RURAL HOUSEHOLDS' PERCEPTIONS AND WILLINGNESS TO PARTICIPATE IN THE SOCIO-ECONOMIC BENEFITS OF NON-TIMBER FOREST PRODUCTS IN THE FACE OF CLIMATE CHANGE: A CASE STUDY OF BUSHBUCKRIDGE LOCAL MUNICIPALITY, MPUMALANGA PROVINCE

BY

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DECLARATION 1

I Taelo Lehlogonolo Theko, declare that the mini-dissertation hereby submitted to the University of Limpopo, for the degree of Master of Science in Agriculture (Agricultural Economics) has not previously been submitted by me for a degree at this or any other university; that it is my work in design and in execution, and that all material contained herein has been duly acknowledged.

Signed: _____   Date: 10/09/2024

Ms TL Theko

DECLARATION 2 – PUBLICATIONS

Taelo L Theko, Mmaphuti A Nkoana, Mapula H Lefophane, Jan J Hlongwane. Rural households' perceptions and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change: A case study of Bushbuckridge local municipality, Mpumalanga province. A Journal of Trees, Forest and People has been identified for paper publication from this mini-dissertation.

DEDICATION

This study is dedicated to my family for their unending encouragement.

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ABSTRACT

Forests, as critical ecosystems, have played an important role in both reducing climate change and promoting sustainable development. However, anthropogenic activities such as deforestation, industrial operations, and fossil-fuel burning have had a considerable impact on these natural dynamics. These disturbances have changed the distribution and availability of the Non-Timber Forest Products(NTFPs). In view of that, this study attempts to fill the gap that says less about the impact of climate change on the NTFPs and the dependent rural communities. The main aim of the study was to assess the perceptions of rural households and their willingness to participate in the socio-economic benefits of NTFPs in the face of climate change. The specific objectives were to profile the socio-economic characteristics of rural households, assess their level perceptions towards the socio-economic benefits of NTFPs in the face of climate change, and analyse the socio-economic factors influencing their willingness to participate in the socio-economic benefits of NTFPs in the face of climate change. Hence, despite numerous studies documenting the impacts of climate change on the NTFPs and the adaptation strategies of rural households, little is known about the value that rural households place on these resources and how they perceive their role in sustaining their livelihoods.

This study aimed to fill this gap by giving a thorough analysis of these elements. Data collection employed a simple random sample technique to select 110 rural households in three villages in Bushbuckridge Local Municipality, namely Mpenyatsatsi, Marite and Masana. Based on structured questionnaires comprehensive data were collected. Descriptive statistics were employed to profile the socioeconomic features of the households, with 57% predominance being female-led households and a high unemployment rate at 56%. On average, respondents' age was about 51 years old. To measure perceptions on the 5-point Likert scale, the study used the Chi-square test, which indicates that the majority (87%) of households recognised that NTFPs provide benefits in socio-economic terms, especially with regards to generating income. Moreover, 69% of households agreed with the statement that in recent decades, the climate has changed markedly enough to affect both NTFPs availability and quantity. The binary regression model was employed to successfully address the third objective of the study, which was to analyse the socio-economic factors

influencing rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change in Bushbuckridge Local Municipality. In this study, willingness to participate is defined as a state that determines whether an individual will take action in deriving the benefits offered by NTFPs, such as generating income, for consumption and used as a safety net during times of hardship. The results indicated that majority (67%) of the sampled rural households reported that they were willing to participate in the socio-economic benefits of NTFPs in the face of climate change. In comparison, minority (33%) of the sampled rural households indicated that they were unwilling to participate. The study revealed that socio-economic factors that were found to be significant in influencing households' willingness to participate include age, educational level, market access, experience, awareness, rainfall perception, household size, and employment status.

The results emphasise the necessity of increasing the level of awareness about NTFPs and the ways to manage and benefit from them in rural communities. The issue of market access and the overall improvement of its infrastructure, as well as the training and educating in new marketing methods, remains decisive for the enhancement of the community's involvement in NTFPs-related work. Additionally, the development of strategies that will help enhance the level of climate resilience seems to be a must, with their focus on the utilisation of technologies of adaptation and sustainable practices in order to address the climate affecting the target region. Furthermore, the policy and educational implications of the results may be summarised as the introduction of educational campaigns in order to promote an increased level of awareness and education of the rural populations, the focus on the improvement of the market infrastructure, and the development of strategies aimed at their adaptation to the existing climate conditions. By addressing these areas, the potential of NTFPs for enhancing the living standards of rural populations and preserving biodiversity will remain high, and the economic development of rural communities may be supported in the context of existing climate alterations.

Keywords: Rural households, Non-timber forest products, Climate change, Perceptions, Willingness to participate, Probability proportional to sample size, Binary logistic regression model.

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LIST OF ABBREVIATIONS AND ACRONYMS

IPCC   The Intergovernmental Panel on Climate Change

UNFCCC   United Nations Framework Convention on Climate Change

CBD   Convention on Biological Diversity

IDP   Integrated Development Plan

DEA   Department of Environmental Affairs

TREC   Turfloop Research Ethics Committee

PPS   Probability Proportional to sample size

VIF   Variance Inflation Factor

SPSS   Statistical Package for Social Sciences

NTFPs   Non-Timber Forest Products

WTP/P   Willingness to Pay/Participate

INTRODUCTION

1.1 Background of the study

Forests are naturally equipped to combat climate change by protecting people and livelihoods as well as creating a base for sustainable economic and social development (Gurung *et al.*, 2021; Patra *et al.*, 2022). However, this natural mechanism is often hampered by anthropogenic activities such as industrial processes, deforestation, agriculture, and the burning of fossil fuels, which leads to climate change (Tieminie *et al.*, 2021). Climate change has significant impacts on forest resources, including non-timber forest products. Given the rise in temperature and alterations to precipitation patterns, the distribution and availability of non-timber forest products are already undergoing alteration (Malhi *et al.*, 2020; Rasul *et al.*, 2008; Tieminie *et al.*, 2021). This has substantial implications for the communities that depend on such resources for their livelihoods and cultural practices. Besides, climate change can directly affect the amount and qualities of non-timber forest products (Arnold *et al.*, 2006; Gurung *et al.*, 2021). For example, healing herb plants may suffer changes in constitution, which reduces their effectiveness in traditional healing (Ibe, 2018). Furthermore, the changes in climatic conditions, such as increased temperatures not only affect local communities that rely on them for their livelihoods but also hinder biodiversity conservation (Grimm *et al.*, 2013; Gurung *et al.*, 2021; Patra *et al.*, 2022).

Non-timber Forest Products (NTFPs) can be defined as resources and materials intercepted in forest ecosystems for domestic purposes or sales and some are of socio-religious and cultural practices (Pandey *et al.*, 2016; Frey *et al.*, 2020). According to Baidoo (2018), NTFPs are defined as wild products derived from forest animals and plants, including birds, insects, fish, wild fruits, vegetables, beverages, palm leaves, nuts, roots, medicinal plants, forage, fuel, poisons, fibres, biochemicals and their by-products such as honey, lac, and silk, catering for both subsistence and commercial needs (Agustino *et al.*, 2011; Hunter, 2021; Priya and Kumar, 2023). Many rural people worldwide, particularly in developing countries, rely heavily on natural resources and services for their livelihoods (Egoh *et al.*, 2012). For rural communities, NTFPs play an important role in their livelihoods; people use these products for their daily personal use or exchange them to supplement income or as a primary source of

income (Pandey *et al.*, 2016; Shrestha *et al.*, 2020). Throughout history, humans have put such products to various uses as food, fodder, fibre, traditional medicine, and agricultural implements because many of those seasoned tastes are deeply embedded in culture (Balick, 2020; Hunter, 2021; Pandey *et al.*, 2016; Talukdar *et al.*, 2021).

According to Gurung *et al.* (2021), NTFPs are important for biodiversity conservation and long-term benefits. They provide local communities with socioeconomic benefits. These non-wood forest products around the world, consisting of fruits, nuts, medicinal plants, and resins, help people earn a living and also provide food resources for their daily diet (Kuyah *et al.*, 2020). Moreover, non-timber forest products can relieve poor people during difficult economic periods. By creating multiple income sources, NTFPs provide financial security for individuals and reduce the vulnerability to dependence on any specific sector (Demie, 2019; Sharma, 2019). Moreover, using non-timber forest products encourages sustainable resource management and protection (Harbi *et al.*, 2018; de Mello *et al.*, 2020). In several studies, it was found that the sale and production of non-timber forest products led directly to employment opportunities for rural communities, especially those who rely on forests to survive (Adam *et al.*, 2013; Frey *et al.*, 2019; Rasul *et al.*, 2008). Hence this study is aimed at analysing rural household's perceptions and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change.

1.2 Problem statement

In most rural communities in developing countries, natural forest resources provide the most easily accessible source of goods, income and services (Fadairo *et al.*, 2020; Wale *et al.*, 2022). The dependence of NTFPs on the environment for growth is profound and includes variables such as climate. Changes in temperature, rainfall and other climatic factors can bring about a substantial alteration to the production or distribution of these goods (Arnold *et al.*, 2006; Malhi *et al.*, 2020; Tieminie *et al.*, 2021). The availability of NTFPs and their diversity can be enhanced as a result of climate change (Arnold *et al.*, 2006; Beltrán-Sánchez *et al.*, 2018; Gurung *et al.*, 2021). For example, with changes in temperature and rainfall patterns, new species may develop, or the existing ones may expand, bringing new opportunities to rural households to harvest and sell these products (Bousfield *et al.*, 2020; Heubach, 2012; Msalilwa, 2013; Verchot *et al.*, 2007). However, Raj *et al.* (2021) caution that climatic

changes can have a negative impact on the availability and quality of NTFPs. Temperature and changes in rainfall can interrupt the natural cycles of the NTFPs, making them hard to find and harvest (Malhi *et al.*, 2020; Ticktin, 2004; Tieminie *et al.*, 2021). In rural households, NTFPs are essential sources of income, subsistence, and sustenance support for vulnerable people during hardships (Suleiman *et al.*, 2017). Many previous studies have examined both the effects of climate change on NTFPs as well as the adaptation measures adopted by rural households in different parts of the world (). However, the value rural households attach to these resources and how they perceive their role in sustaining their livelihoods remains unclear (Amadu *et al.*, 2021; Chao, 2012). This study tries to fulfil this gap by analysing rural household's perceptions and willingness to participate in the socio-economic benefits of NTFPs in the face of climate change. In this study, willingness to participate is defined as the readiness of rural households to take action in obtaining some of the benefits provided by NTFPs, such as utilising the NTFPs for income generation purposes, consumption and as a safety net.

1.3 Rationale

The world faces many issues, including the worsening of poverty levels in most developing countries. However, NTFPs have the potential for uplifting the rural community's livelihoods have received little or no attention. The rationale for studying rural households' perceptions and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change is based on the potential impact of climate change on NTFPs and the livelihoods of rural communities that depend on them. Various studies have shown that climate change is expected to significantly affect forest ecosystems, which will impact the productivity and composition of NTFPs (Bhagwat and Rutte, 2006; Tieminie *et al.*, 2021). Such effects would be due to the changes in temperature and rainfall patterns, occurrences of extreme weather events and the spread of various diseases and pests, which may influence the accessibility, quality, and quantity of NTFPs (Beltrán-Sánchez *et al.*, 2018). Therefore, these changes may also have an impact on rural household's income, food security and health ,especially for rural households which depend on NTFPs for livelihoods sustenance (Locatelli *et al.*, 2008; Mulenga *et al.*, 2011; Ntoko, 2020). Hence, getting to know rural households' perceptions and willingness to participate in the socio-economic benefits of NTFPs in the face of climate change can

help understand the factors influencing the rural household's adaptation measures and build their resilience to the impacts of climate change. Understanding their perceptions of climate change and how it impacts the availability and quality of NTFPs is imperative to develop effective policies and strategies for sustainable NTFPs management (Shackleton *et al.*, 2011). Therefore, understanding the factors that influence rural households' willingness to participate in NTFPs markets can help increase their socio-economic benefits and enhance their livelihoods while promoting sustainable forest management practices.

1.3.1 Aim of the study

The aim was to generate information on rural households' perceptions and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change in Bushbuckridge Local Municipality, Mpumalanga Province of South Africa.

1.3.2 Objectives of the study were to:

i.   Profile the socio-economic characteristics of rural households of Bushbuckridge Local Municipality;

ii.   Assess the level of perceptions of rural households towards socio-economic benefits of non-timber forest products in the face of climate change in Bushbuckridge Local Municipality;

iii. Analyses the socio-economic factors influencing rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change in Bushbuckridge Local Municipality.

1.3.3 Hypotheses of the study

i.   There is no difference in the level of perceptions of rural households towards socio-economic benefits of non-timber forest products in the study area;

ii.   Socio-economic factors do not influence rural household's willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate in the study area.

1.4 Organisation of the dissertation

The rest of this mini dissertation was organised as follows: Chapter 2 reviewed existing literature relevant to rural household's perceptions and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change. Chapter 3 presented research methodology approaches used in this study. It included the study area, sampling and data collection methods, and analytical techniques, along with tables of expected variables. The study area was briefly described before discussing data collection methods and procedures. Chapter 4 reported and discussed the descriptive results, and Likert scale empirical analysis results. Finally, Chapter 5 presented conclusions and offered policy recommendations based on the study findings.

1.5 Chapter summary

This chapter introduced the main concepts and scope of the study. A comprehensive background showed the importance of non-timber forest products and their vulnerability to climate change. The chapter presented the research problem, which emerged from the identified concern about the uncertainty related to rural households' perspectives and willingness to engage in NTFPs for socio-economic benefits in the face of climate change. This chapter also outlined the rationale, aim, objectives, hypotheses of the study and how the study was organized. The following chapter reviews the literature in detail.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature, which, according to Miller (2022), refers to a survey of important and relevant studies as well as other sources which are relevant to the study. This chapter is intended to prepare the reader and build a foundational understanding of core concepts related to rural households' perception and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change. As a result, this chapter analysed several works of literature pertaining to the evaluation of variables or factors impacting rural households' perceptions and willingness to participate in the socio-economic benefits of non-timber forest products.

2.2 Defining terminologies.

2.2.1 Climate change

Climate change refers to long-term alterations in temperature, precipitation, and other atmospheric conditions (Nda *et al.,* 2018; Woolway *et al.*, 2020). Human activities, particularly the burning of fossil fuels and deforestation, release considerable quantities of greenhouse gases in the atmosphere that are driving major changes that have already begun due to natural causes (Nica *et al.*, 2019). The result is global warming, disruption of weather patterns, rising sea levels and many other environmental impacts (Tieminie *et al.*, 2021). Malhi *et al.* (2020) and Nica *et al.* (2019) argued that climate change has profound effects on ecosystems, biodiversity, weather events and human societies and is, therefore, a top global concern.

2.2.2 Rural households

Rural households may be defined as homes or living spaces found in rural areas, areas that are defined as being low in terms of population density and that are heavily dependent on agriculture or other natural resource-based means for subsistence (Mbuli *et al.*, 2021; Muronda *et al.*, 2020). In developing countries, particularly in Africa, Asia, the Caribbean, and Latin America, the economies mainly depend on various informal sectors, including agriculture, tourism, various traditional practices, and fisheries, to provide income, food security as well as employment opportunities (Adjei and Amaning, 2021; Awazi *et al.*, 2021; Madzivhandila and Niyimbanira, 2020). Compared to urban households, rural households face unique issues regarding their

access to various services, infrastructure, and other economic opportunities (Kogo *et al.*, 2021; Leal Filho *et al.*, 2018; Rashid *et al.*, 2019).

2.2.3 Non-timber forest products

Non-timber forest products are items and resources derived from forests that do not involve any timber or wood. NTFPs include a variety of things, such as fruits, nuts, mushrooms, gums and resins, fibres from many different other plants and animal products (Agustino *et al.*, 2011; Hunter, 2021; Priya and Kumar, 2023). Many studies show that non-timber forest products provide a foundation for the livelihoods of many communities. In addition to being used as food and medicine, they also supply cash income and serve other functions (Pandey *et al.*, 2016; Shrestha *et al.*, 2020; Suleiman *et al.*, 2017). Moreover, Zhang *et al.* (2018) argued that the development and utilisation of NTFPs can provide a sustainable economic source and help maintain the balance in an ecosystem of forest habitat at risk.

2.2.4 Perception

Perception is the way individuals interpret and make sense of sensory details from their environment. It requires several steps to do so. This includes the process of recognising, organising and interpreting stimuli received through the senses such as vision, sound (or hearing), touch (physical sensation), taste and smell (Mather, 2016; Sarmadi *et al.*, 2020). According to Chen and Antonelli (2020), perception is affected not only by sensory input but also by personal history and current trends. It can be formed largely in people's hearts and can be shaped by cultural, political, and economic factors. In shaping our perspective, perception plays a fundamental role. This includes what we believe about the nature and essence of things, what stimuli will affect our response to outside parameters, and finally, how those programmes are structured (Qiong, 2017). In this study, rural households' "perception" of non-timber forest products and climate change refers to ways people in rural areas see or get a sense of what such things as non-timber forest products mean. This involves their awareness, beliefs, attitudes, and understanding of the advantages of NTFPs. Both Asamoah *et al.* (2023) and Asamoah *et al.* (2024) support the idea that perceptions can influence how rural households engage with and rely on non-timber forest products, as well as their adaptive strategies in response to the effects of climate change on these products.

