, bark or both plant parts. This means that most of the populations in the study area are using local herbs more than modern medicines for their health care due to the long distance from the communities to the nearby health facilities and the poor transportation network in the area. Identified medicinal plant species are used to treat various diseases like stomach pain, headache, hernia, heart diseases, and eye diseases, loss of appetite, stroke, chest pain, pneumonia, and craziness. This is supported by Leßmeister *et al.*, (2018) who had found out that in southeastern Burkina Faso, medicinal plants had a higher economic value than other NTFPs since over 40% of local communities are engaged in herbal related business and discoveries. This thus should inform us that while the use of wild plants still has an important role in peoples' livelihoods through traditional medicines and food culture, it is important to understand where in the urban and peri-urban environment wild plant collection takes place for public policy to incorporate the land use practice in its designs. In addition to understanding the characteristics of rural and urban collection, the who, where, and when it is important to understand how collection of wild plants is perceived, as public perception can be an important determining factor. For example, if collection of wild plants is a socially accepted practice, it can form a driver in conducting the practice, while a negative view may inhibit people from collecting wild plants, at least in plain sight. Understanding these subtleties can immensely improve effective policy design and become a sustainable food security and income generating practice.

It was further established that for people living near forests, wild animals offer an important part of their diet, in some cases, they supply only animal proteins. The range of products consumed includes birds and their eggs, insects, rodents, and other larger animals. The population engaged in hunting was very few as 15% and males took the highest percentage. This could be attributed to the fact that hunting in the forest is located near reserves is illegal. In line with the study findings, Soe and Yeo-Chang, (2019) established that collection of NTFPs generally contribute about 40% to food security in most forested zones. This is further supported by Steele *et al.*, (2015) who had earlier ascertained that NTFPs contributed over and above 40% on food security in South Africa

and Zambia, respectively. Specifically, the study also showed that spices contributed much to securing daily food at home. They found out that they not only use spices for food but also income generation. The natural flavors found in these spices influence a good number of consumers to use these spices. In Kano, Nigeria, many NTFPs collectors add value on spices which makes them marketable (Suleiman *et al.*, 2017). In the context of Niassa Special Reserve conservation action and rural development, the harvesting of wild animals and spices is central in continued preservation of the woodland. It is thus understood that collection of wild animals and bush meat trade provide the main source of income for a large network of people ranging from hunters and farmers to market women and helpers in both urban and rural communities. In many areas, the gathering and marketing of wildlife, even species such as snails which may be of little value, provides a significant proportion of the household cash income and determines whether a child gets education or not. Wildlife populations in the area are declining because of overexploitation and destruction of wildlife habitat caused by increasing human populations and the associated demands for agricultural lands and land for development of human settlements as well as stringent policies. Particularly, although there are few forest communities depending on bush meat, people now resort to eating species which in the past were not acceptable as comestible. The nutritional value of bush meat is comparable to meat of domestic species in many respects and in some respects such as low levels of fat, bush meat is superior to many domestic species. Wild animals also possess several added advantages over domesticated species in terms of range usage, physiological and ecological adaptations, disease tolerance and productivity. Different wildlife production systems therefore may be more feasible and/or more appropriate in specific areas, and we should not expect that any one approach will provide the answer to food security and income. However, there are several basic issues which require to be addressed to realize the full potential of wildlife as a factor in the search for food security and income in the area. These issues include land tenure systems and evolution of systems that allow people control over land and access to wildlife resources on the land; economic incentives to people for sustainably managing wildlife on their lands, development of enabling policies, equity in revenue sharing, Long-term commitment, and significant investment into the development of sustainable wildlife production systems and the willingness of donor agencies to invest substantially in wildlife research.

In relation to the value chain for NTFPS, it was revealed that there were more similarities than differences between the chains for the 21 NTFPs, many of which have short value chains. The first

step in the value chain is the harvesting. The products are then transported home before selling. Mushrooms, sisal, oils, honey, medicinal plants, and wild fruits are cleaned and graded according to size, while other edibles are cleaned and further processed. Processing edibles like spices involved pounding in a mortar and cooking them. The mixture is poured into a winnowing basket to cool and solidify, before being cut into pieces of different sizes for sale in the village, neighboring villages, local, and town markets. Some products are packaged in plastic bags of different sizes to attract buyers by making it easier for them to carry the product home. The prices were determined by the size of the unit sold. Grass was the only one of the four products that was stored, often being kept until the rainy season when it fetched better prices due to high demand. The shortest chain ended with the products being sold within the village directly to end users or through intermediaries. All products were sold direct to users and/or intermediaries. However, grass was largely sold within the village. Mushrooms, edible and wild fruits entered the value chain and ended with consumers within the village, local, and/or town markets. Suleiman *et al.*, (2017) in line with the above, participating households highly benefited from NTFP collection, production and selling because they rely largely in a network of NTFPs.

Regarding the differences in cash income generated for all the products, it was evident that there was a reduction in cash income received by the traders if the products were sold to intermediaries. This was because they offered wholesale prices to the intermediaries. Traders who took wild fruits to town to sell directly to consumers received a higher price. However, this may not translate into an increase in income because there were transportation costs and associated risks taking the product to town markets which may later reduce actual income. The intermediaries who bought the products in local markets covered transportation costs and took the risk of transport losses. Ulrichs *et al.*, (2019) further found out that forage has a significant influence on food security. This suggested that community members who collected forage increased their food security through looking after their domestic animals. This tallied with the findings of Suleiman *et al.*, (2017) who had earlier ascertained the role of forage collected as NTFPs on food security from Tropical Rain forests in Wudi in Nigeria. The collection of forage is essential in preservation since they act as a good substitute for community members to look after their animals without tampering with forests. This can also improve rural developments in form of increased ability to rear animals needed on national markets (Ulrichs *et al.*, 2019). Furthermore, Matias *et al.*, (2018) found out that the collection of wild fruits and nuts contribute on food security of collectors by 13%. This is

congruent with Peerzada *et al.*, (2022) who found out that wild fruits and nuts provide daily food consumption to children and youths. This was found as a great contribution of NTFPs towards food security.

The study further found out that pricing of the products was based on the quantity, the unit of measurement, the size of the products after grading (especially for ropes, oils, wild fruits, and mushrooms), and the types of buyers. The buyers included final consumers within the villages, in neighboring villages, at the market, and vendors who acted as intermediary buyers. In most cases, final consumers paid more than intermediaries for the same products. However, intermediaries could sometimes pay consumer prices and then still make a profit by reducing the quantities when re-selling the products for the same price. In some situations, the unit price was lowered if the entire product was bought at once (wholesale prices were offered). Demand and supply played a role in price determination for all the products though this was situational. During high supply and low demand market prices tended to decline; consequently, traders were compelled to reduce their prices further, especially for perishable products such as mushrooms and wild fruits. The role of mushrooms towards food security was also reported by Mahonya, *et al*., (2019) who established that collection of mushrooms was found to contribute close to a margin of 28.7% on food security. This has a potential to improve rural development by acting as a good source of sauce for most of the families who enjoy bushmeat or wild edible animals in form of insects, fish, birds, and some mammals which wildlife allows to be consumed. Further, the collection of wild vegetables was also explored to range between 50-70% towards food security in forested zones in South Africa (Shackleton CM, *et al*., 2017). This is confirmed by the study done in non-timber forest products in the Eastern Arc Mountains in Tanzania. These found out that collection of wild vegetables, medicinal plants and grass had a positive and significant influence on food security. These can act as harbors for environment degradation because the rural households collectively benefit from them (Ulrichs *et al.*, 2019).

Seasonality and scarcity of the products had an influence on the prices, for example, grass, berries, honey, fetched higher prices during dry season resulting in prices almost doubling for the same product and quantity. The length of time to collect the products and distance to the market had no influence on the prices as the products were regarded as free resources by most buyers with no capital investment while at the same time excluding labor costs. Aluko and Bobadoye, (2020) also

ascertained that rural households in Kaduna Nigeria obtained over 80% of their incomes from selling NTFPs. Additionally, Zaku *et al.*, (2013) also found out that over 70% of households depended on fuelwood in the country as their major source of energy with an estimated consumption of 27.5 million Kilogram on daily basis in Nigeria. This thus informs us that dealing in NTFPs in several countries is shifting from subsistence exploitation and selling locally and nationally to an international trade. In Western part of Nigeria, game meat and snail harvesting for selling were found to be the main income generating activities for close to a whole year (Opaluwa, *et al*., 2014). In Eastern Arc Mountains in Tanzania, honey, firewood, locust beans, gum Arabic, and charcoal provide a lot of income for rural based households (Jimoh, *et al.*, 2013; Suleiman *et al.*, 2017). These forms of contribution are mentioned in different countries in Africa like Nigeria, Kenya, Uganda, and Tanzania (Secretariat of the Convention on Biological Diversity (SCBD) *et al.*, 2014). The world is struggling with a multiplicity of problems in forest-based communities ranging from poverty and lack of employment. These communities are living in areas which are remote with no access to important social services. In consequence, these communities find themselves relying on natural resources in their proximity. Therefore, forest resources especially the NTFPs must be looked at as a solution to communities to obtain required income and food. This study aimed at assessing the contribution or influence of NTFPs on rural livelihoods of households.