2.3 Review of literature

2.3.1 Overview of climate change: A global, African, and South African review

2.3.1.1 Global overview

To date, climate change is a preeminent global issue that has caused extensive impacts on ecosystems and humankind (Malhi *et al.*, 2020; Nica *et al.*, 2019). Tropical regions are facing the greatest risks to global biodiversity in the 21st century due to climate change. The current trend of climate change has been warming at 0.25 °C per decade, and there is a chance that it can increase to 3.3 °C by the end of this century (Bousfield *et al.*, 2020). According to Kumar *et al.* (2021), the climate on the earth is changing for the worse mostly due to human actions, such as burning fossil fuels and cutting down trees. The Intergovernmental Panel on Climate Change (IPCC) has repeatedly given warnings regarding global warming and attributes the same to temperatures, precipitation patterns across many regions of the world, and severe weather events becoming more frequent and intensified (Alexander *et al.*, 2016; Chen *et al.*, 2018; Masson-Delmotte *et al.*, 2021).

Furthermore, these changes pose significant threats to biodiversity as well as water resources and agriculture (Nhemachena *et al.*, 2020). Hence, global communities worldwide also agree on an immediate need to work together to reduce climate change effects and respond positively to changing environmental conditions (Suhaeb and Tamrin, 2024). In addition, the outcomes of climate change cross over geographical boundaries and become part of a sophisticated community of interrelated difficulties that are just solvable through global collaboration (Folke *et al.*, 2021). We also understand that the problems related to the rise of sea levels, melting of polar ice, loss of biodiversity, and changes in the weather across the globe require joining forces to address the underlying causes and effects of climate change globally (Macelaru and Lulić, 2023; Nhemachena *et al.*, 2020; Wright *et al.*, 2021).

2.3.1.2 African overview

Africa, the continent has particularly few resources to deal with the impact of climate change; hence, it relies largely on rain-fed agriculture, and many African countries have limited capacity for adaptation (Adjei and Amaning, 2021; Awazi *et al.*, 2021; Pereira, 2017). Climate change in Africa expresses itself as different rainfall patterns,

higher temperatures and frequent droughts and floods. These changes pose a real threat to food security and the livelihood of millions of people (Adjei, 2021; Kogo *et al.*, 2021). Moreover, strategies for adapting to change in Africa are often difficult to carry out, and this, in turn, makes the continent more vulnerable to risks arising out of climate (Leal Filho *et al.*, 2018). In addition, Zougmoré *et al.* (2016) observed that African countries realise that they need to devise fully integrated strategies for tackling climate change. Until now, this international collaboration among African countries has mainly been aimed at developing the land people live on and their social institutions in a climate-resistant way (Erezi *et al.*, 2023).

People in many African countries are at risk from variations in rainfall patterns that hit hard at their disease control measures as well, because they rely on rain-fed agriculture (Mbuli *et al.*, 2021; Kangalawe and Lyimo, 2013; Warner and Afifi, 2014). A study by Kogo *et al.* (2021) on climate change and variability in Kenya revealed that climate change would continue to affect the production of crops and food security for communities already facing challenges in dry and semi-dry areas. The study further indicated that climate changes might affect cropping patterns and yields in various regions. Eriksen *et al.* (2021) and Vervoort *et al.* (2014) argue that addressing climate change in Africa requires not only regional collaboration but also tailored strategies considering the unique vulnerabilities and strengths of individual nations.

2.3.1.3 South African overview

Climate change is a major worry in South Africa. The average temperatures each year have gone up by at least 1.5 times more than the global average of 0.65°C in the past five decades, and there has been more frequent extreme rainfall (Ziervogel *et al.*, 2014). Climate change is a massive challenge to South Africa's water resources, food security, health, and infrastructure, as well as its ecosystem services and biodiversity. In the context of ongoing high poverty levels and severe inequality, such impacts thus pose immense challenges to national development (Ziervogel *et al.*, 2014; Zwane, 2019). Additionally, climate change intensifies existing vulnerabilities in South Africa, notably its low adaptive capacity, widespread poverty, and low level of technology deployment (Edokpayi *et al.*, 2020; Flatø *et al.*, 2017). In South Africa, climate change also has a substantial effect on agriculture. For example, yields of both food and cash

crops are declining (Zwane, 2019). Changes in temperature and precipitation patterns affecting the growing seasons have also impacted South African agriculture. These shifts in temperature and precipitation have led to changes in growing seasons, impacting both the time of planting and harvesting (Zwane, 2019). Water scarcity is a serious problem, with changed rainfall patterns and increased evaporation levels seriously affecting water resources vital for irrigation (Nkosi *et al.*, 2021). According to various studies, the impacts of climate change on water availability and demand in South Africa are projected to worsen in the future (Bhagwat and Rutte, 2006; Nhemachena *et al.*, 2020; Tieminie *et al.*, 2021). Olabanji *et al.* (2020) and Remilekun *et al.* (2021) indicated that South Africa's water resources will be entirely depleted and not be enough to meet the needs of the people by 2030.

Furthermore, Serdeczny *et al.* (2017) argued that due to the influence of climate change, South Africa is expected to experience a significant decline in precipitation in sub-Saharan Africa posing risks of drought (Serdeczny *et al.*, 2017). According to Ofoegbu *et al.* (2017), forests in South Africa have also been significantly affected by climate change. Elevated temperatures and precipitation patterns are altering forest ecosystems, modifying the geographic range of tree species and their general health. Prolonged droughts and the spread of pests and diseases threaten forest biodiversity (Nhemachena *et al.*, 2020; Wright *et al.*, 2021). South Africa is expected to have hotter temperatures and less rainfall due to climate change. This will affect how much water is available in different regions and the moisture in the soil, impacting the productivity of farmland. These changes will, in turn, influence food production and international trade patterns (Calzadilla *et al.*, 2014).

2.4 Climate change and non-timber forest products

The direct effect of climate change also varies with the type of NTFPs and the ecosystem. Changes in temperature and precipitation patterns may influence suitable growth conditions for some plant species, leading to shifts in their distribution and abundance (Arnold *et al.*, 2006; Beltrán-Sánchez *et al.*, 2018; Gurung *et al.*, 2021). A study by Muluneh (2021) on the impact of climate change on biodiversity and food security indicated that due to climate change primarily affecting biodiversity, narrowly adapted and endemic species are facing extinction. However, the relationship between climate change and NTFPs is complex and context specific. Some studies

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suggest that certain NTFPs may benefit from climate change, with shifts in environmental conditions favouring the growth and abundance of certain species. For instance, variations in temperature and precipitation can affect the chemical composition of medicinal plants or reduce the sugar content of fruits, impacting their effectiveness or taste respectively (Bousfield *et al.*, 2020; Heubach, 2012; Msalilwa, 2013). Furthermore, Mallick *et al.* (2024) and Temphel (2021) support the idea that adaptive strategies, such as sustainable harvesting practices and the cultivation of climate-resilient NTFPs, can enhance the resilience of both ecosystems and the communities dependent on these resources. Ahammad *et al.* (2021) indicate that efforts to address climate change and promote sustainable forest management play a crucial role in safeguarding NTFPs. International agreements and initiatives, such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD), emphasise the importance of preserving biodiversity and promoting the sustainable use of forest resources (Thajb *et al.*, 2022).

The vulnerability of NTFPs to climate change has implications for the livelihoods of communities that depend on these products. Many indigenous and local communities rely on NTFPs for food, medicine, income, and cultural practices (Egoh *et al.*, 2012; Pandey *et al.*, 2016; Shrestha *et al.*, 2020). The disruption of NTFP' availability due to climate change can jeopardise the well-being of these communities, particularly those with limited alternative livelihood options (Gurung *et al.*, 2021). Changes in the quality or quantity of NTFPs can impact these communities' ability to sustain their traditional practices and meet daily needs, as these products play a crucial role in providing health care and subsistence support (Mulenga *et al.*, 2011; Ntoko, 2020). Pandey *et al.* (2016) indicated that in many developing countries with limited access to modern medicines, up to 80% of the population relies on traditional medicines, primarily plant-based drugs, for their primary healthcare and a significant percentage of people in developed countries, such as 40-50% in Germany, 42% in the USA, 48% in Australia, and 49% in France, also utilise them. Additionally, in both China and India, traditional medicines based on wild plant and animal sources constitute major export industries.

2.5 Rural households' perceptions of non-timber forest products
Rural households' attitudes and perceptions about NTFPs are crucial in shaping the sustainable utilisation of forest resources (Asamoah *et al.*, 2023; Asamoah *et al.*,

2024). These attitudes are often influenced by cultural, social, and economic factors, as well as the ecological significance of NTFPs in the daily lives of rural communities (Chen and Antonelli, 2020; Ihemezie *et al.*, 2021). Understanding the relationship between local perspectives, climate change, and socio-economic factors is essential for promoting equitable distribution of benefits, sustainable resource management, and poverty alleviation in forest-adjacent communities (Asamoah *et al.*, 2023). Human attitudes and behaviours have been connected to the decline of biodiversity worldwide, especially in forests. Success in the protection of nature requires insight into the attitudes and conduct of people in affected areas.

Taking positive actions is usually linked to practical necessity and cultural values. For example, rural communities in mountains support nature conservation because it is necessary for their livelihoods (Asamoah *et al.*, 2024; Falayi, 2014; Ihemezie *et al.*, 2021). As stated by Asamoah (2024), rasping the views of local communities about climate change and its effect on NTFPs production is a very important prerequisite for using these resources sustainably with success. A study by Asamoah *et al.* (2023) on perceptions of commercialisation and value-addition of NTFPs in forest-adjacent communities in Ghana strongly emphasised the necessity of such understanding for successful strategies in commercialising and adding value to NTFPs. The study also revealed the varied beliefs and understandings held by local residents about commercialisation and value addition processes.

By integrating the perspectives and insights of local people, interventions can definitely be tailored to meet the needs and wishes of forest-proximate communities while enabling sustainable resource management (Asamoah *et al.*, 2023; Carson, 2018). In addition, the results of this study indicate that for any approach to be successful at using NTFPs in a sustainable manner and commercialising them as well as improving their function, rural household perspectives and notions must be regarded. This confirms the claim of Ansong and Røskaft (2011) and Chen and Antonelli (2020) that attitudes or actions towards forests are driven more by values than socio-demographic factors. Values in this sense do not refer to the tangible or financial worth placed on forest resources but rather the actual perceptions, knowledge, or outlooks that people hold about forests and their resources and any efforts to sustain them (Ihemezie *et al.*,

2021). Thus, cultural and traditional values are the key determinants of perceptions in rural households about NTFPs.

In addition, most NTFPs are culturally important. Therefore, they play a vital role in the lives of local people since they form part of their various customs, including religious burials, rites, and rituals (Asamoah *et al.*, 2024; Shackleton, 2015). In many cases, the cultural link to some of these forest products also creates a feeling of responsibility among rural households regarding the sustainable management of such resources. Further, this cultural linkage would be vital in shaping attitudes that are identified by households concerned with ensuring a balance between utilisation and preservation (Ameneshewa *et al.*, 2023; Ihemezie *et al.*, 2021). Economic considerations are also major drivers of rural households' perceptions regarding NTFPs. However, for many communities, such forest products are sources of income and livelihood diversification (Heubach *et al.*, 2011; Zhu and Lo, 2021).

A study by Heubach *et al.* (2011) on the economic importance of non-timber forest products for livelihood maintenance of rural west African communities: A case study from northern Benin revealed that, on average, income generated from NTFPs accounted for 39% of total household income and had a strong equalising effect on it (Heubach *et al.*, 2021). NTFPs often are linked to the positive side as economic benefits which arise from selling and trading of products; however, challenges such as market access, pricing and competition do affect the overall economic value of NTFPs to rural households (Frey *et al.*, 2019). Education and awareness intervention contribute towards the shaping of the right attitudes and perceptions concerning NTFPs among rural households (Asamoah *et al.*, 2024; Falayi, 2014).

2.6 Rural Households perceptions of climate change

There have been many studies showings that rural households and farmers generally perceive that climate change has occurred and it has negative consequences on their livelihoods. For example, a study conducted in the central Rift Valley of Ethiopia found that 90% of the respondents perceived that the climate was changing, and about 85% took actions to adapt to variations of climate change (Belay *et al.*, 2017). In addition, a recent study by Guo *et al.* (2022) showed that climate change perception not only influences their livelihood but also indirectly affects the sustainable livelihood capacity through economic and ecological value cognition. Moreover, some studies tried to

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quantify the impacts of climate change on livelihood. Gornall *et al.* (2020) mentioned a wide range of impacts of climate change, such as the yield of crop harvests, pests and diseases and water availability. For example, Zhang *et al.* (2017) estimated that the yield of China's major crops was expected to decrease by 36.25% in rice, 45.10% in corn and 18.26% in wheat by the end of this century since the changes in temperature and precipitation are both negative on the crop yields. Similarly, a study conducted in Ethiopia indicated that the shifts associated with rainfall patterns ultimately resulted in reduced water levels and increased incidences like drought, which had implications on agriculture (loss of cop and livestock), production of electricity using hydropower, as well as ecosystems such as loss of forests, wetlands, and lakes (Mera, 2018). These impacts could have severe implications on rural households' lives, especially for agriculture and forest resource-dependent households.

Another related study conducted by Asamoah (2024) on assessing the Influence of Social Factors on Local Perceptions of Climate Change also indicated that the various factors, including age, gender, education, and occupation, did not have a significant influence. Moreover, rural households also have varying perceptions of effective adaptation strategies to climate change. Some studies have found that households are taking actions such as diversifying their crop portfolio, changing planting dates, and using irrigation to adapt to climate change (Belay *et al.*, 2017; Bellon *et al.*, 2020). However, other studies have found that households may not have the resources or knowledge to effectively adapt to climate change. For example, a study in Nuevo Leon, Mexico, found that while many households were aware of the importance of adaptation, they lacked the resources to implement effective adaptation strategies; their results indicated that perceived knowledge and financial self-efficacy greatly influenced the extent of household-level action taken (González-Hernández *et al.*, 2019).

2.7 Rural livelihoods

Rural livelihoods are defined as the strategies and activities undertaken by rural people to achieve sustainable lives, particularly food, water, shelter, and clothing (The Crawford Fund, 2020). These livelihoods are often linked to the environment and natural resources, as agriculture (and related activities) significantly contribute to rural

populations' employment (Mphande, 2016). Since agriculture is the basis for rural livelihood that not only provides a vital source of food but also supports income-generating opportunities, employment was going to be an influential factor in understanding various other features related to it. This includes farming, livestock rearing, processing, and trading, among other micro-enterprises within the agricultural value chain (Muronda *et al.*, 2020). The sustainability of rural livelihoods is heavily dependent on the health of the agricultural sector, which is influenced by factors such as climate change, market access, and technological advancements (Gitz *et al.*, 2016). Although forests contribute very little to GDP, they play a vital role in providing employment opportunities to rural communities (for the people who are living near forest area). These resources are used in the provision of food, medicine, and shelter; they also contribute to income mainly from timber and non-timber forest products (Egoh *et al.*, 2012; Fadairo *et al.*, 2020; Pandey *et al.*, 2016; Shrestha *et al.*, 2020; Suleiman *et al.*, 2017; Wale *et al.*, 2022).

Forests offer ecosystem services that support agriculture, such as water regulation, soil fertility, and pollination (Wale *et al.*, 2022). Rural livelihoods face numerous challenges, including environmental degradation, climate change, and economic marginalization. However, there are also opportunities for enhancing rural livelihoods through sustainable practices, diversification of income sources, and improved access to education and technology (Fadairo *et al.*, 2020; Mphande, 2016; Olsson *et al.*, 2014). According to Wale *et al.* (2022), policies aimed at supporting rural livelihoods must consider the intricate relationship between agriculture, forest resources, and the broader rural economy. This includes promoting sustainable agricultural practices, protecting and managing forest resources, and providing rural communities with the tools and knowledge to adapt to changing environmental and economic conditions. Figure 2.1 below shows the sustainable rural livelihoods framework.
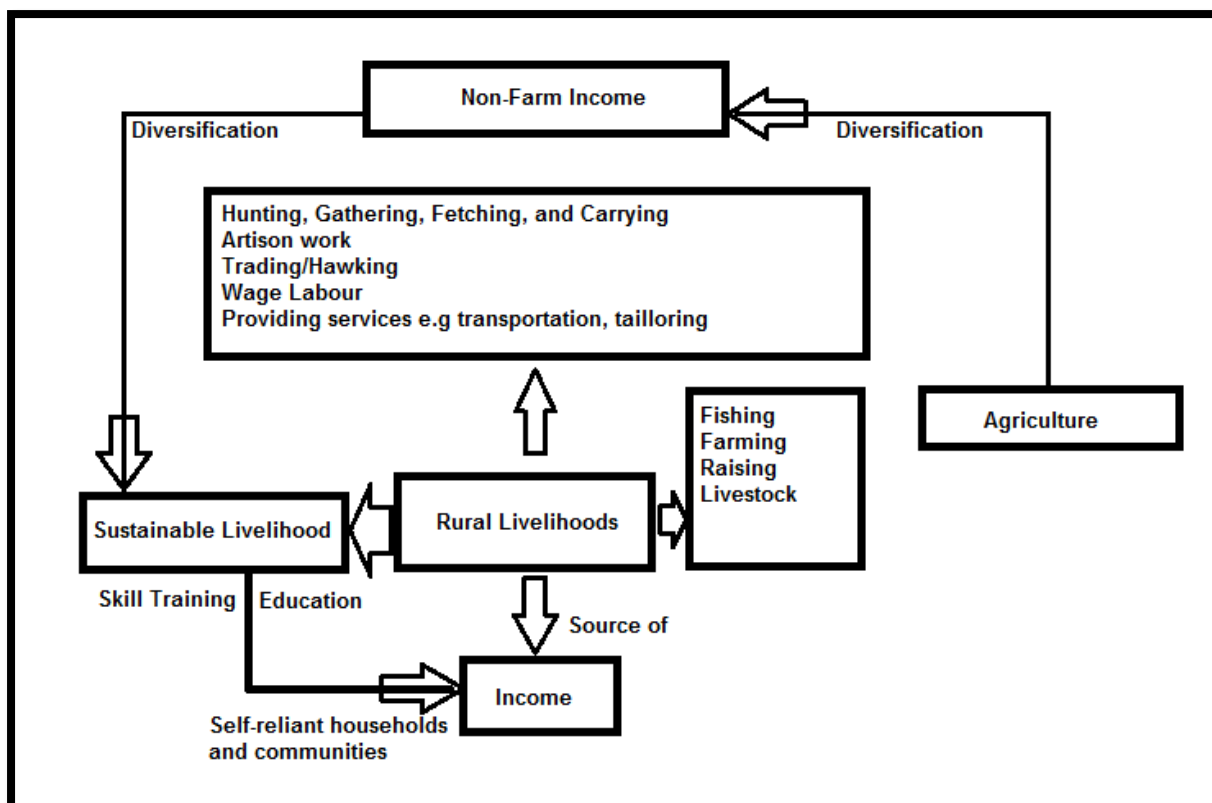
Figure 2.1: The Sustainable Rural Livelihoods Framework

Source: Authors' own compilation adopted from Mpande (2016)

The above framework in Figure 2.1 indicates a comprehensive view of rural livelihoods, showcasing the wide range of activities and facilities that support them. Non-Farm Activities and Diversification Non-farm activities make up a substantial part of rural livelihoods, with rural trades offering alternative sources of income beyond agriculture. It involves trading or hawking goods, which can be anything from local produce to goods produced at home, ranging from goods to handicrafts. Another major occupation is wage labour in regional industries or services, offering more consistent employment than agricultural work. Artisan work, which covers a diverse range of crafts, has long been a key source of rural livelihood. Additionally, rural communities engage in activities such as hunting, gathering, fetching, and carrying, all of which utilize the natural environment. Furthermore, community services such as transport and tailoring serve the public and the private sectors. Undoubtedly, agriculture remains the core of rural livelihoods (Muronda *et al.*, 2020). Farming is not only the major occupation for most people, but it has also been intrinsically intertwined with the country over time. In the rural area, crops are grown for both consumption and

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commercial use (Hunter, 2021). For rural people, fishing is also a significant activity, particularly for people who live near bodies of water. Animal husbandry is another undertaking that keeps people busy. It provides food, money, and advantages for rural families. Figure 2.1 above also shows that the combination of non-farm activities and farming results in diversifying the range of activities and order. This income generation is the cornerstone of a sustainable approach to farming, which includes education, skill development and the emergence of self-sufficient households and communities. Furthermore, education and skill development give people the skills and expertise to make ends meet.

2.7.1 The contribution of non-timber forest products to rural livelihoods

Non-timber forest products can be seen as one of the most crucial contributions to the livelihoods of rural communities worldwide. These products are essential for human sustenance, income generation, and several cultural practices (Egoh *et al.*, 2012). NTFPs also represent a wide range of resources such as fruits, nuts, medicinal plants, resins and fibers, and other non-wood forest products. NTFPs, in rural diets, are a source of essential nutrients that greatly contribute to food security and more diversified nutrition (Hunter, 2021; Priya and Kumar, 2023). In addition, the sale of non-timber forest products is a source of income and offers a range of possibilities to provide for the economic well-being of the rural population and an occasion to diversify their livelihoods (Fadairo *et al.*, 2020; Pandey *et al.*, 2016; Shrestha *et al.*, 2020).

Asamoah *et al.* (2023) emphasized that NTFPs show great potential for reducing poverty. Worldwide, they help lift rural communities living near forests out of poverty by increasing their household incomes anywhere from 19% to 78%. In addition to their economic contributions, NTFPs are an important part of many rural communities' culture and social life. The availability of many products within forests and recourse to a good number of non-timber forest products are essential for a large number of traditional practices, rituals, and ceremonies. The cultural value of these products fosters a sense of identity and community cohesion (Asamoah *et al.*, 2024; Balick, 2020; Shackleton, 2015; Talukdar *et al.*, 2021). Therefore, the sustainable management of NTFPs becomes not only an economic necessity but also a means of preserving cultural heritage and traditional knowledge (Chamberlain, 2019).

2.8 Factors affecting perceptions and willingness to participate in the socio-economic benefits of non-timber forest products.

2.8.1 Age, gender, and marital status.

Socioeconomic factors, which include gender, marital status, and age, have an influence on individuals' perceptions as well as capacities for participation. Gender influences the division of labour and access to resources (Dominguez-Folgueras, 2022). A study by Galati *et al.* (2023), which was undertaken in Italy, gender was significant in influencing whether the household was willing to commit time for forest-related activities. Another study by Fentie and Rao (2016) revealed that the gender of the household head significantly influences the desire to participate in off-farm activities. The study further showed that households that were female-headed engaged in off-farm activities more as compared to male-headed ones. Additionally, the study also revealed that age plays a role in the decision to participate in off-farm activities, with younger households having less access to land to sustain their livelihood compared to older ones.

As a result, younger households heads are more likely to participate in off-farm activities often to sustain their livelihoods. Jha and Gupta (2021) stated that farmers' ability to adapt depends on their thinking abilities, which differ among households and are affected by factors like age, gender, and other socioeconomic aspects. A study on farmers' perceptions and factors determining the adaptation decisions to cope with climate change revealed that gender has an influence on the probability of adoption of adaptation strategies. This suggests that male-headed households have better adaptation capabilities towards climate change than female-headed ones because of their stronger social connections and easier access to forecast information and knowledge through institutional arrangements (Jha and Gupta, 2021). Moreover, marital status and age can influence the level of responsibilities and available time for participation in economic activities (Jabeen *et al.*, 2020; Kuma and Godana, 2023). A study on forest-based livelihoods, income, and poverty in rural Pakistan found younger households' members to be more willing to participate in forest-related activities due to the lack of employment opportunities (Ali and Behera, 2015).

2.8.2 Educational Level

The education level of households is a critical factor. Higher education enhances the ability to obtain, process, and use relevant information about off-farm activities (Fentie and Rao, 2016). The findings of Kazungu *et al.* (2021) indicated that households' socio-demographic attributes are insignificant factors determining participation, except for the educational level variable, which was found to have a negative influence towards the household's willingness to participate. The study further suggested that better-educated households have better livelihood opportunities, and they are less interested in forest-related issues. On the other hand, Ali and Behera (2015) found educated household members to be more likely to participate because they are seeking employment and are aware of the potential benefits of participating. Similarly, Gurung *et al.* (2012) indicated that households with higher levels of education and better social status had a greater knowledge of ecosystems. They viewed forests as an important component of a sustainable landscape, contributing to their likelihood of participating. Similarly, educational level was found to have a positive influence towards farmers and household participation decisions (Zhu *et al.*, 2016).

2.8.3 Household size

Household size remains a strong determinant that affects various dimensions of rural livelihoods and agricultural decision-making, which was sufficiently informed by most studies. Suleiman *et al.* (2017) indicated a positive relationship between household size and harvesting of non-timber forest products. Therefore, larger households will contribute more towards this activity because they have enough labour to allocate. However, Mango *et al.* (2014), in contrast to the above findings, revealed a negative connection between household size and food security in rural households, meaning that larger families may face more challenges in providing enough food. An interesting perspective on this issue is given by Mauna *et al.* (2018), who further revealed a significant negative influence of household size on rural households' dependence on non-timber forest products in a study conducted in the South Nandi Forest. These findings underline the complex interrelation of household size and diverse socio-economic dimensions. The impact of household size extends beyond forestry activities. Khoza *et al.* (2019) found that while household size did not directly influence smallholder farmers' decision to participate in the agro-processing industry in Gauteng

Province, South Africa, it did affect the extent of their participation. Larger households were more likely to engage in the processing or send more products for agro-processing, indicating varying effects of household size on agricultural activities. In analysing the willingness to pay for indigenous plants, Omotayo *et al.* (2021) utilized a probit model and found a significant positive relationship between household size and willingness to pay. This suggests that participants from larger households were more inclined to pay for indigenous plants, possibly due to their higher anticipated food needs, leading to increased demand for indigenous plants as a food source.

2.8.4 Experience in harvesting and selling

Experience is an important determinant of the attitudes and behaviour of individuals towards economic activities in the households themselves (Wolf and Moser, 2011). Many existing studies have drawn attention to the impact of this variable on how households engage in various economic activities. Fasakin *et al.* (2022) highlighted that experience plays a crucial role in influencing the willingness of young people to engage in agriculture. Similarly, Khoza *et al.* (2019) revealed that smallholder farmers with more farming experience were more likely to participate in agro-processing, although this did not impact the extent of their involvement in agro-processing activities. However, Ajah and Nmadu (2012) found experience to be having a negative influence towards maize productivity; any increase in experience resulted in a decrease in maize productivity. Haile *et al.* (2022) also reported a negative influence of household experience on market participation, suggesting that older farmers, who are more experienced (household heads), might prioritize food security and be less inclined to take risks in demanding their crop yields.

On the contrary, Onyeneke *et al.* (2018) argued that increasing farming experience significantly increases the probability of adaptation in agricultural production and management systems. Alaka (2023) studied household socio-economic factors affecting investments in climate-smart agriculture practices among smallholder farmers in Eastern Cape Province, South Africa and noted a significant positive relationship between farming experience and money invested in climate-smart agriculture practices. As such, it appears the number of years a farmer is involved in farming increases the likelihood of the amount of money put into climate-smart

agriculture practices. Ntshangase *et al.* (2021) found that farmers' experience in goat farming had a positive effect on market participation and the degree of commercialisation. It was evident that farmers with more experience would participate more in the market than those with less experience.

2.8.5 Household income

Household income is a crucial determinant of participation and diversification in economic activities, as shown in recent studies. For instance, Khoza *et al.* (2019) discovered that farm income reduces household involvement in agro-processing activities. Similarly, Haile *et al.* (2022) revealed that higher household income reduces the likelihood of smallholder farmers participating in the maize market in Southwest Ethiopia. Specifically, a 1% increase in household income reduces the probability by 2.34% of a smallholder farmer being involved in the maize market. This suggests that in houses with higher non-farm income, farmers may prefer to use their earnings to buy other goods and services rather than relying on income earned from selling their produce. For this reason, their produce will be used for household consumption. In addition, Ahmad *et al.* (2023) employed a binary logistic regression to study determinants of farmers' adoption of agroforestry practices. Their study shows that 60.5% of the respondents preferred to adopt agroforestry practices. From their study, they also found that socio-economic factors had a positive influence on tree planting on farmers' farmland. Particularly, higher total household income increases the probability of farmers adopting agroforestry practices; hence, the creation of awareness by the government, subsidies, and higher income encouraged the farmers to practice them.

2.8.6 Distance to the forest

Biophysical factors such as the availability and accessibility of forest resources can also impact rural households' willingness to participate in forest resource management. In the reiterations available in the academic literature, most studies demonstrated that households closer to the forests were significantly inclined to participate in the management and utilisation of forest resources than those households living further away (Ali, 2018; Chhetri *et al.*, 2013). In addition, Haile *et al.* (2022) reported a statistically significant difference in the distance to the nearest

market across the maize market participants and non-participant households. In another review, Khoza *et al.* (2019) discovered that the distance to markets was linked to a reduced probability of smallholder farmers choosing to participate in agro-processing only. This suggests that for every additional kilometer in the distance to agro-processing markets, there is a decrease in the probability of smallholder farmers participating in the agro-processing sector. This negative relationship indicates that when the distance between farms and market areas increases, farmers are less willing to expand into value addition through agro-processing alongside their primary production activities. Similarly, Fentie and Rao (2016), while investigating factors influencing farmers' participation in non-farm activities in Ethiopia, found that distance from off-farm activities and distance to the market were highly significant variables in influencing participation of farmers in non-farm activities.

2.8.7 Awareness of the benefits of NTFPs

The main determinant to influence households' willingness to participate in any economic activity is being fully aware of the advantages that are attributed to that activity. For example, according to a study by Chu *et al.* (2020), environmental awareness is one of the factors that influence households' willingness to accept improved ecosystem services in China. Furthermore, a study carried out in the Eastern Cape Province of South Africa shows that when smallholder farmers are unfamiliar with the activities of climate-smart, they are unwilling to invest their resources in such techniques. The findings also showed that when the farmers are familiar with climate-smart techniques, they are more willing to invest in them as a way to improve productivity (Alaka, 2023). Thus, awareness influences economic participation by shaping investment choices, encouraging diversification, and empowering individuals.

A study on the socio-economic factors influencing smallholder farmers' decision to participate in the agro-processing industry revealed that only a small proportion of smallholder farmers participate in the agro-processing industry. Socio-economic factors, including awareness, play a role in this decision (Khoza *et al.*, 2019). Additionally, Fentie and Rao (2016) in their study on factors influencing farmers' participation in off-farm activities, found that 65.5% of the respondents were not participating in off-farm activities, and one of the key reasons for not participating was the lack of awareness.

2.8.8 Market and credit access

Credit and financial support are also critical factors influencing households' willingness to participate in the socio-economic benefits of NTFPs. A study on factors affecting farmers' participation in China's group guarantee lending programme stated that most farmers form part of group guarantees to get credit access (Kong *et al.*, 2015). Their willingness to participate in group guarantees is influenced by their need to access formal credit. Limited financial resources can limit the ability to invest in production inputs, technology, and access markets (Lefore *et al.*, 2019). The households with access to credit can more easily participate in margin activities, such as supplementing their income by raising livestock and selling forest resources (Argaw, 2017; Babulo *et al.*, 2008). One of the common problems of rural farmers is that they cannot reach the market. The products of farmers who lack sufficient means to access the market are difficult to obtain. As a result, fewer resources are used by farmers, and agricultural production is limited.

Many rural areas have bad road conditions and lack transportation facilities, creating gaps between farmers and essential tools, methods, and approaches. That is why farmers get accustomed to mobility conditions and end up practicing agriculture using low-tech methods, which are inefficient and produce lower yields (Kaiser and Barstow, 2022). Market access can determine whether or not households are willing to participate in economic-related activities. Market access by an improved transport facility increases a person's willingness to participate in economic activities. This is because the increased transport facility means that households can easily sell their goods or services with lower transaction costs (Osebeyo *et al.*, 2014; Ali *et al.*, 2017). According to Babulo *et al.* (2008) and Furo *et al.* (2022), the respondents must have access to a well-functioning market in terms of their forest resource-related activities in rural households to improve their economic welfare.

2.8.9 Transportation costs

The importance of transportation increases with remoteness, especially in rural areas where resources are often not fully used, and economic activities are limited. In general, poor access in developing areas is seen as a major cause of ongoing poverty, as shown by low agricultural production and economic activity (Kaiser and Barstow, 2022). Abokyi *et al.* (2020) and Manda *et al.* (2020) stated that higher transportation

costs make farmers less likely to sell their agricultural products in the market. The reduction in transportation costs is significant in remote areas as it is necessary for smallholder farmers to access more lucrative maize and legume markets. Acheampong *et al.* (2018) indicated that improved road infrastructure is usually associated with better market access, decreased transportation costs, and increased agricultural production. In addition, many people have shifted to non-farming activities, to have a higher income, and better food security. Overall, the decrease in transaction costs concerning market access is associated with a higher likelihood of market participation.

2.8.10 Rainfall and temperature perceptions

When households and farmers perceive a high risk of adverse climate conditions, they may be reluctant to invest in long-term projects or projects such as crops that are highly sensitive to weather changes. The implication is that farmers are more likely to allocate their limited resources to climate-resilient methods. However, this will reduce productivity and income if these methods are less profitable. In their study, Khan *et al.* (2020) used a binary logistic model to identify the most important drivers of selection regarding adaptation strategies among farm households. Specifically, the study revealed that perceptions regarding rising temperatures and declining rainfall significantly affected the choice of adaptation methods. Similarly, Abid *et al.* (2016) found that the perception of rainfall significantly affected adaptation to climate change among rural households in Pakistan.