The findings further revealed that gender differences in roles was prevalent in edibles other than the whole chain. However, involvement at each stage was influenced by the distance to be covered to get the resource and the type of product. Thus, only women and children were involved in harvesting mushrooms because of the long distances traveled to get other resources (5–14 km). Grass selling was done by men and women. Firewood was mostly collected by women and children. Poles and Ropes were mainly collected by women and men. Medicinal plants were mostly collected by women. By execution, in all three administrative posts, it is only women who are involved who carried out all the activities such as collecting, transporting, and selling NTFPs to final consumers. The value chain of edibles was the exclusive domain of women and children/girls, who collected the product, transported, processed, sold to intermediaries, and direct to consumers. Wild vegetables, berries, tubers, and fruits attracted the involvement of all groups (men, women, boys, and girls). However, in Mecula, only men and women participated in the collection, transportation, cleaning, and selling with most participation by men. On the contrary,

respondents indicated that there were few men participating in the wild fruits trade in all three administrative posts. NTFP traders also enjoyed non-monetary benefits. For all NTFPs, the traders mentioned their self-employed status; the trade had taught them business skills, using part of the product without purchasing, flexibility to undertake the trade, the ability to work with family members and to multitask with other productive works, or household chores. For mushrooms, wild fruit and other edibles, traders also saw their involvement in the trade as a way of keeping traditional products and knowledge alive for passing on to future generations. In concurrence with the study findings, Kilonzo *et al.,* (2018) had also established that age differences, sex differences, income differences, resource differences, location differences, distance differences of NTFPs participants are central in obtaining economic value of NTFPs.

The economic value analysis conducted established that 21 NTFPs ranging between food products, firewood, and construction materials were collected, produced, and traded by households living adjacent to Mecula-Lugenda Corridor zones. The identified and quantified NTFPs in the study area were firewood, honey, bush meat, wild mushrooms, medicinal plants, honey, poles, thatch grass, ropes, wild vegetables, palm leaves, wild fruits, berries, forage, rubber, tree oils and resins, sisal, and wild tubes. The mean annual value of the identified NTFPs ranged from 600.00MZN/$9.68 to 6,000.00MZN/$96.77. Fish and poles had the highest mean annual value followed by others. The NTFPs were collected mainly from farmlands and village forests and illegally from reserve forests for some NTFPs like dried firewood, mushrooms, wild vegetables, and medicinal plants. The most dominant NTFPs in terms of mean annual value per household were firewood, mushroom, medicinal plants, and honey. Forest communities collected firewood largely for subsistence and less for trade. In line with earlier studies, the economic value of NTFPs is not limited to food security but also income generation. Ojea, *et al*., (2016) conducted a study in Rain Forests in Lesotho where they established a contribution of 33% of NTFPs on income generated by farmers indirectly from rain forests since they would save the money, they would use to buy firewood to do something else, in either way, it is a contribution to income generation. Particularly, they found out that firewood had greatly contributed to savings among households. This implied that community members who collected firewood were highly likely to have growth in income. These findings concur with earlier studies done by Steele *et al.,* (2015) who had found out that firewood took first priority among the NTFPs consumed in Ecuador and Peru. These were consumed both at household or subsistence and commercial levels by majority of rural dwellers.

They were contributing to 70% of income generated by a good number of community members who relied on forests for a living. In addition, in line with the above study, Zaku *et al.*, (2013) had conducted a study in Kaduna State, Nigeria. These had also found that wild vegetables are a main source of incomes like the findings this current study.

Furthermore, Shackleton, *et al*., (2017) found out a significant role of wild vegetables on income generation. This suggests that community members who collected wild vegetables like greens, pepper, eggplants etc. increased their income by a margin of 30%. Further, collection of mushrooms increased seasonal income of farmers by 15.6%. Further, the collection of medicinal plants contributed increased income generation among herbalists by 75%. This tallied exactly with what Schaafsma *et al.*, (2014a) and Newton, *et al.*, (2016b) established that medicinal plants like garlic, gingers, feverfew, ginseng etc. contributed 51.2% on the incomes generated by neighboring communities in Eastern Arc Mountains in Tanzania. Secretariat of the Convention on Biological Diversity (SCBD) *et al.,* (2014) also found out that charcoal was contributing 35% on the incomes generated from NTFPs. This tallies with Munanura *et al.,* (2014) who had done a study in Rwanda on forest dependence at Volcanoes National Park. These found out that the number of people selling spices collected from the volcano forest were higher and this had contributed on the employment and incomes generated.

Still, NTFPs remain an important source of income for the rural poor throughout the developing world, especially in Sub-Saharan Africa. In a study of household use of natural resources in the Kat River Valley of South Africa of Singh and Chatterjee (2022) noted that NTFPs share of total household income was about 20%. The study revealed that households purchased significantly more NTFPs as wealth increased, and a greater proportion of wealthy households did so. On the other hand, a greater proportion of poor households were involved in the sale of one or more NTFPs, and they sold greater quantities and volumes per household, as compared to wealthy households. Detailed examination of use and value of four NTFPs (wood fuel, wild fruits, edible herbs, and grass) revealed that in all instances, the poorest households used more of the resource per capita than the other wealth classes. Even if absolute amounts used were similar between poor and rich households, the income derived from NTFPs by poor households makes a greater contribution to their welfare because it represents a higher proportion of income, relative to wealthier households. Wealthy households typically have a greater number of income streams,

thus NTFPs represent a lower, but still important, proportion of total livelihood income. This is a clear indication that the poor tend to rely more on NTFPs than wealthier households. Kinyili and Ndunda, (2022) reported that ad hoc trade in NTFPs is a common safety net for rural households in South Africa and other African countries (for example, as a fallback for income in the off season or during periods of weak crop yields), which in some instances becomes a permanent source of livelihood. Although the cash income from NTFP trade are small, they provide an important contribution that complements the diverse livelihood strategies within a household, especially for the poorer sectors of rural society (Andrés and Delvaux, 2018). In developing countries, most of the rural households and a large proportion of urban households depend on NTFPs to meet some parts of their nutritional, health, and raw material needs, and for income from selling these products in local markets. In some cases, NTFPs are the only source of income for local communities (Pedersen, *et al.,* 2020), and they form an integral part of the rural economy. Kinyili and Ndunda, (2022) observed that NTFPs are an important source of livelihood for rural communities in Mozambique especially during times of economic, social, or bio-physical shocks.

It is learnt that commercial NTFPs can provide a significant means for food access, monetary growth, and sustainable forest management to local communities. Perhaps with the increasing demand for natural, wild health products across the globe, many products which were previously only locally consumed are finding expanded markets. In several areas, NTFPs are collected both for domestic and largely commercial sale. Besides having established NTFP market in different areas, primary collectors face challenges in obtaining good value on their product due to lack of awareness among them, regarding the quality specifications and requirements in the market. The rural poor involved in harvesting NTFP do remain the least paid people in the whole trade chain and are subjugated by the middlemen as they are less alert about the price trends in the markets. Furthermore, to maximize their profits, the local traders end up prejudicing poor gatherers to increase the quantity of raw materials. The low pricing of different NTFPs in the state is due to unscientific processing and quality deterioration. The traditional practice of drying NTFPs on roadsides increases the content of foreign material in the collection and lack of proper grading/ cleaning practice, the collectors are unable to sell their harvest at average grade prices. Another problem is posed by the premature harvesting due to which the villagers end up having low quality collections. This means that Farmer Producer Companies (FPC) need to be developed within the value chain in the area can help the farmers and other stakeholders in adopting scientific process

of harvesting, drying, and grading their products. Though, scientific value chain developing is in emerging stage in the area but is gaining its importance amongst the stakeholders rapidly. FPC can also ensure that post-harvest handling and value addition through semi processing to ensure higher return to the farmers. Therefore, to fetch higher market price, capacity development of farmers about the market price trends and quality assurance through value addition to raw product is essential. FPC can directly and indirectly help farmers in developing their understanding about the products being collected for commercial sale and its value addition. It has been realized that the demand of 99% of NTFPs by the international export can only be met through proper trainings and consultations with the primary collectors to promote hygienic, sustainably harvested mature seeds and post-harvest handling. This is why few collectors and traders sell to international export companies. The high demand in the international market provides an opportunity to utilize this NTFP as a viable economic livelihood option. The value chain facilitates an improved understanding of competitive challenges, helps in the identification of relationships and coordination mechanisms, and assists in understanding how value chain actors deal with powers and who governs or influences the chain. Developing value chains is often about improving access to markets and ensuring a more efficient product flow while ensuring that all actors in that chain benefit.

7.4 Summary

The economic value analysis conducted established that 21 NTFPs ranging between food products, firewood, and construction materials were collected, produced, and traded by households living adjacent to Mecula-Lugenda Corridor zones. The mean annual value of the identified NTFPs ranged from 600.00MZN/$9.68 to 6000.00MZN/$96.77 Fish and poles had the highest mean annual value followed by others. The NTFPs were collected mainly from farmlands and village forests and illegally from reserve forests for some NTFPs like dried firewood, mushrooms, wild vegetable, and medicinal plants. The most dominant NTFPs in terms of mean annual value per household were firewood, mushroom, medicinal plants, and honey. The study findings thus established that collection of NTFPs generally contribute 38.6% to food security in NSR. Specifically, the study also showed that spices contributed much to securing daily food at home. They found out that they not only use spices for food but also income generation. The natural flavors found in these spices influence a good number of consumers to use these spices.

CHAPTER EIGHT: CONCLUSION AND RECOMMENDATIONS

8.1: Conclusion.

In Mecula-Lugenda Corridor, gathering and marketing of main NTFPs is an activity done by people to take care of their primary needs. But the conservation techniques of these products are not well developed. The NTFP value chain is complex and short, with multiple actors involved. Profit margins of the main collectors are very low compared to semi-wholesalers and wholesalers, due to the poor organization of collectors, low access to market information, low power in price negotiation, lack of storage and drying facilities, concentrated poverty in rural areas as well as the high purchasing and price setting power of wholesalers who intervene in the current value chain.

Secondly, it was confirmed that collection, production and selling of NTFPs have a positive and significant influence on rural livelihoods in terms of food security and household incomes of people in Mecula-Lugenda Corridor NSR of Mozambique. These practices pose a great potential to conserve forests in the area since they always fight to ensure that their source of income and food is sustainable. These can be important practices in addressing concerns of food insecurity, unemployment, and poverty alleviation in Mecula-Lugenda corridor, NSR of Mozambique and other parts of Sub-Saharan Africa. For instance, collection, production and selling of firewood, wild vegetables, medicinal plants, spices, charcoal, forage, honey, wild tubers, wild fruits and nuts and ropes had a positive and significant influence on both food security and incomes of rural households. This means that they contributed largely to their survival and the survival of the forests. Even though, the collection of these NTFPs had contributed largely on food security and income generation, production and selling of these products has remained less and on subsistence basis.

It was revealed by the study that communities living near the forests are highly dependent on NTFPs in Mecula-Lugenda Corridor NSR. The study revealed that 90.9% of the households participate in collecting, production, and selling non-timber forest products. Twenty factors or characteristics were found to have a significant association with dependence on forest resources. These included availability of NTFPs, taking a collection of NTFPs as a family job, strong cultural value attached to forests, seasonal engagement in collection, nearby forests being a home for community leaders, distance to the nearest forest, the house construction materials, forests being

a major source of medicine and forests being a resource for education institutions. Other factors are forests being a major source of household food security, ready income for households, tourist attraction in the area and affordability of distance to markets. The binary logistic regression revealed gender, age, education, family size, and time spent in the area as significantly associated with dependence on NTFPs. Additionally, forest fires, strong cultural value attached to forests; seasonal engagement in collection, nearby forests being homes for community leaders, distance to the nearby forest, construction needs, a major source of medicine, education, household food security. ready income, tourist attraction, and affordability of a distance to markets were found to have a significant influence. On the other hand, dangerous wildlife, restriction of cultivation in non-gazetted forests, restriction of hunting in non-gazetted forests, forest fires negatively affected the dependence on NTFPs/resources.

Finally, the mean annual value of the identified NTFPs ranged from 600.00MZN/$9.68 to 6.000.00MZN/$96.77. Fish and poles had the highest mean annual value. The most dominant NTFPs in terms of mean annual value per household were firewood, mushrooms, medicinal plants, and honey. This implied that the community attached much economic value to firewood, mushrooms, medicinal plants, and honey which was statistically and economically true.

8.2: Recommendations

The value chain of NTFPs, the NTFP value chain in Mecula-Lugenda Corridor needs some focus action such as providing equipment to the collectors necessary for collection, processing and conservation; building the capacity of collectors on drying, conservation and processing techniques, creating and empowering collectors' organization and their networking with buyers, developing of market information system and an enabling environment that facilitate market access to local collectors. Together these solutions can give more power to local collectors in the NTFP value chain in Mecula-Lugenda Corridor. Furthermore, improving NTFPs quality can improve NTFP price in rural, national, and international markets and then reduce the pressure on forest resources and on biodiversity in general. However, more research is needed on how to improve the power of collectors in the process from gathering to selling products so that the income of the collectors can be increased contribute to biodiversity conservation in rural areas.

There is also a need to promote off-farm income generating activities. These can range from adding value to NTFPs collected and engaging in handcraft. This promotion can be done by different stakeholders while prioritizing technical and financial support programs. These can in long run promote diversification of these into formal sector employment, coupling them with education and development of skills. This will help reduce household overreliance on NTFPs for livelihoods and income generation. For effective conservation of NTFPs, strategies should take into consideration groups which were found to have more stakes, such as women, men, and youths, in planning and implementing sustainable utilization and management of forest resources. In addition, interventions aimed at conserving the forest should consider both in-situ and ex-situ conservation of the most utilized plants and trees. For instance, trees and plants which provide NTFPs in form of spices, firewood and medicines need to be preserved to avoid exhaustion or relieve pressure on the wild stock. Provision of energy saving stoves. Lastly, biogas as alternative fuel wood is recommended to reduce household overreliance on the forest wood plant.

Thirdly there is a need to understand the mentioned factors characterizing dependence on NTFPs among households living adjacent to forests before the forest management policies are implemented sustainably at local levels. There is a need to clearly take note of the time spent by households because it was established as an important factor that highly contributes to dependence on forest resources. This means that forest management plans need to put this into consideration. Further, Wildlife Conservation Society, Government Authorities and Community Forest Associations in Mozambique most especially in Mecula-Lugenda Corridor need to ensure that aspects are raised above when designing or revising Participatory Management Plans. The users of forest resources can design initiatives locally. This may make them more effective and sustainable.

Lastly, ANAC and WCS who are saddled with the responsibilities of managing the resources of the Reserve should design programs that will create more awareness for the people to see the need to protect the flora and fauna species from being threatened. Domestication of indigenous tree species should be encouraged for the reduction of poverty and for balance to be maintained in the ecosystem. There is a problem of encroachment by people living in the Corridor in the search for different NTFPs. Therefore, the government should encourage the cultivation of edible and medicinal tree species around homes (home gardens) incorporated with honey production. This

will reduce encroachment into the forest for tree species exploitation for economic and medicinal reasons.

References.

Adewumi, I. I. (2021) *Effect of Utilisation of Selected Non-Timber Forest Products [NTFPs] on Rural Households' Poverty Status in Southwestern Nigeria*. Kwara State University (Nigeria).

Ali, D. (2021) 'Effect of the Altitudinal Gradient on the Structure and Diversity of the Tree Component in Monte Unango', *International Journal of Energy and Environmental Science,* 6(2), p. 40.

Allan, J. R., Venter, O., Maxwell, S., & Wilson, K. (2017). Patterns of forest loss in one of Africa's last remaining wilderness areas: Niassa national reserve (northern Mozambique). Parks, 23(2), 40–50. doi:10.2305/IUCN.CH.2017.PARKS-23-2JRA.en.

Aluko, O. J. and Bobadoye, A. (2020) 'Adaptive strategies to deforestation among Non-Timber Forest Products (NTFPS) collectors across gender line in Oluwa Forest Reserve Area of Ondo adaptive strategies to deforestation among non-timber forest products (ntfps) collectors across gender lin', (September). doi: 10.4314/as.v19i2.8.

Amusa, T. O., Jimoh, S. O. and Azeez, I. O. (2017) 'Socio-economic factors influencing marketing of non-timber forest products in tropical lowland rainforests of south-western Nigeria§', *Southern Forests*. doi: 10.2989/20702620.2016.1255411.

Andrés, P. and Delvaux, G. (2018) 'Access to common resources and food security: Evidence from National Surveys in Nigeria'.

Angelsen, A. Larsen, H. O., Lund, J. F., Smith-Hall, C., Wunder, S., & Noack, F. (2014a) 'Environmental Income and Rural Livelihoods: A Global-Comparative Analysis', *World Development*, 64(S1), pp. S12–S28. doi: 10.1016/j.worlddev.2014.03.006.

Angelsen, A., Pamela, J., Ronnie, B., Brian, B., Nicholas, J. H., Simone. B., Jan., Carsten, S., & Sven, W. (2014b) 'Environmental Income and Rural Livelihoods: A Global-Comparative Analysis', *World Development*, 64(S1), pp. S12–S28. doi: 10.1016/J.WORLDDEV.2014.03.006.

Ao, G., Xu, Q., Xiong, L., Lui, Q., Wang, F., & Wu, W. (2021) 'The influence of nontimber forest products development on the economic-ecological coordination-evidence from Lin'an District, Zhejiang Province, China', *Sustainability (Switzerland)*, 13(2), pp. 1–20. doi:

10.3390/su13020904.