2.9 Chapter summary

This chapter provided a comprehensive examination of non-timber forest products and their significance in rural livelihoods in the face of climate change. It defined key terminologies, and reviewed literature pertaining the global, African, and South African perspectives on climate change, emphasising its profound impacts on biodiversity, agriculture, water resources, and livelihoods. Furthermore, the chapter explored the relationship between climate change and NTFPs, as well as factors affecting rural households' willingness to participate in forest resource management, including socio-economic and biophysical factors. It underscores the importance of education, market access, and awareness in shaping rural household's perceptions of NTFPs.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter highlights the methodological approaches that were adopted in the study. The areas elaborated in these chapters are the selection of the study area, the instruments for data collection, the sampling methods adopted, and the empirical model for data analysis. The chapter starts with a brief background of the case study, the Bushbuckridge Local Municipality in Mpumalanga Province. The procedure of sampling and data collection adopted in the study is further elaborated in the chapter. In addition, the chapter introduces the conceptual framework used in the study and the empirical models that were adopted to achieve each of the research objectives, along with an explanation of each of the selected models for data analysis.

3.2 The Area of study

This study was conducted at Bushbuckridge Local Municipality. This municipality is one of four local municipalities comprising Ehlanzeni District Municipality, covering over a third of its geographical area in Mpumalanga Province. It is on the eastern edge of the Drakensberg Mountains and covers an area of approximately 6,500 km² (Okoh, 2018).
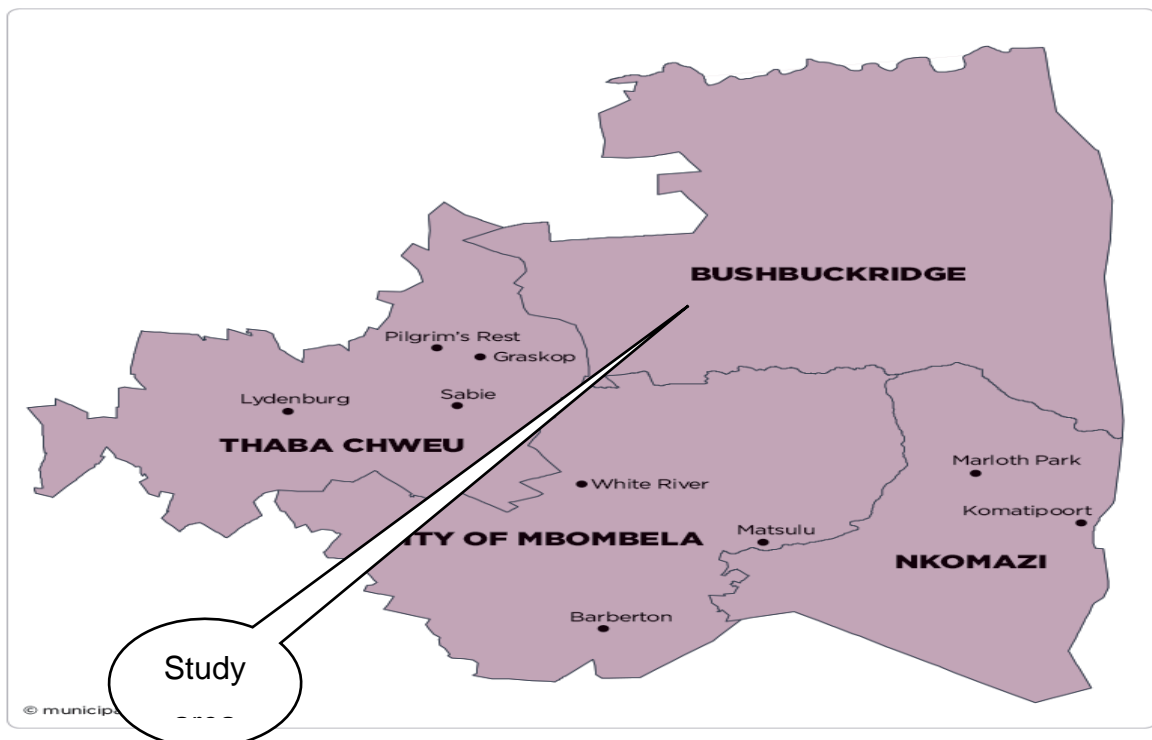
Figure 3:1 Bushbuckridge Local Municipality jurisdiction.

Source: www.demarcation.org.za.

The municipality serves as a gateway to major tourist attractions in Mpumalanga and the eastern part of Limpopo Province. The name "Bushbuckridge" originated from the large herds of bushbuck found in the area during the 1880s and a prominent ridge in the southeastern part of the municipality (Mukorera *et al.*, 2022). Bushbuckridge Local Municipality is bordered by Mopani District Municipality of Limpopo Province to the north, Mozambique to the east, Mbombela and Nkomazi Local Municipality to the south, and Thaba Chweu and Maruleng Local Municipality to the west (IDP, 2011-2016). According to the IDP report for 2021-22, Bushbuckridge Local Municipality is home to 546,000 people and has an estimated number of 110 586 households.

Bushbuckridge Local Municipality ranks second in its high unemployment rate, following Nkomazi Municipality. Job opportunities within the municipality are scarce, leading to its classification as a nodal area. The primary sectors offering employment are community services (government), accounting for 34.1% of employment, an increase from 32.9% in 2014, and trade, comprising 25.3%. There is a noticeable trend of community services playing a larger role as employers, while agriculture and trade sectors are decreasing in their share of employment (IDP, 2020-2021). Approximately 60-70% of the population capable of working is without employment opportunities (Shackleton, 2000). Agriculture and forestry in the municipal area have a significant competitive advantage in terms of the climate, biodiversity, and number of dams. The area is characterised by a mosaic of landscapes, including savannas, grasslands, and forests, and is home to various plants and animals (Shackleton, 2000). The Mist-belt Forest, situated on the R40 towards Bushbuckridge and not too distant from Inyaka dam, is a notable forest within the Bushbuckridge area. It forms part of the broader Mpumalanga Forests ecoregion, which is regarded as a global biodiversity hotspot due to its remarkable levels of species richness and endemism (Thornton, 2012).

3.2.1 Climate change, Biodiversity and Rural livelihoods

3.2.1.1 Temperature and rainfall

In Mpumalanga, temperatures typically range from 15 to 29°C annually. Over the period from 2015 to 2035, there is a projected increase of 2°C in annual temperatures, which is expected to result in higher rates of evapotranspiration**.** In the mid-future (2040–2060), the average annual temperatures are expected to deviate by 1 to 3°C (2 to 5°F). By the late future period (2080–2100), these anomalies are projected to rise

even further to 3–6°C (4–7°F) across the province (Department of Environmental Affairs (DEA), 2013). This significant increase will lead to heightened levels of evapotranspiration. As a region that receives summer rainfall, precipitation is not across Mpumalanga. It is important to note that the Lowveld receives less rainfall than the escarpment, with most precipitation occurring as downpours between November and March. For instance, rainfall ranges from 500 mm in the eastern Lowveld and about 1,100 mm in the escarpment (DEA, 2013). Even though some of this rainfall may increase in other regions of the province, higher temperatures enhance evapotranspiration, implying no additional water. Regarding the provincial climate summary from the DEA, the rains are coupled with thunderstorms, but changes are expected over the next three decades, during which summer rainfall is expected to drop (Mpumalanga Climate Change Vulnerability Assessment, 2015).

3.2.1.2 Biodiversity and rural livelihoods

The ecosystem resources of Mpumalanga include mountain catchments, rivers, wetlands, and various connecting natural habitats such as nodes and corridors. They represent a wide range of essential services. In Mpumalanga, these elements constitute a vital network within the landscape (Venter and Mitchell, 2015). In Mpumalanga, these resources are essential for providing valuable services to the terrestrial inhabitants, including fisheries, supporting rural livelihoods, and sustaining economic activities such as tourism, particularly in large conservancies like the Kruger National Park (Mpumalanga Climate Change Vulnerability Assessment, 2015). With climate change, there is an expected alteration in the distribution of ecosystems and species. The ecological impacts of climate change will worsen the decline of ecosystems (Malhi *et al.*, 2020; Rustad *et al.*, 2012). Individuals living in informal settlements around Mpumalanga are recognised as the most vulnerable population greatly affected by droughts, storms, floods, and wildfires. Decreased rainfall will impact rural agriculture, leading to higher demand for irrigation, especially where infrastructure is lacking (Mpumalanga Climate Change Vulnerability Assessment, 2015; Local Government Climate Change Support Programme Inception Report, 2016). Along with reduced runoff and increased drought risk, this will directly affect food security and rural livelihoods. Climate changes also influence the shift away from traditional practices; for instance, crop farmers may shift towards more resilient or

drought-tolerant crops or explore alternative livelihoods such as participating in the socio-economic benefits of non-timber forest products (Murphy *et al.*, 2016).

3.3 Data collection instruments

This study used quantitative data, and permission to collect data was granted by the Turfloop Research Ethics Committee (TREC) at the University of Limpopo. A semi-structured questionnaire was utilised as a research instrument for data collection in this study. Prior to the formal data collection process, a pre-test of the questionnaire was conducted with a sample of 20 rural households, which were randomly selected in the study area. The pre-test questionnaire included, rural household's perceptions on climate change, non-timber forest products and the impacts of climate change on these forest resources. This pre-test aimed to assess the suitability of the questionnaire design, as well as the clarity and relevance of the questions. Based on the findings from the pre-test, necessary modifications were implemented to the questionnaire to ensure that it effectively captured the pertinent information aligned with the study objectives. The process of data collection took place from mid-December 2023 to mid-January 2024 and was conducted by three enumerators under the supervision of the researcher. The chosen enumerators received training prior to data collection and were fluent in the local languages spoken in the study area, specifically Tsonga and Sepulana (a dialect of Sepedi).

3.4 Sampling procedures and sample size

The sample size was selected from the population size of rural households using the simple random sampling technique. According to Yates *et al.* (2008), all members of the population have a comparable chance of being chosen for the sample when using the simple random sampling approach. Moreover, this study considered areas closer to the forests in Bushbuckridge Local Municipality to form part of the sample size. The areas that are closer to the forests include the Mphenyatsatsi, Marite, and Masana villages. According to the IDP report for 2021-22, the above-mentioned areas have the following estimated total number of households: 384, 409 and 333, respectively. As a result, this study used the probability proportional to sample size approach (PPS) to calculate sample size, considering the three regions closest to the forests, as Nkoana *et al.* (2019) have done in determining factors influencing household's willingness to purchase water and electricity in Moletjie in Aganang Municipality of Limpopo Province in South Africa. The proportional to-sample size approach is a technique that samples

from a finite population, wherein each population unit has a size measure at the start of sampling, and the chances of choosing a unit are proportional to its own size (Skinner, 2014). Table 3.4.1 below shows the sample size in the selected villages of Bushbuckridge Local Municipality.

Table 3.1: Sample size in selected villages of Bushbuckridge Local Municipality (110).

Villages	Population Size of households	Sample size	Percentages
Mphenyatsatsi	384	38	35%
Marite	409	40	36%
Masana	333	32	29%
Total	1126	110	100%

Author's compilation (2023)

Based on proportional probabilities, interviews were conducted with 35% from Mphenyatsatsi, 36% from Marite, and 29% from Masana villages among the total number of rural households. Consequently, the total number of rural households in each village within Bushbuckridge Local Municipality varies, as indicated in Table 3.1. A structured questionnaire was administered through face-to-face interviews, surveying 110 rural households across the three villages, drawn from a sample frame of 1126.

3.5 Data analysis

The data obtained from the chosen rural households underwent thorough editing, coding, and cleaning to ensure consistency, uniformity, and accuracy. Subsequently, it was input into computer software for analysis. Specifically, IBM SPSS Statistics version 29.0.0.0 was employed to process the data. The analysis encompassed two distinct approaches, descriptive and econometric, aimed at comprehensively examining the collected data.

3.5.1 Data integrity

In this study focusing on rural households, maintaining data integrity emerged as a significant concern. Data integrity, which refers to the accuracy and consistency of collected or stored data (Sharma *et al.*, 2021), is crucial in reducing the risk of data corruption throughout various processes such as data reading, writing, or storage. To ensure data integrity, several measures were implemented. Firstly, daily monitoring of

the data collection process was established, facilitating the timely identification and resolution of any issues encountered during data capture. Additionally, both the researcher and enumerators revisited some of the sampled rural households within our study area to address any missing variables and uphold data accuracy through follow-up visits. Furthermore, continuous spot checks were conducted to validate the completeness and accuracy of collected data, thus ensuring the thorough capture of all necessary information. These measures collectively safeguarded the integrity of the data and enhanced the reliability of the study's findings.

3.5.2 Data processing

The data from the questionnaires was processed in the following manner:

- ❖ First, we put the data into a spreadsheet on a computer.
- ❖ Then, the data cleaning process took place. This involved searching for mistakes or problems in the information from the questionnaires. When information was found to be incomplete, wrong, or not important, it was fixed or deleted.
- ❖ The data was also checked to see if it made sense and was accurate. This is called data validation.

After that, analytical techniques such as descriptive statistics were used to analyse and describe the socio-economic characteristics of the selected rural households of Bushbuckridge Local Municipality and their perceptions of climate change and non-timber forest products. The following section discusses the analytical techniques were used in this study in detail.

3.6 Analytical techniques and data analysis

3.6.1 Descriptive statistics

Descriptive statistics was employed in the study to achieve the first objective of profiling rural household's socio-economic characteristics in Bushbuckridge Local Municipality. The association of variables in a sample is explained using descriptive statistics, which is used to arrange and summarise data (Kaur *et al.*, 2018). To describe and investigate the sample size of the study, all the obtained data was organised, arranged, and analysed in terms of arithmetic means, percentages, and standard deviations, which are all examples of simple descriptive statistics.

3.6.2 Likert scale measurement and Chi-square contingency test

To successfully address the study's second objective which was to assess the level of perceptions of rural households towards socio-economic benefits of NTFPs with climate change in place, the researcher made use of the 5-point Likert scale specified as not very important = 1; not important= 2; undecided = 3; important = 4 and very important =5. A Likert scale is a rating scale utilised to assess the respondents' perspectives (Batterton and Hale, 2017). Descriptive statistics were also used to assess the data acquired with this scale. To find the Likert mean, the scores from the five points of the Likert scale were added and then divided by 5. So, 1 + 2 + 3 + 4 + 5 equals 15, and dividing by 5 gives us 3, representing the average score indicating the level of respondents' perception. The following formula presents the Likert scaling type measuring instrument:

$X = \sum Fx/N$

Where: X represents the mean score;

$\sum$ is the summation sign;

F is the frequency; and

N is the number of respondents.

Decision rule: If the mean score value is equal to 3 or greater, it indicates that the respondents have a positive perception towards the socio-economic benefits of NTFPs. However, if the average score is less than 3, it indicates that they have a negative perception towards those benefits.

3.6.3. Binary logistic regression model

Binary logistic regression model was adopted to analyse the socio-economic factors influencing rural household's willingness to engage in the socio-economic benefits of NTFPs in the face of climate change. Binary logistic regression, according to Wuensch (2015), is a statistical technique that is utilised to estimate a categorical variable (often dichotomous) from a set of explanatory variables. Binary regression model allows one to estimate the likelihood that a specific event will occur. This model assumes that there is a linear relationship between the logit (log-odds) of the outcome and the independent variables (Das and Rahman, 2011). According to Tu (1996), the maximisation of a likelihood function serves as the convergence condition for logistic regression models.

The following equation is the general expression of Binary Logistic Regression Model:

$$Y_i = In\left(\frac{pi}{1-\text{pi}}\right) = \beta_0 + \beta i X_1 i \ldots \ldots \ldots \beta k X k + U i \ldots\ldots\ldots\ldots \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, for i=n observations and

Y_i represents the dependent variable

$In\left(\frac{pi}{1-pi}\right)$, represents the log of probabilities wherein

Pi represents the possibility that the rural households are willing to participate in socio-economic benefits of NTFPs in the face of climate change and

$1 - Pi$ represents the probability that the rural households are not willing to participate in socio-economic benefits of NTFPs in the face of climate change. In addition,

X_i represents independent variables;

β_0 stands for an intercept;

β_1, β_2, β_3…β_i represent a vector of unknown parameters which measures.

Variation in X_i for a unit in the change in explanatory variables, and

U_i represent a random disturbance term.

The specific binary logistic regression model of the study is given as outlined below:

WTP = β_0 + β_1AGE + β_2LED + β_3GND + β_4MRS + β_5HS + β_6ES + β_7MC + β_8CRD+ β_9EXP+ β_{10}AWS + β_{11}TC+ β_{12}DST+ β_{13}RNF+ β_{14} TC+ Ui $\cdots \cdots \cdots \cdots \cdots \ldots\ldots \cdots \cdots \ldots\ldots$ $\cdots \cdots \cdots \cdots \cdots \cdots$ (2)

Table 3.2: Variable descriptions in the Binary Logistic regression model.