Assaf, C., Adams, C., Ferreira, F.F. and França, H. (2021) ‘Land use and cover modeling as a tool for analyzing nature conservation policies–A case study of Juréia-Itatins’, *Land use policy,* 100, p. 104895.

Awono, A. and Levang, P. (2018) ‘Contribution of environmental products to the household economy in Cameroon : essential , complementary or trivial ?’, 2(1). doi: 10.15406/freij.2018.02.00018.

Balama, C., Elmqvist, T., Muhammed, N., & Rockström, J. (2016) ‘Economic Valuation of Nontimber Forest Products under the Changing Climate in Kilombero District , Tanzania’, 2016.

Balvanera, P., Siddique, I., Dee, L., Paquette, A., Isbell, F., Gonzalez, A., ... & Oudenhoven, A. P. (2014) ‘Linking Biodiversity and Ecosystem Services : Current Uncertainties and the Necessary Next Steps’, (January). doi: 10.1093/biosci/bit003.

Barbour, M. G., Burk, J. H., & Pitts, W. D. (1987) *Terrestrial Plant Ecology. The Benjaminn/Cumming Pub. Co.* Inc. California.

Bharath Kumar, L. B., Chandran, R., & Vasudeva, R. (2011) ‘Participation behavior of indigenous people in non-timber forest products extraction in western ghats forests*’, in *Karnataka J. Agric. Sci*, pp. 170–172.

Blaney, S., Beaudry, M. and Latham, M. (2009) ‘Contribution of natural resources to nutritional status in a protected area of Gabon’, *Food and Nutrition Bulletin*, 30(1), pp. 49–62. doi: 10.1177/156482650903000105.

Boadu, A. A. and Asase, A. (2017) ‘Documentation of herbal medicines used for the treatment and management of human diseases by some communities in southern Ghana’, *Evidence-based Complementary and Alternative Medicine*, 2017. doi: 10.1155/2017/3043061.

Boon, D. M. (2009) ‘The livelihood potential of non-wood forest products: The case of Mbooni Division in Makueni District, Kenya’, *Environment, Development and Sustainability*, 11, pp. 989–1004.

Borah, D., Deka, P. C., Nath, S. C., & Saikia, P. K. (2020) 'Assessment of non-timber forest products (NTFPS) in Behali reserve forest, Assam, Northeast India', *Ethnobotany Research and Applications*, 19, pp. 1–15. doi: 10.32859/era.19.43.1-15.

Bourne, L. and Walker, D. H. T. (2005) 'Visualising and mapping stakeholder influence', *Management Decision*, 43(5), pp. 649–660. doi: 10.1108/00251740510597680.

Cardozo, E. G., Baccaro, F. B., & Dáttilo, W. (2015) 'Species richness increases income in agroforestry systems of eastern Amazonia', *Agroforestry Systems*, 89(5), pp. 901–916. doi: 10.1007/S10457-015-9823-9.

Carvalho Ribeiro, S. M., Overbeck, G. E., Siqueira, J. O., & Schiavetti, A. (2018) 'Can multifunctional livelihoods including recreational ecosystem services (RES) and non-timber forest products (NTFP) maintain biodiverse forests in the Brazilian Amazon?', *Ecosystem Services*, 31. doi: 10.1016/j.ecoser.2018.03.016.

Caspa, R.G., Myambi, G.N., Amang, M.J., Mabe, M.N., Nwegueh, A.B. and Foahom, B. (2020) 'Socio-economic benefits of non-timber forest products to the AFCOE2M communities of Southern Cameroon', *Sustainable Agriculture Research*, 9(526-2021–477), pp. 30-38.

Chamberlain, J. L., Darr, D. and Meinhold, K. (2020) 'Rediscovering the contributions of forests and trees to transition global food systems', *Forests*, 11(10), pp. 1–21. doi: 10.3390/f11101098.

Charnley, J. (2005) *The closed treatment of common fractures*. Cambridge University Press.

Chirwa, P.W. and Adeyemi, O. (2020) 'Deforestation in Africa: Implications on Food and Nutritional Security', *Zero Hunger*, pp. 197–211. doi: DOI: 10.1007/978-3-319-95675-6_62.

Chou, P. (2018) 'The Role of Non-Timber Forest Products in Creating Incentives for Forest Conservation: A Case Study of Phnom Prich Wildlife Sanctuary, Cambodia', *Resources*, 7(3), p. 41. doi: https://doi.org/10.3390/resources7030041.

Dash, M., Behera, B. and Rahut, D. B. (2016) 'Determinants of household collection of non-timber forest products (NTFPs) and alternative livelihood activities in Similipal Tiger Reserve, India', *Forest Policy and Economics*, 73(September), pp. 215–228. doi: 10.1016/j.forpol.2016.09.012.

Debrot, A. O., Van Bochove, J. W., & Thorpe, A. (2020) 'Non-timber forest product livelihood-focused interventions in support of mangrove restoration: A call to action', *Forests*, 11(11), pp. 1–17. doi: 10.3390/f11111224.

Delgado, T. S., McCall, M. K. and López-Binqüist, C. (2016) 'Recognized but not supported: Assessing the incorporation of non-timber forest products into Mexican forest policy', *Forest Policy and Economics*, 71. doi: 10.1016/j.forpol.2016.07.002.

District, M. (2020) 'Map of Niassa Special Reserve (Mecula- Marrupa Corridor). Mozambique'.

Donaldson, T. and Preston, L. E. (1995) 'The stakeholder theory of the corporation: Concepts, evidence, and implications.', *Academy of management Review*, 20(1), pp. 65–91.

Dovie, D. B. K., Shackleton, C. M., and Witkowski, E. T. F. (2002) 'Valuing non-timber forest products - indicator for interplay between poverty, livelihoods and the environment.', in. Rio de Janeiro: Open Meeting of the Global Environmental Change Research Community.

E. Lopes, B. Soares-Filho, F. Souza, R. Rajão, F. & Merry, S. C. C. R. (2019) 'Mapping the socio-ecology of Non Timber Forest Products (NTFP) extraction in the Brazilian Amazon: The case of açaí (Euterpe precatoria Mart) in Acre', *Landscape and Urban Planning*, 188, pp. 110–117. doi: DOI:10.1016/J.LANDURBPLAN.2018.08.025.

Elum, Z. A., Modise, D. M. and Marr, A. (2017) 'Farmer's perception of climate change and responsive strategies in three selected provinces of South Africa', *Climate Risk Management*, 16. doi: 10.1016/j.crm.2016.11.001.

Endamana, D., Angu Angu, K., Epanda, M., Dikangadissi, J. T., & Nzooh Dongmo, Z. L. (2016) 'Contribution of non-timber forest products to cash and non-cash income of remote forest communities in Central Africa', *International Forestry Review*, 18(3). doi: 10.1505/146554816819501682.

Epanda, M. A., Palla, F., Nzooh Dongmo, Z. L., Endamana, D., & Lapeyre, R. (2020a) 'Contribution of non-timber forest product valorisation to the livelihood assets of local people in the northern periphery of the Dja Faunal Reserve, East Cameroon', *Forests*, 11(9). doi: 10.3390/F11091019.

Eriksen, S. and Silva, J. A. (2009) 'The vulnerability context of a savanna area in Mozambique: household drought coping strategies and responses to economic change', *Environmental science & policy*, 12(1), pp. 33–52.

FAO (2010) *Global Forest Resources Assessment. Country Report United Republic of Tanzania FRA2010/222*. Rome Italy.

FAO (2018) *the State of the World'S Forests*.

Félix, A., Nhamussua, R. R., Manjate, M. J., & Manuel, A. D. F. J. (2020) 'Critérios de conservação regional da zebra das planícies (equus quagga crawshayi) na Reserva Especial do Niassa', *Nature and Conservation*, 13(4), pp. 12-21.

Figueira Fernandes Elizalde, S. R. (2020) *Bee diversity in Angola and community change along an altitudinal gradient at Serra da Chela (Bruco)*.

Forest, A. (2020) 'Distribution and Importance Value Index of Woody Species Under Different Successional Stages at Jello-Muktar Dry', 8(1), pp. 1–8. doi: 10.11648/j.ajaf.20200801.11.

Frank Ellis, A. F. (2004) 'Rural Livelihoods and Poverty Reduction in Four African Countries', *Journal of Development Studies*, 4(40), pp. 1–30. doi: 10.1080/00220380410001673175.

Frey, G. E., Chamberlain, J. L. and Jacobson, M. G. (2021) 'Producers, production, marketing, and sales of non-timber forest products in the United States: a review and synthesis', *Agroforestry Systems*, pp. 1–14. doi: https://doi.org/10.1007/s10457-021-00637-3.

Fuad, A., Bouyssou, D., & Monjardet, B. (2007) *Utility Maximization, Choice and Preference*. Springer Science & Business Media.

Greene, W. H. D. A. H. (2008) 'Modeling Ordered Choices: A Primer and Recent Developments'.

Gujarati, D.N., S. (2007) *"Basic Econometrics" (fourth edition).* New Delhi.: Tata MacGraw–Hill publishing company limited.

Gurung, L. J., Bhuju, D. R., Bhandari, B., & Bajracharya, B. (2020). Dataset of non-timber forest products use and impacts of recent climate change in the Upper Madi Watershed, Nepal. Data in Brief, 33, 106404. doi:10.1016/j.dib.2020.106404

Ha, T. N. H., De, L. B. L., Prior, J., & Tuoc, P. K. (2016). Community Participation and Harvesting of Non-Timber Forest Products in Benefit-Sharing Pilot Scheme in Bach Ma National Park, Central Vietnam. Tropical Conservation Science, 9(2), 877–902.

Hamza Mgumia, F. (2017) 'Traditional Uses of Miombo Woodland Tree Species in Sikonge District, Tanzania', *International Journal of Natural Resource Ecology and Management*, 2(4), p. 69. doi: 10.11648/j.ijnrem.20170204.11.

Harbi, J., Risyad, I. F., & Pratiwi, D. (2018). Making a bridge between livelihoods and forest conservation: Lessons from non-timber forest products' utilization in South Sumatera, Indonesia. Forest Policy and Economics, 94. doi:10.1016/j.forpol.2018.05.011..

Heubes, J., Schmidt, M., Stuch, B., & Wittig, R. (2012). Impact of Future Climate and Land Use Change on Non-timber Forest Product Provision in Benin, West Africa: Linking Niche-based Modeling with Ecosystem Service Values. Economic Botany, 66(4), 383–397. doi:10.1007/S12231-012-9216-1.

Hlongwane, J. J., Ledwaba, L. J., & Belete, A. (2014) 'Analyzing the factors affecting the market participation of maize farmers: A case study of small-scale farmers in greater Giyani Local Municipality of the Mopani District, Limpopo Province.', *African journal of agricultural research*, 9(10), pp. 895–899.

Hong, N. T. and Saizen, I. (2019) 'Forest Ecosystem Services and Local Communities: Towards a Possible Solution to Reduce Forest Dependence in Bach Ma National Park, Vietnam', *Human Ecology*, 47(3), pp. 465–476. doi: 10.1007/s10745-019-00083-x.

Howley, P., Hynes, S., and Donoghue, C. O. (2012) 'Explaining the non-economic behavior of farm foresters: The effect of productivist and lifestyle motivations'.

Hutauruk, T. R., Lahjie, A. M., Simarangkir, B., Aipassa, M. I., & Ruslim, Y. (2018) 'Setulang forest conservation strategy in safeguarding the conservation of non-timber forest products in Malinau District', *IOP Conference Series Earth and Environmental Science*, 144(1). doi: DOI: 10.1088/1755-1315/144/1/012055.

Huynh, H. T. N., Lobry de Bruyn, L., Prior, J., & Tuoc, P. K. (2016). Community participation

and harvesting of non-timber forest products in benefit-sharing pilot scheme in Bach Ma National Park, Central Vietnam. Tropical Conservation Science, 9(2), 877–902. doi:10.1177/194008291600900218.

Ifeoma, C. E., Chinazo, K. O., Chinasa, A. U., & Samuel, E. O. (2021) 'Antiplasmodial, antinociceptive and antipyretic potential of the stem bark extract of Burkea africana and identification of its antiplasmodial-active fraction', *J Tradit Complement Med*, 11(4), pp. 311–317. doi: DOI: 10.1016/j.jtcme.2020.12.004.

Immaculada, O. and Yadvinder, M. (2016) 'Many shades of green: the dynamic tropical forest–savannah transition zones', *Philosophical Transactions of the Royal Society B: Biological Sciences*, 371(1703), p. 20150308. doi: 10.1098/rstb.2015.0308.

J.L.G. Wong, and T. Kirsti, N. B. (2001) 'Resource Assessment of Non-wood Forest Products: Experience and Biometric Principles', *Forest Products Div.Department for International Development, London (United Kingdom)*, p. 109.

Jamnadass, R. H., Dawson I.K., Franzel, S., Leakey, R. R. B., Mithöfer, D., and Akinnifesi, F. K. (2011) 'Improving livelihoods and nutrition in Sub-Saharan Africa through the promotion of indigenous and exotic fruit production in smallholders' agroforestry systems: a review.', *International Forest Review*, 13, pp. 338–354.

Jaquet, S., Paudel, G., & Banjade, M. R. (2015). Does outmigration lead to land degradation? Labour shortage and land management in a western Nepal watershed. Applied Geography, 62, 157–170. doi:10.1016/J.APGEOG.2015.04.013.

Jimoh, S. O., Amusa, T. O., & Azeez, I. O. (2013) 'Population distribution and threats to sustainable management of selected non-timber forest products in tropical lowland rainforests of south western Nigeria.', *Journal of Forestry Research*. Available at: https://doi.org/10.1007/s11676-013-0327-z.

Jimoh, S. O., Amusa, T. O. & Azeez, I. O. (2013) 'Population distribution and threats to sustainable management of selected non-timber forest products in tropical lowland rainforests of south western Nigeria', *Journal of Forestry Research*, 24(1), pp. 75–82. doi: 10.1007/s11676-013-0327-z.

JohnWateridge (1998) ‘How can IS/IT projects be measured for success?’, *International Journal of Project Management*, 16(1), pp. 59–63.

Kajembe, G. C. & Mgoo, J. S. (2000) ‘Potentials of Non Wood Forest Products in Household Food Security in Tanzania : The Role of Gender Based Local Knowledge’.

Kalaba, F. K., Tembo, G., Phiri, A., Tembo, E., & Hara, M. (2009). The role of indigenous fruit trees in rural livelihoods: the case of communities in the mwekera area, copperbelt province, Zambia. Acta Horticulturae. doi:10.17660/actahortic.2009.806.14.

Kar, S. (2010) ‘Non-timber Forest Product (NTFP) utilization and livelihood development in Bangladesh. PhD thesis. The Pennsylvania State University.’

Khosravi, S., Maleknia, R. and Khedrizadeh, M. (2017) ‘Understanding the Contribution of Non-timber Forest Products to the Livelihoods of Forest Dwellers in the Northern Zagros in Iran’, *Small-scale Forestry*, 16(2). doi: 10.1007/s11842-016-9353-y.

Kilonzo, M., Kizito, F., & Tungu, A. (2018). Evaluation of socio-economic factors influencing exploitation of non-timber forest products in Tanzania. International Journal of Biodiversity and Conservation, 10(August), 330–336. doi:10.5897/IJBC2018.1198.

Kimdung, N., Bush, S. R. and Mol, A. P. J. (2016) ‘NGOs as Bridging Organizations in Managing Nature Protection in Vietnam’. doi: 10.1177/1070496516642499.

Kinyili, B. M. and Ndunda, E. (2022) *IN Forestry Sciences*. doi: 10.22271/ed.book.1651.

Koch, O., Ibisch, P.L. and Bloch, R. (2022) ‘Climate change and shifting land-use: Consequences for smallholder agroforestry systems and rural livelihoods in the southwest Ethiopian Highlands.’, *Agro ecology and Sustainable Food Systems*, 46(5), pp. 672–711.

Koontz, M., Lundberg, C., Lane, R., Day, J., & Pezeshki, R. (2016) ‘Aboveground net primary productivity in a riparian wetland following restoration of hydrology.’, *Biology*, 5(1), p. 10. doi: doi: 10.3390/biology5010010.

Kothari, C. R. (2004) ‘Research methodology: Methods and techniques. New Age International’.

Kyando, M.T., Nyahongo, J.W., Røskaft, E. & Nielsen, M. R. (2019) ‘Household reliance on

environmental income in the Western Serengeti Ecosystem, Tanzania'.

Lele, U., Dasgupta, S., Dewan, A., & Van Beukering, P. (2013). Changing Roles of Forests and their Cross-Sectorial Linkages in the Course of Economic Development. (pp. 1-172).

Leßmeister, A., Epp, L. S., Boukari, M., & Wendorff, J. (2018). The contribution of non-timber forest products (NTFPs) to rural household revenues in two villages in south-eastern Burkina Faso. Agroforestry Systems. doi:10.1007/s10457-016-0021-1.

Lopes, E., Vieira, D. L. M., de Almeida, A. S., & Santos, M. C. F. (2018). Mapping the socio-ecology of Non Timber Forest Products (NTFP) extraction in the Brazilian Amazon: The case of açaí (Euterpe precatoria Mart) in Acre. Landscape and Urban Planning, (July), 0–1. doi:10.1016/j.landurbplan.2018.08.025.

Lubega, G., Mario Paulo da Silva, F., Ssekandi, J., and Rebeiro, N. S. (2021) 'Evaluating the Effect of Non-Timber Forest Products on Rural Livelihoods in Macula-Marrupa Corridor Niassa Special Reserve, Mozambique: Implication for Income and Food Security', *American-Eurasian J. Agric. & Environ. Sci.*, 21(1), pp. 11–21. doi: DOI: 10.5829/idosi.aejaes.2021.11.21.