Variables		Description	Unit of measure/Type of variable		Expected Signs
			Dependent variable		
Y_1	WTP	Willingness to participate in socio-economic benefits of NTFPs	(1) P is the probability that the rural household is willing to participate,(0)1-P is the probability that the rural household is not willing to participate	Dichotomous	
			Independent variables		
X_1	AGE	Age	Actual age	Years	+
X_2	LED	Level of education	Number of years in schooling	Years	±
X_3	GND	Gender	1 if the respondent is male; 0 otherwise.	Dummy.	+
X_4	MRS	Marital status	1 if the respondent is married, 0 otherwise.	Dummy.	+
X_5	HS	Household size	Number of individuals residing in the house for six months	Number	+
X_6	EMP	Employment status	1 if the respondent employed; 0 otherwise	Dummy.	-
X_7	MC	Market access	1 if the respondent has market access ;0 otherwise	Dummy.	+
X_8	CRD	Credit access	1 if the respondent has credit access ;0 otherwise	Dummy	±
X_9	EXP	Experience in harvesting NTFPs	Number of years spent on harvesting NTFPs	Number	+
X_{10}	AWS	Awareness	1 if the respondent is aware of the socio-economic benefits of NTFPs ; 0 otherwise	Dummy	+
X_{11}	TC	Transportation costs	The amount of money spent on transportation costs to the forest	Rands	-
X_{12}	DST	Distance to forest	Distance to where the NTFPs are located	Kilometres	-
X_{13}	RNF	Rainfall	1 if the respondent has perceived rainfall changes in the past 10/20/30 years; 0 otherwise	Dummy	+
X_{14}	TC	Temperature	1 if the respondent has perceived changes in temperature in the last 10/20/30 years; 0 otherwise.	Dummy	+

Author's compilation (2023).

The independent variables mentioned in the table above were hypothesised to influence rural households' willingness to participate in the socio-economic benefits of non-timber forest products (dependent variable). These independent variables were chosen based on previous studies or literature. These variables include age, gender, marital status, educational level, employment status, awareness, market access, credit access, transportation costs, distance to the forest, experience in harvesting NTFPs, rainfall and temperature. Furthermore, the study considered marginal effects. According to Norton *et al.* (2019), marginal effects are important in binary logistic regression because they allow one to estimate the impact of changes in the

explanatory variables on the probability of the outcome variable and identify which variables are most important in predicting the outcome variable. Thus, in this study, marginal effects were accounted for to determine how much alterations in the explanatory variables influence rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change.

The general model of marginal effects to supplement Binary logistic model is given as:

$$\frac{\partial P_J}{\partial X_K} = P_J\left(\beta_{JK} - \sum_{J=1}^{J} P_K \beta_{JK}\right) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{ (3)}$$

3.6.4 Validation of the results

To validate the results, this study examined both the issues of heteroscedasticity and multicollinearity. The Variance Inflation Factor, also known as VIF was used in the study to check for multicollinearity issues. The variance inflation factor is a measure that helps to assess the extent of multicollinearity in a regression analysis. Where in the VIF value of less than 10 shows that there is no multicollinearity and the VIF value of greater than 10 shows that there is some degree of multicollinearity. Furthermore, to verify that the homoscedasticity assumption of the binary logistic model is not violated, the researcher conducted a Breusch-Pagan/Cook-Weisberg test to examine the presence of heteroscedasticity.

3.7 Chapter Summary

This chapter outlined the study's area, the sampling strategy used, the various methodologies and tools for gathering data, and the procedures for data processing and analysis. It also described the empirical model applied to evaluate the willingness of rural households to engage in the socio-economic benefits of non-timber forest products. To summarise, the survey included questions regarding the socio-economic profiles of rural households, their attitudes towards non-timber forest products and climate change, and their willingness to participate in the socio-economic benefits of non-timber forest products. The following chapter will detail the descriptive statistical outcomes for the surveyed rural households.

CHAPTER FOUR
RESEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter consists of the results and discussions of sections which are divided according to the objectives of the study. This chapter covers the descriptive analysis of the socio-economic characteristics of the rural households of Bushbuckridge Local Municipality in Mpumalanga Province, the perceptions of the rural households towards the socio-economic benefits of non-timber forest products in the face of climate change. Data was collected from 110 sampled rural households in Bushbuckridge municipality, Mpumalanga, from December 2023 to January 2024, and further analysed using the statistical packaging for the social sciences (SPSS).

4.2 Descriptive statistics

4.2.1 Gender of the sampled rural household head

Figure 4.2.1 Gender distribution among sampled rural households in Bushbuckridge Local Municipality, Mpumalanga Province (n=110)

Source: Field survey (Mid-December 2023 to Mid-January 2024)

Figure 4.2.1 illustrates the gender composition of the surveyed rural households in Bushbuckridge Local Municipality. Out of the 110 sampled households, 57% were female-headed households, while 43% were male-headed. This indicates a moderate but noticeable inclination towards female participation in activities related to non-timber forest products, healthcare, and agricultural activities (Trường *et al.*, 2020). According to Zhu *et al.* (2020), women often play a central role in the sustainable

management of non-timber forest resources due to their intimate knowledge of local ecosystems and their reliance on NTFPs for household needs.

4.2.2 Marital status of the sampled rural household head.

Marital status of the sampled households

Figure 4.2.2: Marital status of the surveyed rural households in Bushbuckridge Local Municipality, Mpumalanga Province (n=110)

Source: Field survey (Mid-December 2023 to Mid-January 2024).

Figure 4.2.2 illustrates the marital status distribution among the surveyed rural households in Bushbuckridge Local Municipality. Out of the 110 sampled households, 9% of respondents reported being divorced, 29% were married, 7% were single, 14% were widowed, and a majority of 41% indicated that they were staying together but unmarried. The marital status distribution can significantly influence the socio-economic factors driving rural households' willingness to participate in selling forest resources or non-timber forest products. For instance, married individuals may be more motivated to generate additional income for their families, while unmarried individuals may have different priorities or financial responsibilities (Xie *et al.*, 2020). Figure 4.2.3 below shows the educational level of the sampled rural household head.

Level of Education of the sampled households

Legend:
- No formal education
- Primary education
- Secondary education but did not matriculate
- Matriculated
- Tertiary
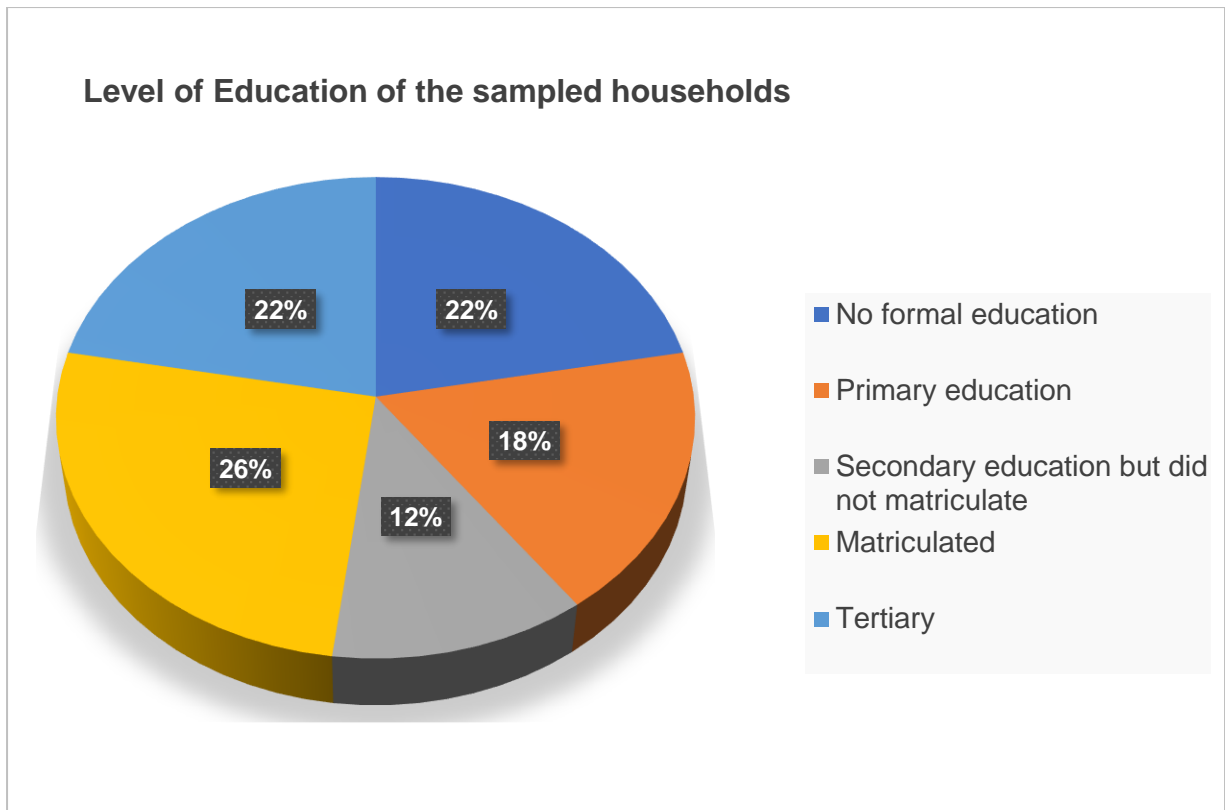
Figure 4.2.3 Educational background of the surveyed rural households in Bushbuckridge Local Municipality, Mpumalanga Province (n=110).

Source: Field survey (Mid-December 2023 to Mid-January 2024)

Data obtained through a field survey conducted mid-December 2023 to mid-January 2024 provides insights into the educational levels of the rural household heads who were interviewed. Data depicts that among the 110 respondents, 22% reported no formal education, while 18% had completed primary education, which is their highest level of education. Additionally, 20% of the respondents had secondary education without matric, 25% matriculated, and 13% possessed tertiary education. Figure 4.2.4 below shows the employment status of the rural household head.

Employment status of the sampled households
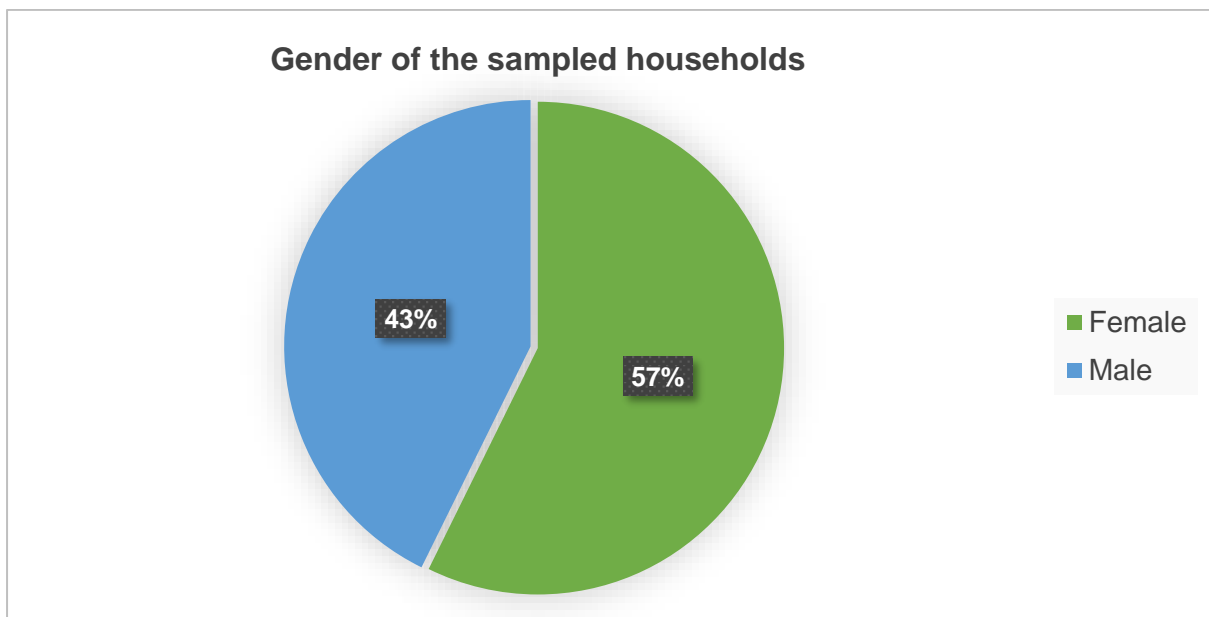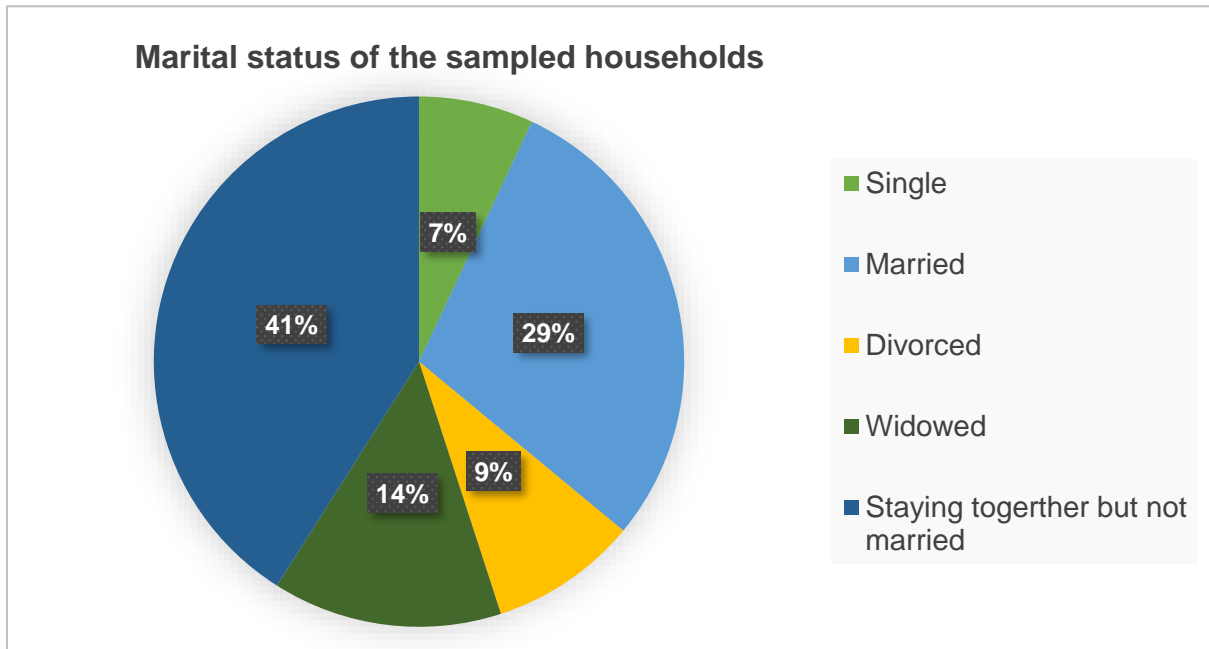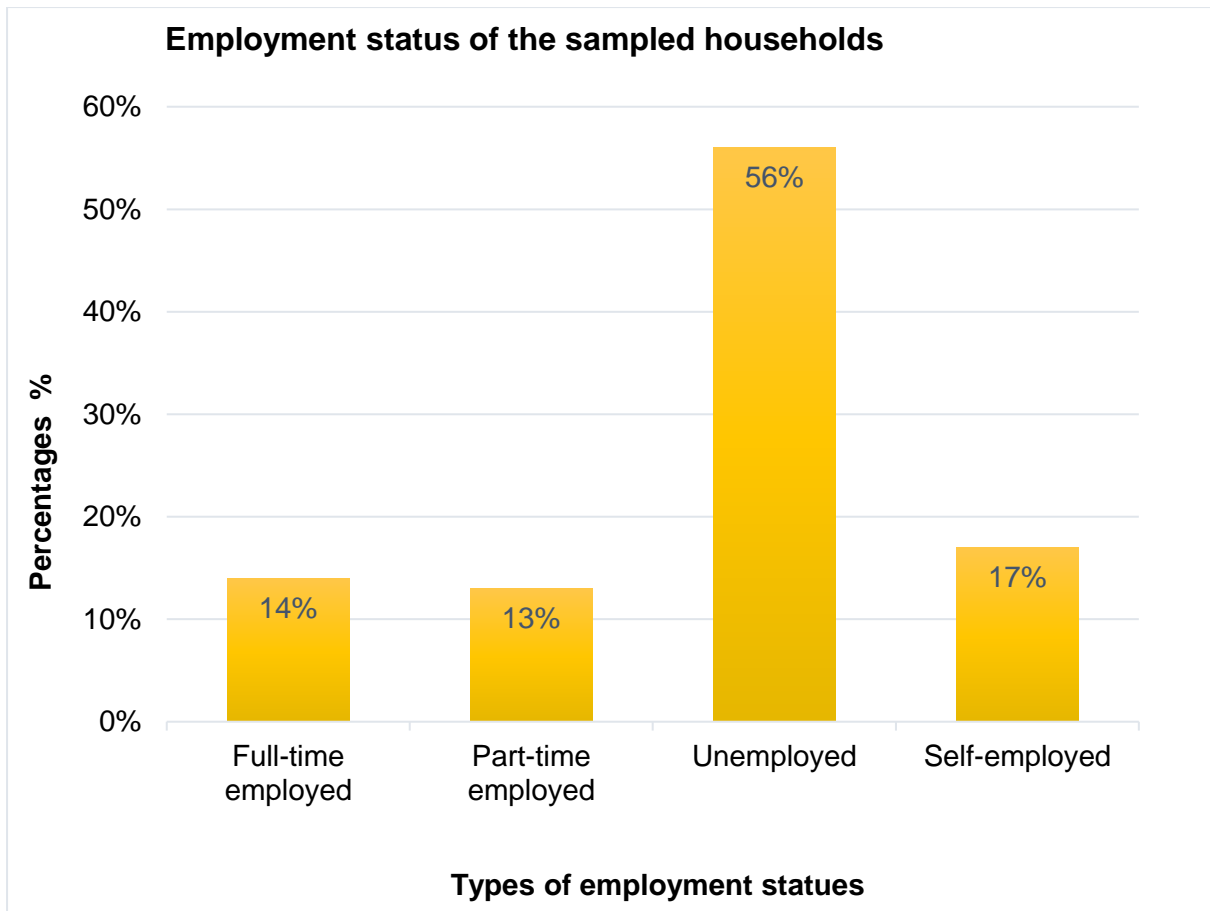
Figure 4.2.4: Employment status of sampled rural households in Bushbuckridge Local Municipality, Mpumalanga Province (n=110)

Source: Field survey (Mid-December 2023 to Mid-January 2024)

The above figure illustrates the employment status of rural households in Bushbuckridge Local Municipality. The results indicate that, among the 110 sampled rural households, 56% were without employment, while the remaining 44% were engaged in various employment categories. Specifically, 14% were in full-time employment, 18% in part-time employment, and 17% were self-employed. This reveals a notable 12% gap between unemployed and employed rural households. These findings highlight the high prevalence of unemployment in rural areas. Based on the data from sampled rural households of Bushbuckridge Local Municipality, it is evident that a significant percentage of rural households in this area were unemployed. Several studies have indicated that the high unemployment rate in rural areas has a direct impact on household forest management behaviour, as households may rely more heavily on forest resources for their livelihoods and may have limited financial

resources to invest in forest management activities (Chinangwa *et al.*, 2016; Liu and Xu, 2019; Verma and Paul, 2016).

Table 4.1 Rural households' sources of income (n=110)

Income sources	Received	Frequency	Percentage(%)
Employment Income	Received	48	44%
	Not received	62	56%
Farm income	Received	7	6%
	Not received	103	94%
Forest resources (non-timber forest products)	Received	12.1	11%
	Not received	97.9	89%
Child-support grants	Received	66	60%
	Not received	44	40%
Old age grants	Received	30	27%
	Not received	80	73%
Remittances	Received	23	21%
	Not received	87	79%
Other sources of income	Received	17	15%
	Not received	93	85%

Source: Field survey (Mid-December 2023 to Mid-January 2024)

The presented table 4.1 analyses the various income sources for rural households in Bushbuckridge Local Municipality, drawn from a sample size of 110 households. The data presents a variety of income sources. A notable portion that is 44%, of these households benefit from employment-related income, while a majority, that is 56%, do not. In contrast, farm-related income is considerably less common in the study area, with a mere 6% of households, indicating farming as a source of income, in opposition to the 94% without such income. About 11% of households indicated that they receive income from selling forest resources. According to Granlund and Hochfeld (2020), social grants are a critical component of household income, especially child-support grants. In this study, majority (60%) of households indicated that they are receiving child-support grants, and only 27% receive old-age grants. Remittances are also a source of income for 21% of households. Other varied income sources account for

15% of the total household's income in Bushbuckridge Local Municipality. Figure 4.2.5 depicts credit accessibility by the sampled rural households.
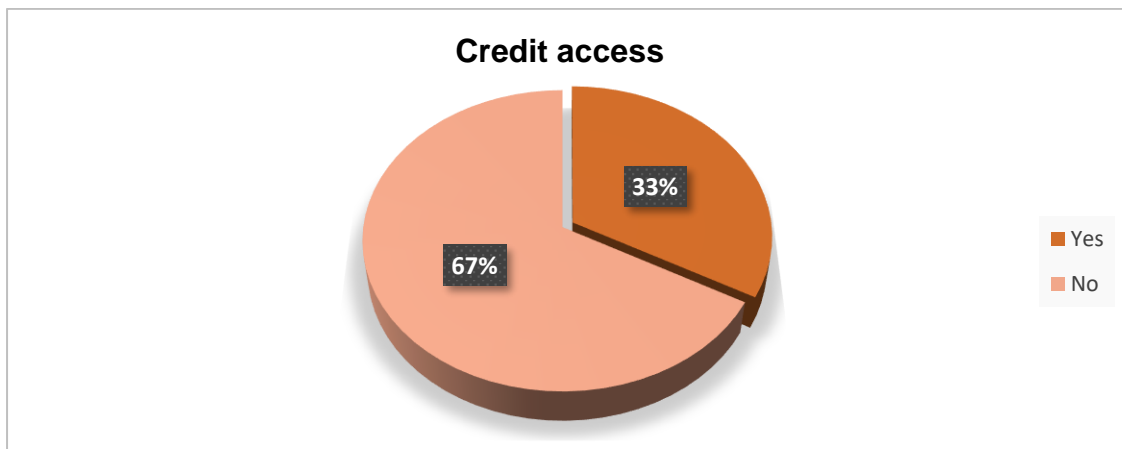
Figure 4.2.5: Rural households' access to credit.
Source: Field survey (Mid-December 2023 to Mid-January 2024)

Figure 4.2.5 illustrates the access to credit among rural households. According to the results, 33% of rural households reported having access to credit, while 67% indicated a lack of access to credit. This highlights a significant gap in credit accessibility within rural communities. According to Argaw (2017) and Babulo *et al.* (2008), households with access to credit access can easily participate in income-generating activities such as livestock farming and trade forest resources to sustain their livelihoods.
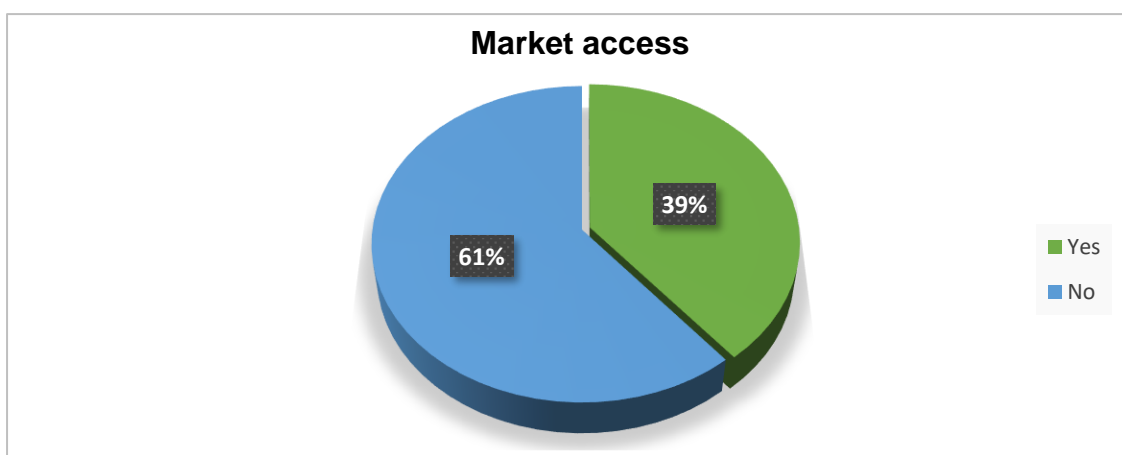
Figure 4.2.6: Rural household's access to market.
Source: Field survey (Mid-December 2023 to Mid-January 2024)

In Figure 4.2.6, 33% of the rural households have access to market, while 67% do not. The accessibility of markets is a crucial factor for rural households involved in forest resources to improve their economic well-being (Babulo *et al.,* 2008; Furo *et al.,* 2022). Figure 4.2.7 below shows rural households' perception of climate change over the last 10/20/30 years.

Rural household's perceptions of climate change over the last 10/20/30 years.
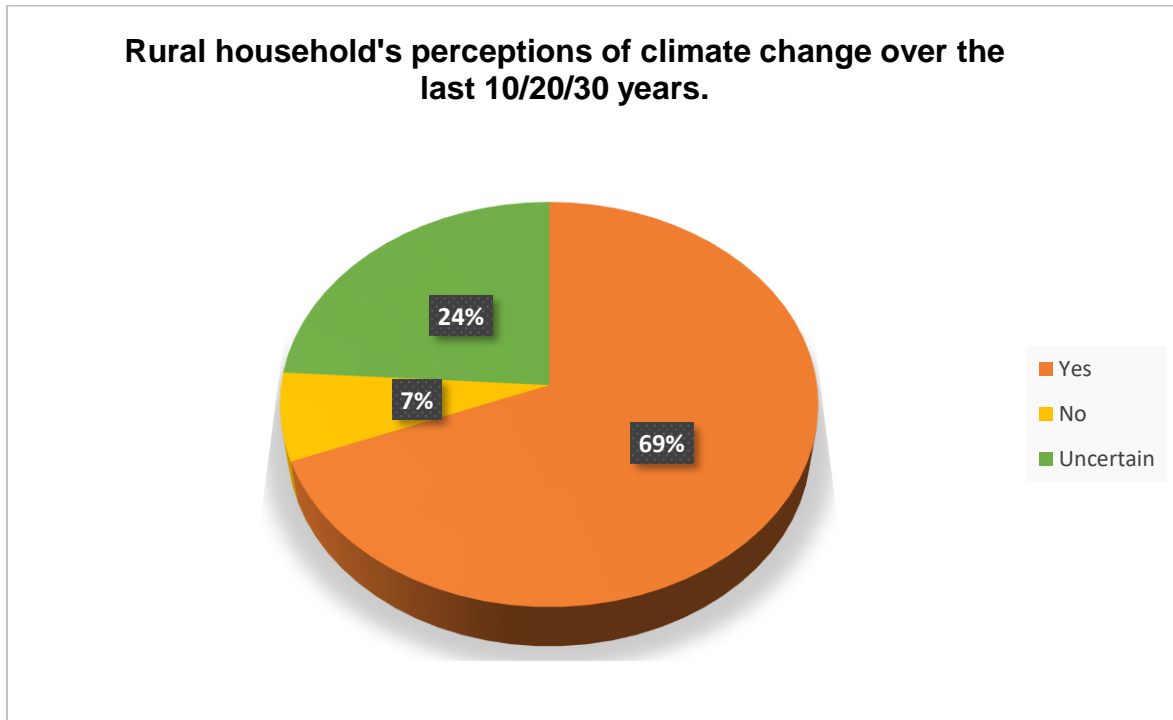
Figure 4.2.7 Rural household's head perception of climate change of the last 10/20/30 years.
Source: Field survey (Mid-December 2023 to Mid-January 2024)

Figure 4.2.7 depicts how rural household heads' view climate change in the past: 10/20/30 years. Most of the surveyed rural households' heads agreed that there was a noticeable climate change. Figure 4.2.7 reveals that 69% of rural households support the validity of climate change, while another 24% are not certain about any changes occurring, and only 7% do not believe in anything happening over the past 10/20/30 years. This study's result is consistent with other studies which highlighted that rural communities are not only increasingly aware of the climate change phenomenon but also stressed to develop strategies to cope with its consequences in terms of non-timber forest products (Asamoah *et al.*, 2024; Dey *et al.*, 2018).

4.3 Rural households' perceptions of climate change

4.3.1 Rainfall changes

4.3.1.1 The number of rainfall days perceived by rural households during the rainy seasons over the last 10/20/30 years.
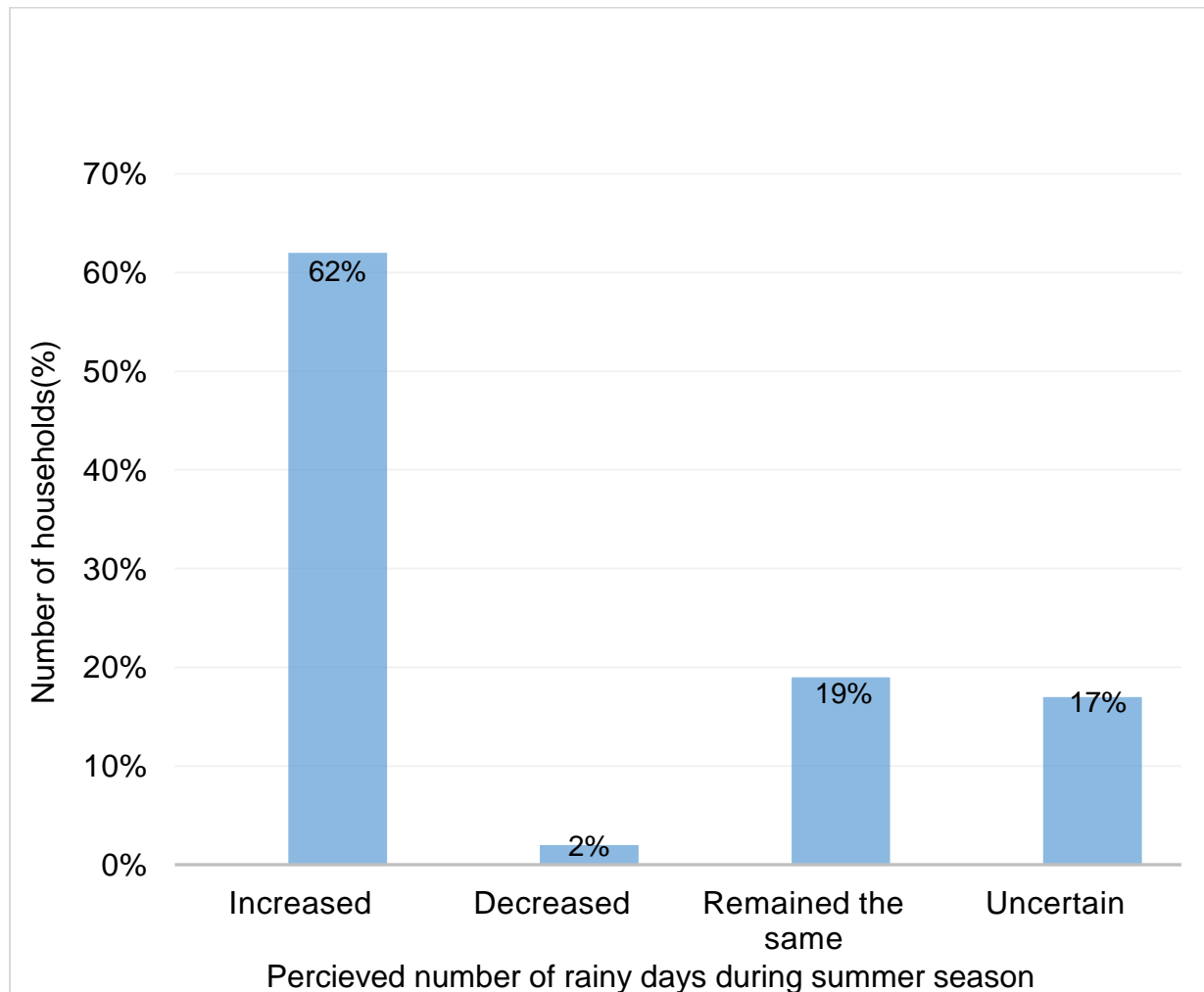
Figure 4.3.1: Rural households' perception of changes in rainfall (n=110)

Source: Field survey (Mid-December 2023 to Mid-January 2024)

Figure 4.3.1 illustrates how rural households perceive changes in rainfall. Of the 110 households surveyed, 62% reported noticing more rainfall, while only 2% reported a decrease during rainy seasons. Furthermore, 19% indicated no noticeable changes in rainfall over the past few decades, while 17% were unsure whether there had been any change in rainfall frequency.