Lufuke, M., Hafizi, F., Friel, S., & Baum, F. (2023). Women's Empowerment, Food Security, and Nutrition Transition in Africa. International Journal of Environmental Research and Public Health, 20(1). doi:10.3390/ijerph20010254.

Mahonya, S., Shackleton, C. M. and Schreckenberg, K. (2019) 'Non-timber Forest Product Use and Market Chains Along a Deforestation Gradient in Southwest Malawi', *Frontiers in Forests and Global Change*, 2(November), pp. 1–12. doi: 10.3389/ffgc.2019.00071.

Marshall, E., Newton, A. C. and Schreckenberg, K. (2003) 'Commercialisation of non-timber forest products: First steps in analysing the factors influencing success', *International Forestry Review*, 5(2), pp. 128–137. doi: 10.1505/IFOR.5.2.128.17410.

Masiero, M., Guariguata, M. R., & Cronkleton, P. (2019). Valuing forest ecosystem services: A training manual for planners and project developers. Food and Agriculture Organization of the United Nations (FAO).

Massingue, A. O. (2019) 'Ecological Assessment and Biogeography of Coastal Vegetation and

Flora in Southern Mozambique'.

Mate, R., Johansson, T. and Sitoe, A. (2014) 'Biomass Equations for Tropical Forest Tree Species in Mozambique', pp. 535–556. doi: 10.3390/f5030535.

Matias, D. M. S., Magsino, R. M., Apale, M. B., Tupas, J. L. M., Villamor, G. B., Lasco, R. D., & Pulhin, F. B. (2018). Commercializing traditional non-timber forest products: An integrated value chain analysis of honey from giant honey bees in Palawan, Philippines. Forest Policy and Economics, 97, 223–231.

Mau, W., Sullivan, D. W., Kinsky, N. R., Hasselmo, M. E., Howard, M. W., & Eichenbaum, H. (2018) 'The same hippocampal CA1 population simultaneously codes temporal information over multiple timescales', *Current Biology*, 28(10), pp. 1499–1508.

Mbanze, A. A. (2020) 'Conservation by local people in the Niassa National Reserve: money or in-kind payments to adopt conservation-friendly practices.'

Mcfadden, D. (1960) 'Economic choices'.

McSweeney, K. (2004) 'Forest product sale as natural insurance: The effects of household characteristics and the nature of shock in eastern honduras', *Society and Natural Resources*, 17(1), pp. 39–56. doi: 10.1080/08941920490247245.

Melo, A. S. and Alegre, P. (2008) 'O que ganhamos " confundindo " riqueza de espécies e equabilidade em um índice de diversidade ? Introdução', 8(3).

Memiaghe, H. R., Lutz, J. A., Korte, L., Alonso, A., Kenfack, D., & Chuyong, G. B. (2016). Ecological Importance of Small-Diameter Trees to the Structure, Diversity and Biomass of a Tropical Evergreen Forest at Rabi, Gabon. PLoS ONE, 11(5). doi:10.1371/journal.pone.0154988.

Metian, M., Troell, M., Christensen, V., Steenbeek, J. and Pouil, S. (2020) 'Mapping diversity of species in global aquaculture', *Reviews in Aquaculture*, 12(2), pp. 1090–1100. doi: https://doi.org/10.1111/raq.12374.

Mipun, P., Bhat, N.A., Borah, D. and Kumar, Y. (2019) 'Non-timber forest products and their contribution to healthcare and livelihood security among the Karbi tribe in Northeast India',

Ecological Processes, 8(1), pp. 1–12.

Morgan, P. and Pontines, V. (2014) 'Financial Stability and Financial Inclusion', *Ssrn*, (December). doi: 10.2139/ssrn.2464018.

Mugenda, O.M. and Mugenda, A. G. (2003) 'Research Methods, Quantitative and Qualitative Approaches.Nairobi: African Centre for Technology Studies'.

Mugido, W. and Shackleton, C. M. (2019) 'The contribution of NTFPS to rural livelihoods in different agro-ecological zones of South Africa', *Forest Policy and Economics*, 109. doi: 10.1016/j.forpol.2019.101983.

Muhammad, Z. Y. H. (2002) 'Effect of socio-economic aspects of mango growers on the adoption of recommended horticultural practices', *Pakistan Journal of Agricultural Sciences.*, 39(1), pp. 20–21.

Muimba-Kankolongo, A. (2018) *Food Crop Production by Smallholder Farmers in Southern Africa: Challenges and Opportunities for Improvement*. Academic Press.

Mujawamariya, G. and Karimov, A. A. (2014a) 'Importance of socio-economic factors in the collection of NTFPs: The case of gum arabic in kenya', *Forest Policy and Economics*. doi: 10.1016/j.forpol.2014.02.005.

Mujawamariya, G. and Karimov, A. A. (2014b) 'Importance of socio-economic factors in the collection of NTFPs: The case of gum arabic in Kenya', *Forest Policy and Economics*, 42, pp. 24–29. doi: 10.1016/J.FORPOL.2014.02.005.

Mukul, S. A., Uddin, M. B., Rashid, M. M., Khan, M. N. I., & Uddin, M. S. (2016). Role of non-timber forest products in sustaining forest-based livelihoods and rural households' resilience capacity in and around protected areas: A Bangladesh study. Journal of Environmental Planning and Management, 59(4), 628–642. doi:10.1080/09640568.2015.1035774.

Mulenga, B. P., Richardson, R. B., Mapemba, L. D., & Tembo, G. (2014). Rural household participation in markets for non-timber forest products in Zambia. Environment and Development Economics, 19(4), 487–504. doi:10.1017/s1355770x13000569.

Munanura, I. E., Bizimana, C., Nsabimana, D., & Akimanizanye, P. (2014). Household Poverty Dimensions Influencing Forest Dependence at Volcanoes National Park, Rwanda: An Application of the Sustainable Livelihoods Framework. Natural Resources, 05(16), 1031–1047. doi:10.4236/nr.2014.516087.

Munawaroh, E., Isnaini, Y., Ajiningrum, P. S., Susiarti, S., & Purwanto, Y. (2020) 'Cultural significance analysis to support the valuation of non-timber forest products of the Malay Community in Tanjung Jabung, Jambi, Sumatera', *Journal of Tropical Ethnobiology,* 3(2), pp. 149–174. doi: https://doi.org/10.46359/jte.v3i2.52.

Mundoli, S., Joseph, G. and Setty, S. (2016) '"Shifting agriculture": the changing dynamics of Adivasi farming in the forest-fringes of a tiger reserve in south India', *Agro ecology and Sustainable Food Systems,* 40(8), pp. 759–782.

Musah, S., Wrighton, P.J., Zaltsman, Y., Zhong, X., Zorn, S., Parlato, M.B., Hsiao, C., Palecek, S.P., Chang, Q., Murphy, W.L. and Kiessling, L. L. (2014) 'Substratum-induced differentiation of human pluripotent stem cells reveals the coactivator YAP is a potent regulator of neuronal specification.', *Proceedings of the National Academy of Sciences,* 111(38), pp. 13805-13810.

Mushi, H., Yanda, P. Z., & Kleyer, M. (2020) 'Socioeconomic factors determining extraction of non-timber forest products on the slopes of Mt. Kilimanjaro, Tanzania', *Human Ecology,* 48(6), pp. 695-707.

Mutenje, M. J., Ortmann, G. F. and Ferrer, S. R. D. (2011) 'Management of non-timber forestry products extraction: Local institutions, ecological knowledge and market structure in South-Eastern Zimbabwe', *Ecological Economics,* 70, pp. 454–461.

Nabaloum, M., Ouédraogo, A., Savadogo, P., & Nacoulma, B. M. I. (2019). Conditions and Determinants of Access to Forests for the Non-Timber Forest Products Harvesting in Burkina Faso. (7), 14–28.

Nambiza, W. (2013) *Endline Survey for the project "Improving livelihood security and sustainability for rural communities in the Eastern Arc Mountains Project" and "Baseline Survey for the New Generation Watershed Management project". TFCG Technical Paper*. 42.

Ndayambaje, J.D., and Heijman, W.J.M. (2012) 'Household determinants of tree planting on farms in rural Rwanda. Small-scale forestry', 11(4), pp. 1–32.

Ndum, A.M.G. and Grace, M. A. (2022) *Chapter-7 Silvicultural Applications in the Regeneration of Some Non-Timber-Forest-Products Species., Forestry Sciences,*.

Negi, V., Kumar, Y., Negi, P., Uniyal, A., & Sharma, V. (2022). Tree species composition and diversity in natural temperate forests of the North-Western Himalayas. Acta Ecologica Sinica, (September). doi:10.1016/j.chnaes.2021.09.014.