4.3.2 Temperature changes

4.3.2.1 The number of cold days perceived by sampled rural households during winter seasons over the last 10/20/30 years.
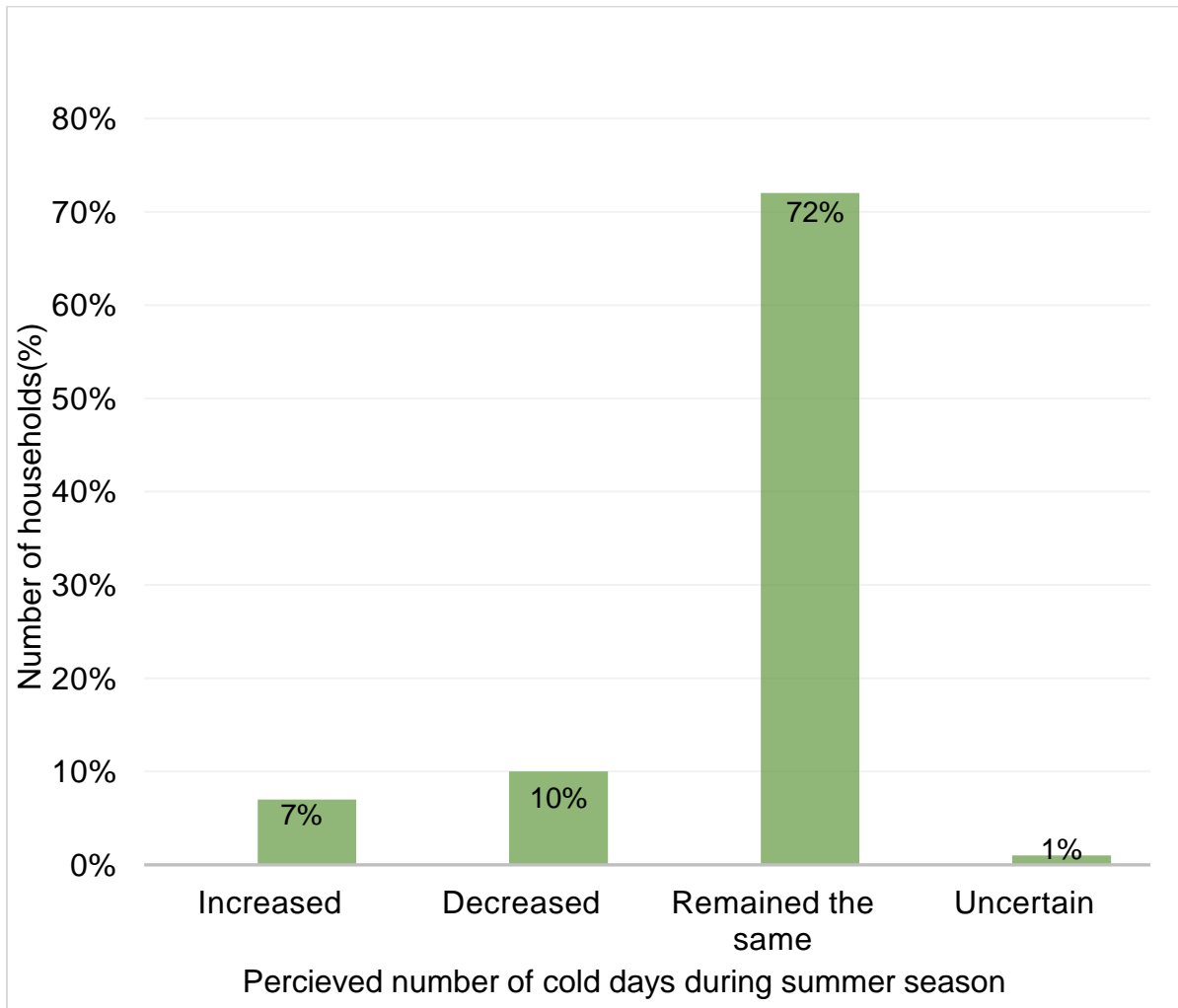
Figure 4.3.2.1: Rural households' perception of changes in the number of cold days (n=110)

Source: Field survey (Mid-December 2023 to Mid-January 2024)

Figure 4.3.2.1 displays how rural households perceive changes in the number of cold days during winter seasons. Of the 110 households surveyed, 7% reported an increase, while 10% noted a decrease in the number of cold days. The majority, 72%, stated that the number of cold days remained the same over the past few decades, with only 1% expressing uncertainty about the changes.

4.3.2.2 The number of hot days perceived by sampled rural households during summer seasons over the last 10/20/30 years.
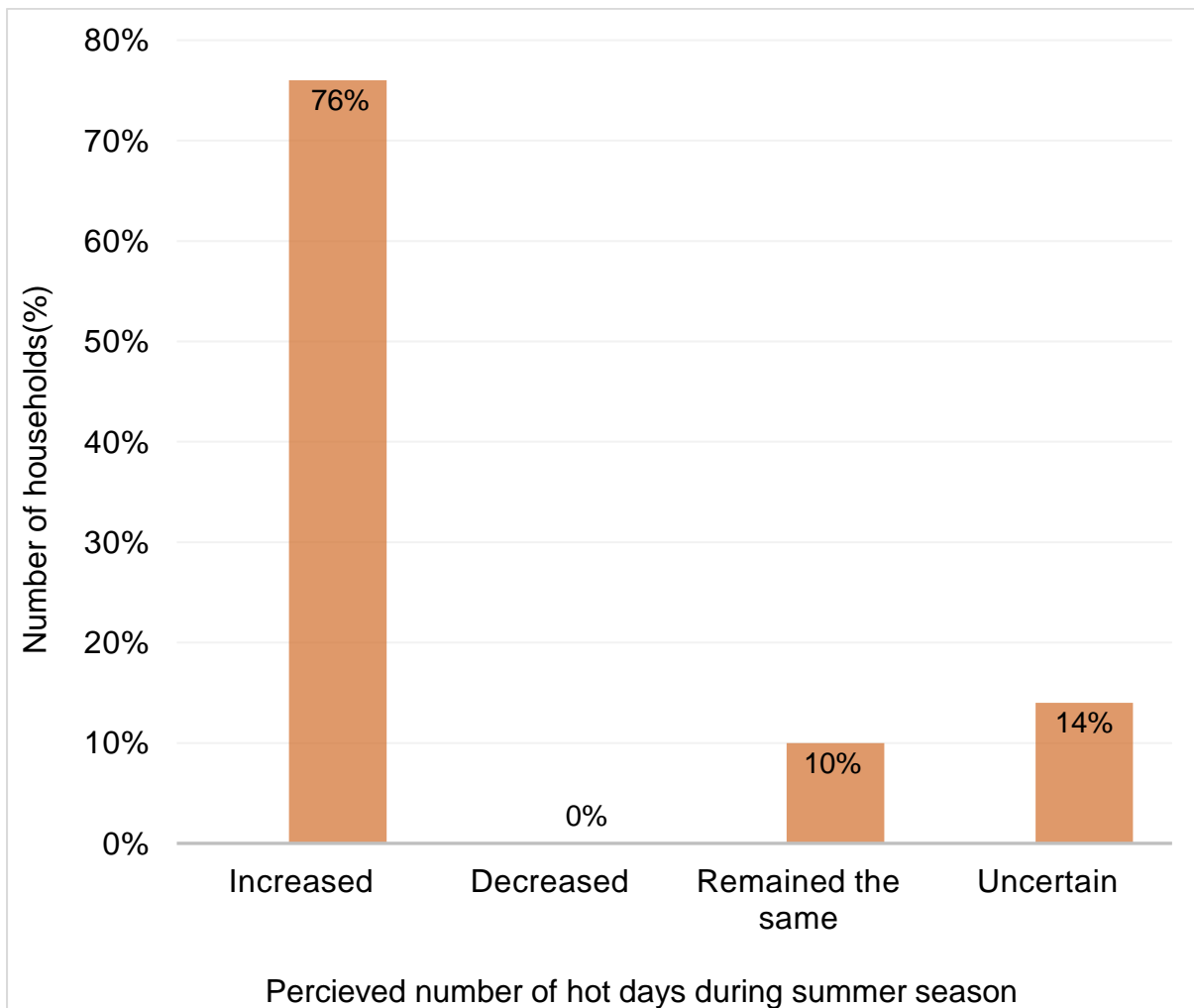
Figure 4.3.2.2: Rural households' perception of changes in the number of hot days (n=110).

Source: Field survey (Mid-December 2023 to Mid-January 2024)

Figure 4.3.2.2 illustrates rural households' perceptions of changes in the number of hot days during the summer seasons. Among the 110 households surveyed, the majority of them (76%) reported an increase in the number of hot days. None of the households reported a decrease, while 10% indicated that the number of hot days remained the same over the past few decades. Additionally, 14% expressed uncertainty regarding any changes in the frequency of hot days.

4.4 Rural households' awareness of non-timber forest products.

4.4.1 Rural household's awareness of the benefits derived from NTFPs.
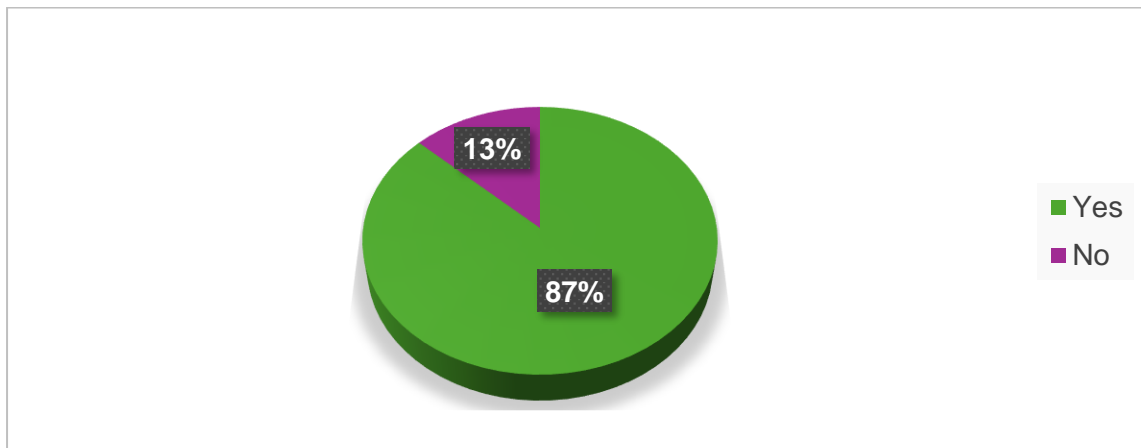
Figure 4.4.1: Rural households' awareness of the benefits derived from non-timber forest products.

Source: Field survey (Mid-December 2023 to Mid-January 2024)

In Figure 4.4.1, 87% of the sampled rural households are aware of the benefits derived from non-timber forest products, while 13% are not aware. Therefore, this indicates a strong awareness among the rural population with regards to the benefits offered by non-timber forest products. Figure 4.4.2 shows the perceived changes in the extraction of non-timber forest products.

Figure 4.4.2: Rural households' perceived changes of non-timber forest products.

Source: Field survey (Mid-December 2023 to Mid-January 2024)

Figure 4.4.2 above depicts that most sampled rural households perceive that non-timber forest products are increasing over time. To get this information, rural households were asked if they had observed or noticed any change (increased, decreased, or constant) in non-timber forest products over the past 10/20/30 years. About 64%, 24%, and 12% of sampled rural households perceived leafy green vegetables as increasing, remaining the same and decreasing, respectively. Similarly, 85%, 9% and 6% perceived mushrooms as increasing, remaining the same and decreasing, respectively. More than 45% of the sampled rural households perceived medicinal plants, tea trees and bushmeat as increasing. Additionally, about 85% of the sampled rural households indicated no change in the availability of round poles over time, which are used for house roofing by many households in the area. Figure 4.4.3 shows rural household's perception of NTFPs as a mechanism for income generation.
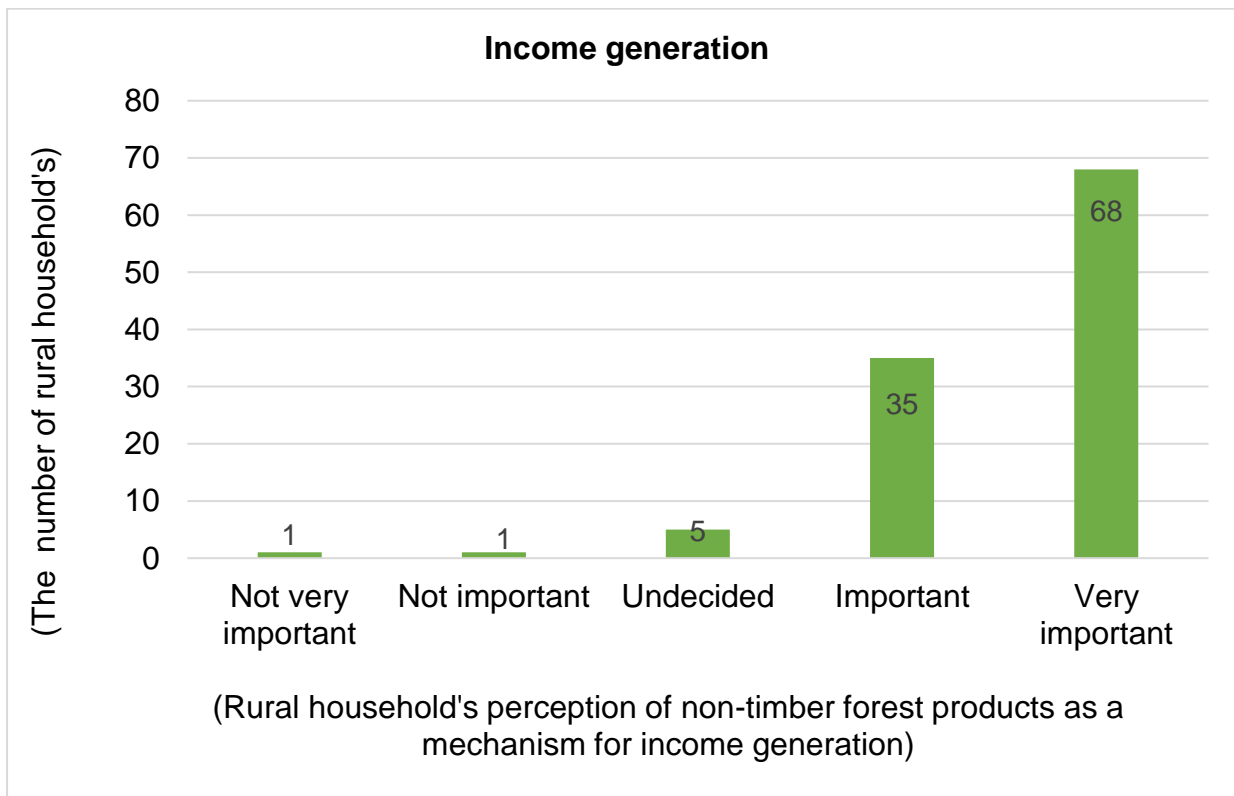
Income generation

Figure 4.4.3: Rural households' perception of non-timber forest products for income generation purposes.

Source: Field survey (Mid-December 2023 to Mid-January 2024)

Figure 4.4.3 above reveals different opinions among the interviewed households. Specifically, 68 of the sampled rural households find non-timber forest products very important for income generation purposes, while only 2 households believe they are not important. Additionally, 35 households consider them important, and 5 remain

undecided. This diversity in responses highlights the different viewpoints within rural communities regarding the significance of non-timber forest products in their income generation. This result is in line with a study by Kruger (2019), who revealed that majority of rural households often perceive non-timber forest products as a valuable mechanism for income generation purposes. Figure 4.4.4 below indicates the perception of rural households towards non-timber forest products for consumption purposes.
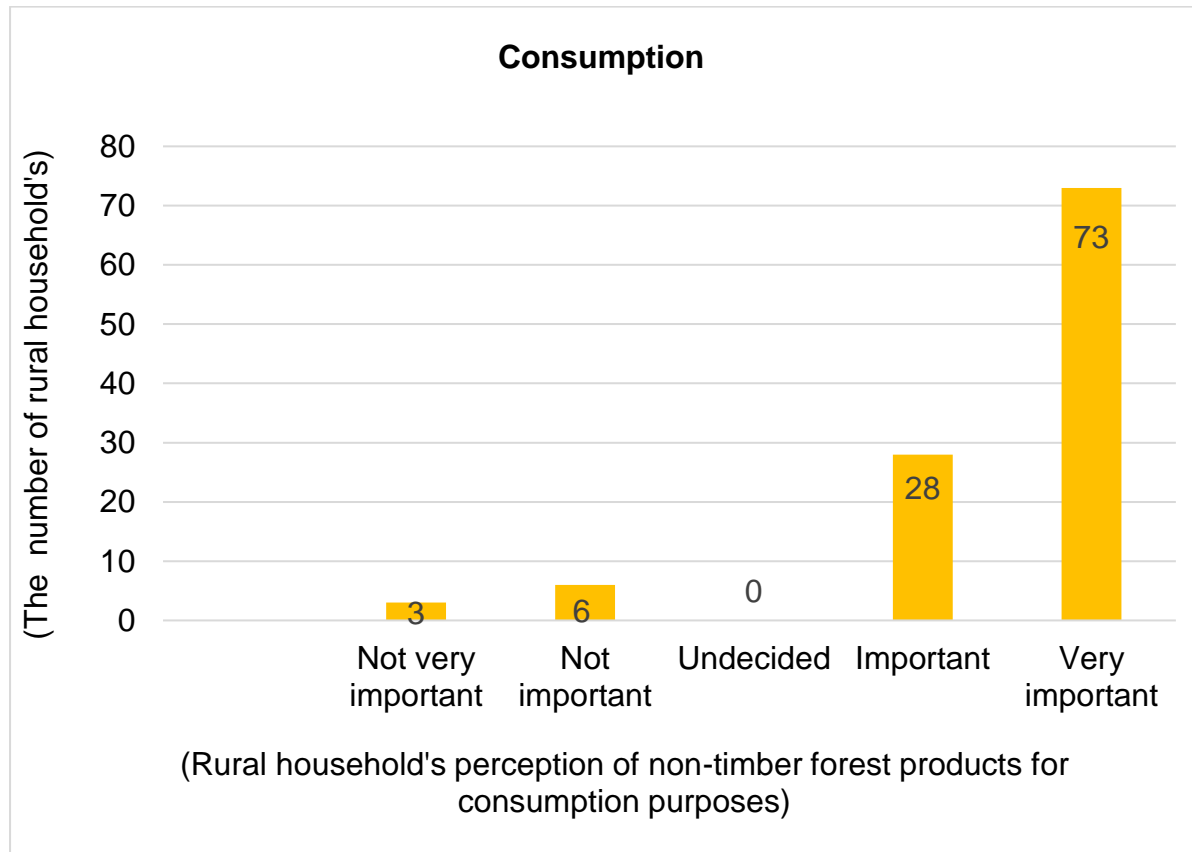
Consumption

Figure 4.4.4: Rural households' perception of non-timber forest products as a mechanism for consumption purposes.