Newton, P., Miller, K., and Daniel C, (2016) 'Who are forest-dependent people ? A taxonomy to aid livelihood and land use decision-making in forested regions Land Use Policy Who are forest-dependent people? A taxonomy to aid livelihood and land use decision-making in forested regions', *Land Use Policy*, 57(June), pp. 388–395. doi: 10.1016/j.landusepol.2016.05.032.

Nguyen, T., Lawler, S., Goldoftas, B. and Le, C. (2019) 'Biodiversity conservation or indigenous people's welfare: A dilemma for forest management in Vietnam's Bu Gia Map National Park.', *Community Development*, 50(4), pp. 406–421.

Nguyen, T. Van, Nguyen, H. T., Vu, T. H., & Nguyen, T. V. (2020). Determinants of non-timber forest product planting, development, and trading: Case study in central Vietnam. Forests, 11(1), 1–18. doi:10.3390/f11010116.

Nguyen Vu Linh (2015) 'Impact assessment of the pilot policy on benefit-sharing mechanism in management , protection and sustainable development of Special-Use Forests in Vietnam - Case study at Bach Ma National Park -'.

Ojea, E., Maria, L., Alló, M., & Barrio, M. (2016) 'Ecosystem Services and REDD: Estimating the Benefits of Non-Carbon Services in Worldwide Forests', *World Development, Elsevier*, 78, pp. 246-261. doi: DOI: 10.1016/j.worlddev.2015.10.002.

Opaluwa, H. I., Onuche, U., and Sale, F. A. (2011) 'Factors Affecting the Collection and Utilization of Non- Timber Forest Products in Rural Communities of North Central, Nigeria', *Journal of Agriculture and Food Technology*, 1(5), pp. 47–49.

Opeluwa, J. A., Olawuyi, S., and Anjorin, T. D. (2011) '"Analysis of Women Participation in

Agricultural Production in Egbedore Local Government Area of Osun State, Nigeria",' *International journal of agricultural economics and rural development*, 4.

Oso, W.K. and Onen, D. (2008) *A General guide to writing research proposals and report. Kampala: Makerere University*.

Pandey, A. K., Tripathi, Y. C. and Kumar, A. (2016) 'Non Timber Forest Products (NTFPs) for Sustained Livelihood: Challenges and Strategies', in *Research Journal of Forestry*, pp. 1–7. doi: 10.3923/rjf.2016.1.7.

Patience Tugume. P., Buyinza, M., Namaalwa, J., Kakudidi, E. K., Mucunguzi, P., Kalema, J., & Kamatenesi, M. (2015) 'Socio-economic predictors of dependence on Non-timber forest products: lessons from Mabira Central Forest Reserve Communities', *Journal of Agriculture and Environmental Sciences*, 4(2).

Paumgarten, F. (2007) *The significance of the safety-net role of NTFPs in rural livelihoods, South Africa, environmental sciences.*

Pedersen, S., Gangås, K. E. and Chetri, M. (2020) 'Economic Gain vs . Ecological Pain — Environmental Sustainability in Economies Based on Renewable Biological Resources'.

Peerzada, I. A., Shah, M. A., Qazi, P. H., Rather, A. M., & Ahmad, R. (2022). Potential of NTFP Based Bioeconomy in Livelihood Security and Income Inequality Mitigation in Kashmir Himalayas. Sustainability (Switzerland), 14(4). doi:10.3390/SU14042281.

Penjani, K., Vedeld, P., and Sjaastad, E. (2009) 'Forest Incomes and Rural Livelihoods in Chiradzulu District Malawi', *Ecological Economics*, 68(3), pp. 613–624. doi: DOI: 10.1016/j.ecolecon.2008.08.018.

Plottu, E., and Plottu, B. (2007) 'The concept of Total Economic Value of environment: A reconsideration within a hierarchical rationality". Ecological Economics.', pp. 51–62.

Plowman, N. S., Chen, S. C., & Yanoviak, S. P. (2020). Nest microhabitats and tree size mediate shifts in ant community structure across elevation in tropical rainforest canopies. Ecography, 43(3), 431–442. doi:10.1111/ecog.04730.

Polesny, Z. (2014) ‘Non-timber forest products utilization in Phong Dien Nature Reserve , Vietnam : Who collects , who consumes , who sells ?’, 322(4), pp. 39–49.

Pouliot, M. and Treue, T. (2013) ‘Rural People’s Reliance on Forests and the Non-Forest Environment in West Africa: Evidence from Ghana and Burkina Faso’, *World Development*, 43, pp. 180–193. doi: 10.1016/J.WORLDDEV.2012.09.010.

Razafindratsima, O. H., Grogan, K., Zhou, W., & Pflugmacher, D. (2021). Reviewing the evidence on the roles of forests and tree-based systems in poverty dynamics. Forest Policy and Economics, 131(June), 102576. doi:10.1016/j.forpol.2021.102576.

Reserve, N. N. and Mariri, B. (2018) ‘A unique wilderness of Niassa National Reserve where carnivores continue to persist and thrive with the full participation and support of local communities . To Promote coexistence between carnivores , wildlife and people in Niassa National Reserve , Moza’.

Reserve, N. S. (2016) ‘Forest parameters and carbon accounting under different fire regimes in Miombo woodlands, Niassa Special Reserve, Northern Mozambique’.

Reuben, G., Siobhan, C., Marco, V., Caoimhe, S., James, G. K., Rod, B., Ying-Ru, L., and Yves Souteyrand, B. W. (2010) ‘Highly active antiretroviral treatment as prevention of HIV transmission: review of scientific evidence and update’, 5(4), pp. 298–304. doi: 10.1097/COH.0b013e32833a6c32.

Ribeiro, N. S., Moscovitch, G., Spiegel, S., Jacobson, M., Ribeiro, R., & Estes, L. D. (2021). Prediction of forest parameters and carbon accounting under different fire regimes in Miombo woodlands, Niassa Special Reserve, Northern Mozambique. Forest Policy and Economics, 133. doi:10.1016/j.forpol.2021.102625.

Roswell, M., Dushoff, J., & Winfree, R. (2021) ‘A conceptual guide to measuring species diversity.’, *Oikos*, 130(3), pp. 321–338.

Rovero, J. (2007) *Economic valuation of selected non-timber forest products in Chiwale general land forest: a case study of Masasi district, Mtwara region-Tanzania (Doctoral dissertation, Sokoine University of Agriculture).*

Ryan, C. M., Williams, M., Grace, J., Woollen, E., Lehmann, C. E. R., Woodward, F. I., & Veenendaal, E. M. (2016). Ecosystem services from southern African woodlands and their future under global change. Philosophical Transactions of the Royal Society B: Biological Sciences, 371(1703). doi:10.1098/rstb.2015.0312.

Saifullah, M. K., Kari, F. B. and Othman, A. (2018) 'Income Dependency on Non-timber Forest Products: An Empirical Evidence of the Indigenous People in Peninsular Malaysia', in *Social Indicators Research*. Springer Netherlands, pp. 215–231. doi: 10.1007/s11205-016-1480-5.

Sakai, S., Sugiyama, A., Ohtsuka, R., Kitchanov, A., Umemura, M., & Maruyama, A. (2016). Social and ecological factors associated with the use of non-timber forest products by people in rural Borneo. Biological Conservation, 204. doi:10.1016/j.biocon.2016.10.022.

Salimo, M., Ribeiro, N. S., Farão, A., Chauque, A., Bandeira, R., Fernando, J., ... & Branquinho, C. (2022) 'Long-Term Effect of Fire Frequency on Miombo Woody Vegetation Dynamics: The Case of Niassa Special Reserve, Northern Mozambique. Northern Mozambique.', *SSRN Electronic Journal*.

Sari, A.S.P. and Sembiring, R. K. B. (2019) 'Improving Students' English Speaking Skill Through the Implementation of Talking Stick Method to the Fifth Grade Students of State Primary School 028226 Binjai.', *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, 2(4), pp. 507–513.

Schaafsma, M. (2012) *Mapping NTFP collection in Tanzania: a comparison of surveys. In: CSERGE Working Paper 2012-05.*

Schaafsma, M., Morse-Jones, S., Posen, P., Swetnam, R. D., Balmford, A., Bateman, I. J., & Turner, R. K. (2014). The importance of local forest benefits: Economic valuation of non-timber forest products in the eastern Arc mountains in Tanzania. Global Environmental Change, 295–305. doi:10.1016/j.gloenvcha.2013.08.018.

Secretariat of the Convention on Biological Diversity (SCBD) *et al.* (2014) *Biotropica*. First edit, 48(2), pp. 1–33. doi: 10.1111/btp.12386.

Sekaran, U. (2003) *Research Methods for Business: A Skill-Building Approach*. ohn Wiley. Edited

by 4th Edition. New York.

Sekaran, Uma (2003) *Research methods for business (4th edition), New York, USA: John Wiley & Sons*. doi: 10.1017/CBO9781107415324.004.

Shaankerbc, K. N., and Ganeshaiahbc, S. R. (2015) 'The influence of livelihood dependency, local ecological knowledge and market proximity on the ecological impacts of harvesting non-timber forest products', *Forest Policy and Economics*, 50(285–291).

Shackleton, C. M., Shackleton, S. E, and Buiten E, B. N. (2017) *The importance of dry woodlands and forests in rural livelihoods and poverty alleviation in South Africa*.

Shanley, P., Pierce, A. R., Laird, S. A., & Guillen, A. (2015). From Lifelines to Livelihoods: Non-timber Forest Products into the Twenty-First Century. In Tropical Forestry Handbook (pp. 1–50). doi:10.1007/978-3-642-41554-8_209-1.

Singh, S. and Chatterjee, S. (2022) 'Trees, Forests and People Value chain analysis of Rhododendron arboreum squash " buransh " as a non-timber forest product (NTFP) in Western Himalayas : Case study of Chamoli district , Uttarakhand in India', *Trees, Forests and People*, 7(January), p. 100200. doi: 10.1016/j.tfp.2022.100200.

Sisak, L., Riedl, M. and Dudik, R. (2016) 'Non-market non-timber forest products in the Czech Republic-Their socio-economic effects and trends in forest land use', *Land Use Policy*, 50, pp. 390–398. doi: 10.1016/j.landusepol.2015.10.006.

Smit, M., Meintjes, J.J., Jacobs, G., Stassen, P.J.C. and Theron, K. I. (2005) 'Shoot growth control of pear trees (Pyrus communis L.) with prohexadione-calcium', *Scientia Horticulturae*, 106(4), pp. 515–529.

Soe, K. T. and Yeo-chang, Y. (2019) 'Livelihood Dependency on Non-Timber Forest Products : Implications for REDD +', pp. 1–25.

Soe and Yeo-Chang (2019) 'Livelihood Dependency on Non-Timber Forest Products: Implications for REDD+', *Forests*, 10(5), p. 427. doi: 10.3390/f10050427.

Steele, M. Z., Gitonga, N., Ogada, M. J., & King, L. E. (2015). The influence of livelihood

dependency, local ecological knowledge and market proximity on the ecological impacts of harvesting non-timber forest products. Forest Policy and Economics, 50, 285–291. doi:10.1016/j.forpol.2014.07.011.

Suleiman, M. S., Dauda, E. N., Abubakar, U. B., & Abdul, K. A. (2017). Non-timber forest products and their contribution to households income around Falgore Game Reserve in Kano, Nigeria. Ecological Processes, 6(1). doi:10.1186/s13717-017-0090-8.

Sundriyal, H. U. R. M., & Sundriyal, R. C. (2020). Richness of non-timber forest products in Himalayan communities—diversity, distribution, use pattern and conservation status. Journal of Ethnobiology and Ethnomedicine, 16(1), 1–15.

Swamy, L., Drazen, E., Johnson, W.R. and Bukoski, J. J. (2018) 'The future of tropical forests under the United Nations Sustainable Development Goals', *Journal of Sustainable Forestry*, 37(2), pp. 221–256.

Talukdar, N.R., Choudhury, P., Barbhuiya, R.A. and Singh, B. (2020) 'Importance of Non-Timber Forest Products (NTFPs) in rural livelihood: A study in Patharia Hills Reserve Forest, northeast India', *Trees, Forests and People*, 3, p. p.100042. doi: https://doi.org/10.1016/j.tfp.2020.100042.

Tassou, M. (2017) 'Factors Affecting Household Participation In Non-Timber Forest Products Market In Eastern Uganda', in *Master Thesis, Department of Agricultural Economics in Partial Fulfilment of the requirements for the award of a Master of Science Degree in Agricultural and Applied Economics, University of Nairobi*, pp. 399–404.

Tekle Tegegne, Y., Cramm, M. and Van Brusselen, J. (2018) 'sustainability Sustainable Forest Management, FLEGT, and REDD+: Exploring Interlinkages to Strengthen Forest Policy Coherence'. doi: 10.3390/su10124841.

Teshome, J. Y. (2019) 'Role of Dry Forests in Rural Socio-economic Development in Sub-Saharan Africa', 8(2), pp. 29–37.

Timko, J. A., Waeber, P. O. and Kozak, R. A. (2010) 'The socio-economic contribution of non-timber forest products to rural livelihoods in Sub-Saharan Africa: Knowledge gaps and new directions', *International Forestry Review*. doi: 10.1505/ifor.12.3.284.

Tugume, P., Mpairwe, D., Buyinza, M., & Nabanoga, G. (2016). Socio-economic predictors of dependence on Non-timber forest products: lessons from Mabira Central Forest Reserve Communities. Journal of Agriculture and Environmental Sciences, 4(2), 195–214. doi:10.15640/jaes.v4n2a23.

Turreira-García, N., Sunderland, T. C. H., Nalini, E., Channa, P., & Oeur, I. (2018). Who Wants to Save the Forest? Characterizing Community-Led Monitoring in Prey Lang, Cambodia. Environmental Management, 61(6), 1019–1030. doi:10.1007/s00267-018-1039-0.

Ulrichs, M., Boano, C., Warner, K., Lazrus, H., Craddock, S., & Cannon, T. (2019). Building resilience to climate risks through social protection: from individualised models to systemic transformation. Disasters, 43, 368–387. doi:10.1111/disa.12339.

Västberg, O.B., Karlström, A., Jonsson, D. and Sundberg, M. (2020) 'A dynamic discrete choice activity-based travel demand model.', *Transportation science*, 54(1), pp. 21-41. doi: https://doi.org/10.1287/trsc.2019.0898.

Verma, S.K. and Paul, S. K. (2016) 'Sustaining the non-timber forest products (NTFPs) based rural livelihood of tribal's in Jharkhand: Issues and challenges', *Jharkhand Journal of Development and Management Studies,* 14(1), pp. 6865–6883.

Vo, Q. T., Kuenzer, C., Vo, Q. M., Moder, F., Oppelt, N., & Leinenkugel, P. (2013). Remote sensing in mapping mangrove ecosystems - an object-based approach. Remote Sensing, 5(1), 183–201. doi:10.3390/rs5010183.

Mugido, W., & Simelane, C. M. (2017). The Contribution of NTFP Trade to Rural Livelihoods in Different Agro-Ecological Zones of South Africa. International Forestry Review, 19(3), 306–320. doi:10.1505/146554817821865063.

Weyer, D., Shackleton, C. M., & Adam, Y. O. (2018) 'HIV/AIDS and other household shocks as catalysts of local commercialization of non-timber forest products in Southern Africa.', *Development Policy Review*, 36, pp. O285–O301.

Williams, R. and Dame, N. (2015) 'Heteroskedasticity', pp. 1–16.

Wongnaa, C.A., Ansong, M., Obirikorang, K.A., Nkrumah, E.E. and Arhin, A. (2020)

‘Contribution of Non-Timber Forest products to rural and urban incomes in Ghana’, *Rural-Urban Linkages and Sustainable Development*, p. 101.

Wood, E., Tappan, G., & Hadj, A. (2004). Understanding the drivers of agricultural land use change in south-central Senegal. J. Arid Environ. 59, 565–582. *et al.* (2004) ‘Urban Forest and Rural Cities: Multi-sited Households, Consumption Patterns, and Forest Resources in Amazonia’, *Ecology and Society*.

Wood, E., Tappan, G., & Hadj. (2008) ‘Urban Forest and Rural Cities: Multi-sited Households, Consumption Patterns, and Forest Resources in Amazonia’, *Ecology and Society*.

Wood, E., Tappan, G., Hadj, A., DeFries, R., & Rosenzweig, C. (2015) ‘Ecosystem Services Flows: Why Stakeholders’ Power Relationships Matter’, *PLoS One*.

Wood, E. C., Tappan, G. G. and Hadj, A. (2004) ‘Understanding the drivers of agricultural land use change in south-central Senegal’, *Journal of Arid Environments*, 59(3), pp. 565–582. doi: 10.1016/J.JARIDENV.2004.03.022.

World Conservation Society (2017) ‘Embedding animal welfare in staff culture: The Taronga Conservation Society Australia experience’, *International Zoo Yearbook*, 51(1), pp. 203-214.

Zaku, S. G., Adamu, S. A., Mohammed, U., & Abubakar, I. S. (2013). Wood fuel consumption in Nigeria and the energy ladder: A review of fuel wood use in Kaduna State. Journal of Physical Science and Technology, 4(May), 85–89. doi:10.5897/JPTAF.

Zella, A. Y., Saria, J. and Law, Y. (2018) ‘Consequences of climate change and variability in managing Selous Niassa trans frontier conservation area’, *Biodiversity International Journal*, 2(6), pp. 500–516. doi: 10.15406/bij.2018.02.00105.

Zhu, H., Yin, H., Yang, H., & Zhang, L. (2017). Determinants of engagement in non-timber forest products (NTFPs) business activities: A study on worker households in the forest areas of Daxinganling and Xiaoxinganling Mountains, northeastern China. Forest Policy and Economics, 80. doi:10.1016/j.forpol.2017.03.019.