Source: Field survey (Mid-December 2023 to Mid-January 2024)

In Figure 4.4.4, 73 out of 110 rural households consider non-timber forest products extremely important for consumption, and 28 find them important. Additionally, 6 households think they are not important, and 3 believe they are not very important. All households gave a clear opinion with no household being undecided. A study by Pandey *et al.* (2016) on non-timber forest products for sustained livelihood revealed that communities collect non-timber forest products (NTFPs) mainly to fulfil their basic needs, and the percentage of this collection varies across nations, ranging from 5.4%

to 55% nationwide. In Manipur, a state in North-Eastern India, almost 90% of the population relies heavily on forest products, and around 250,000 women are engaged in the collection of these resources (Talukdar *et al.*, 2021). Figure 4.4.5 below shows the perception of rural households towards non-timber forests as safety nets.
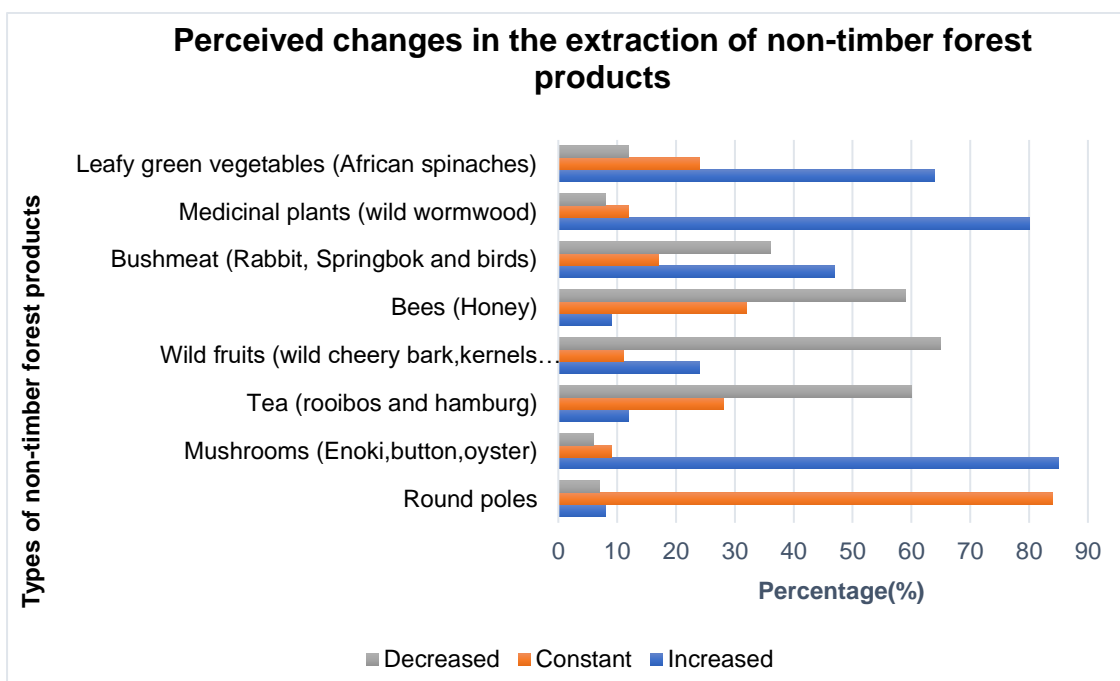
Saftey net
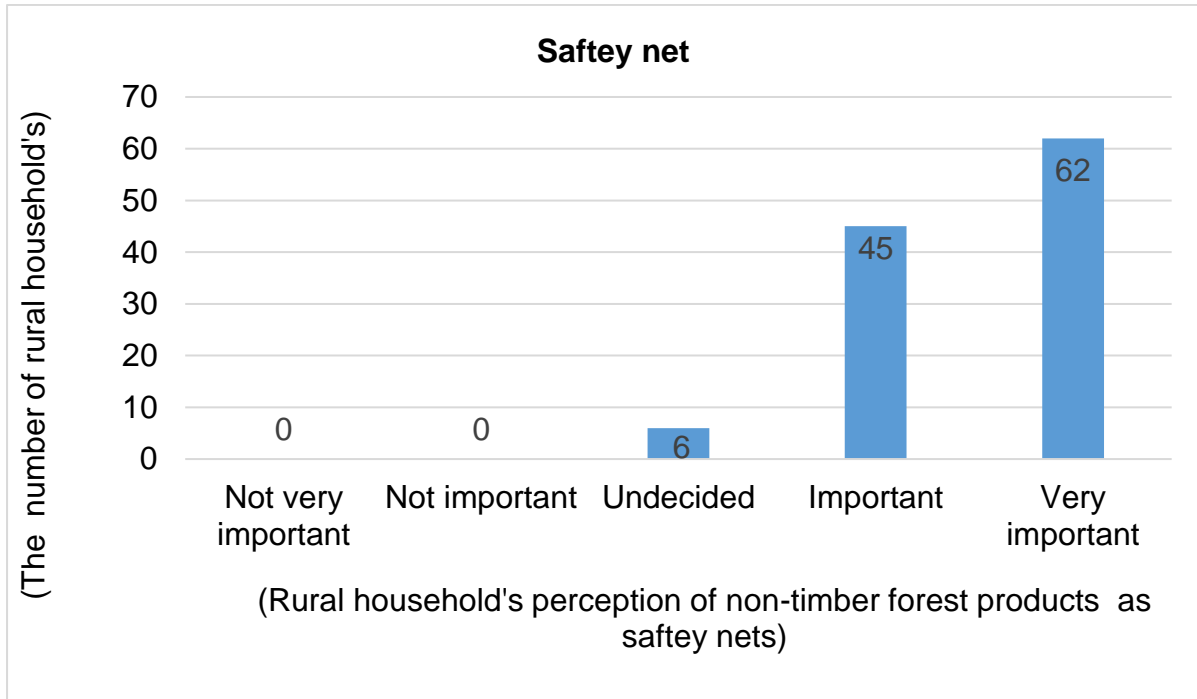
Figure 4.4.5 Rural households' perception of non-timber forest products as a safety net.

Source: Field survey (Mid-December 2023 to Mid-January 2024)

Figure 4.4.5 provides insights into how rural households perceive non-timber forest products (NTFPs) as a safety net. In this study, a safety net is defined as a mechanism that provides a level of support during times of hardship or difficulties. The findings of Demie (2019) on the Contribution of Non-Timber Forest Products in Rural Communities' Livelihoods around Chilimo Forest, West Shewa, indicated that they play an important role in supporting livelihoods and, therefore, provide an important safety net for households throughout the year, particularly during periods of hardship. Figure 4.4.5 above indicates that the majority, 62 rural households, consider NTFPs extremely important in providing support during challenging times. Additionally, 45 rural households find them important in this role, while 6 rural households remain undecided. Moreover, none of the interviewed households regards NTFPs as not important or not very important as a safety net. This diversity in opinions highlights the varied views within rural communities regarding the role of non-timber forest products

as a safety net. The table below shows the importance of the selected benefits of NTFPs, as rated by the surveyed rural households.

Table 4.2: Importance of selected benefits of NTFPs rated by the households.

Items	Not very important (1)	Not important (2)	Undecided (3)	Important (4)	Very Important (5)	Total	Mean score	Decision
Income generation	1(1)	1(2)	5(15)	35(140)	68(340)	498	4.53	Important
Consumption	3(3)	6(12)	0(0)	28(112)	73(365)	492	4.47	Important
safety net	0(0)	0(0)	6(18)	45(180)	62(310)	508	4.62	Important
Health and medicinal benefits	22(22)	60(120)	4(12)	18(72)	6(30)	256	2.33	Not Important
Employment opportunities	0(0)	2(4)	9(27)	81(324)	18(90)	445	4.04	Important
Cultural importance	2(2)	0(0)	22(66)	76(304)	12(60)	432	3.93	Important

Source: Author's own compilation

Mean score= Total/N(110), the Likert mean was calculated by adding up the five points of the Likert scale and then dividing by 5. So, 1 + 2 + 3 + 4 + 5 = 15, and 15 divided by 5 equals 3. If the score is below 3, it means the item is not important. If the score is 3 or above, it means the item is important. This result represents the average score of the respondents' perceptions. The numbers in parentheses show the product of the Likert scale rating and the number of responses. Numbers outside the parentheses indicate how many respondents chose that Likert scale rating. To obtain the results in Table 4.2 above, this study used the Likert scale measurement with a mean score for decision making. The results show that 5 out of the 6 items which were ranked according to importance by the sampled rural households were found to be important, with a mean score of greater than 3. These items include income generation, consumption, safety net, employment opportunities and cultural significance. Adam *et al.* (2013) stated that collecting and selling non-timber forest products offers job

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opportunities for rural communities, especially those who depend on forests for their livelihoods. Additionally, other studies emphasised that besides the economic value of NTFPs, they often carry cultural and social importance in rural areas. Many local customs, traditions, and events are closely connected to the presence and utilisation of certain NTFPs (Asamoah *et al.*, 2024; Balick, 2020; Talukdar *et al.*, 2021). The results in Table 4.2 above indicate that the health and medicinal benefits of NTFPs are perceived as not important based on the decision rule. The mean score for health and medicinal benefits is 2.33, which is less than 3. Figure 4.4.6 below shows rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change.

Willingness to participate in the socio-economic benefis of non-timber forest products (n=110)
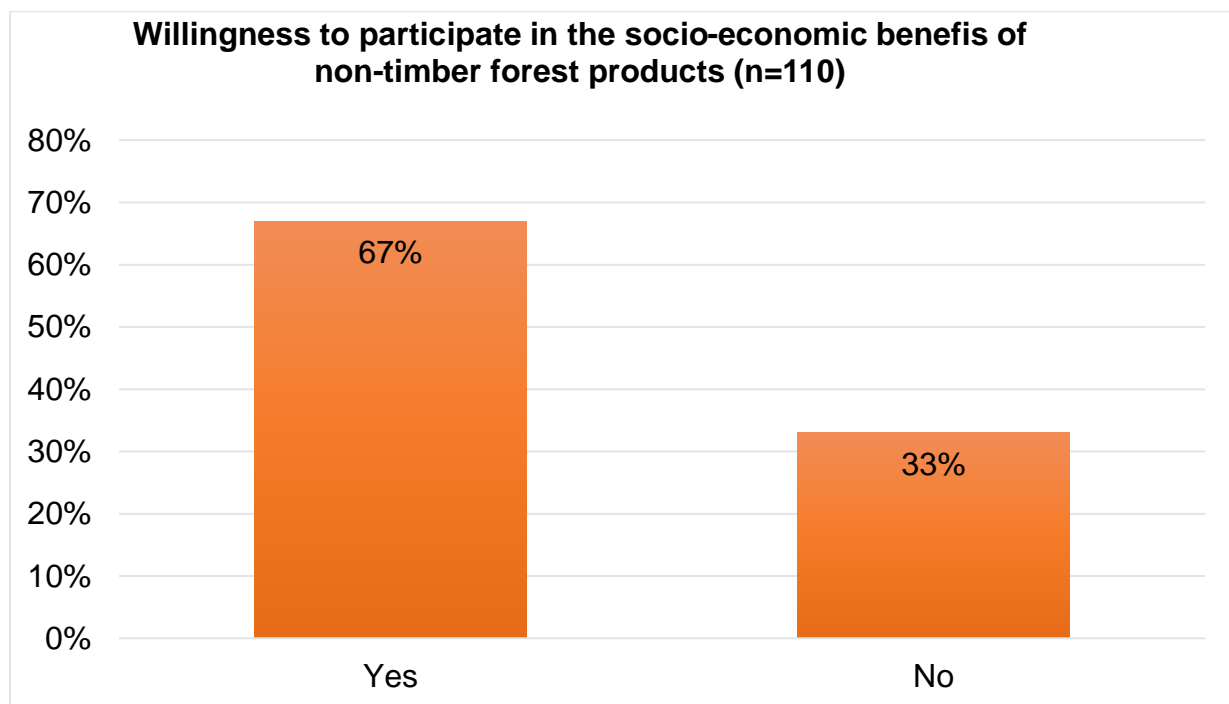
Figure 4.4.6: Rural households' willingness to participate in the socio-economic benefits of non-timber forest products (n=110).

Source: Field survey (Mid-December 2023 to Mid-January 2024).

Rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change is depicted in Figure 4.4.6 above. The proportion of willingness to participate is based on a field survey conducted in 2023, with a sample size of 110 households from the Bushbuckridge Local Municipality in Mpumalanga Province. Figure 4.4.6 illustrates the responses to whether rural households are willing to engage in the socio-economic benefits of NTFPs in the face of climate change challenges. The findings reveal that a significant majority, 67% (74)

of the surveyed households, are willing to participate in activities related to non-timber forest products in the face of climate change. On the other hand, 33% (36) of the surveyed rural households are unwilling to participate. It is important to note that willingness to participate, in this context, goes beyond just economic aspects, indicating a more comprehensive engagement with non-timber forest products for adaptation purposes. According to Dey *et al.* (2018), acknowledging climate change as a driving force behind willingness to participate emphasises the essential role of perception as an important factor for effective climate change adaptation strategies among rural households.

Table 4.3: Sampled rural households' reasons for not willing to participate in the socio-economic benefits of NTFPs (n=36).

Reasons	Frequency	Percentage
I do not know which ones are safe to be eat and which ones are not.	3	8%
It is far (distance to the forest)	5	14%
I do not have time; I have other work to do.	4	11%
I do not have money for transportation, packaging and buying equipment's needed for harvesting the NTFPs.	12	33%
It is not easy to reach the markets due to unreliable transport which is caused by the lack of proper roads.	9	25%
Some of the products are no longer found in larger quantities in the forest.	3	8%

Source: Field survey (Mid-December 2023 to Mid-January 2024)

The study asked rural households if they were willing to participate in the socio-economic benefit of NTFPs. About a third (33%) of the respondents indicated that they could not afford things like transportation, packaging material and equipment needed to collect NTFPs, especially for selling purposes. Another quarter (25%) said it is difficult to get to the market because of poor roads around the area and unreliable transport. Some (14%) of them indicated that the forest is far away from where they are based. Moreover, about 11% of the respondents indicated that they are too busy with other work (employment), which makes it difficult for them to find and collect NTFPs. A few (8%) of the respondents were worried about whether the NTFPs were

safe to eat or not, and a small group (also 8%) said they could not find enough of certain the non-timber products in the forest anymore.

Table 4.4: Descriptive analysis table for continuous variables (n=110)

	N	Min.	Mean	Max.	Std. Deviation	T-test (Sig. 2-tailed)
Age	110	29	50.61	74	10.807	128.6***
Household size	110	2	5.22	11	1.844	57.3***
Distance	110	1	3.567	25	4.4168	42.8***
Experience	110	0	8.62	32	9.793	39.5***
Transportation cost	110	18	20.95	30	5.188	45.9***
Household income	110	2 350	9 850.71	22 480	4 658.291	68.6***
Income generated from NTFPs	110	1070	2 196	4 792	1129.84	18.3***
Valid N (listwise) 110						

Source: Field survey data (Mid-December 2023 to Mid-January 2024)

4.1.2. Age, household size, distance, experience, transportation costs, household income and income generated from NTFPs.

Table 4.1 above indicates the age distribution of the surveyed rural households ranges from 29 years, which is the minimum age, to 74 years, which is the maximum age. The mean age is 50.61, with a standard deviation of 10.807. A study by Asamoah *et al.* (2024) on assessing the Influence of Social Factors on Local Perceptions of Climate Change, Product Value Addition, Multiple Uses of NTFPs, and Their Influence on Poverty Alleviation in Ghana indicated that understanding the age demographics is important for assessing the perspectives of different age groups regarding NTFPs utilisation and climate change. Regarding household size, the findings indicate that the maximum household size is 11 and the minimum is 2, with a mean of 5.22, which implies an approximate value of 5 people per household and a standard deviation of 1.844. The results above also indicate that the distance from household to the forest in kilometres ranges from 1 to 25km, with the mean of the distance sitting at 3.567, which is approximately 4 km and a standard deviation of 4.4168. Pertaining experience

in NTFPs-related activities, the maximum number of years of experience is found to be 32, and the minimum is 0. The average year of experience was 8,62 (i.e. 9 years), with a standard deviation of 9.793.

Transportation incurred by rural household heads from their household to the forest ranged from R18 (minimum) to R30 (maximum), with a mean cost of R20.95, which is approximately R21 and a standard deviation of 5.188. Moreover, the findings indicate that the maximum household income is R22 480 per month, and the maximum contribution to household income from NTFPs is R 4 792. The two-tailed test results above are statistically significant at a 1% level of significance, showing that there is a highly significant mean difference between rural households' age and their harvesting experience influenced their perception of climate change, non-timber forest products, and willingness to participate in the socio-economic benefits of the NTFPs. The results also depict that the mean total income generated from NTFPs is R2 196, with a minimum and maximum of R1070 and R4 792 respectively. The two-tailed tests result for this variable is highly statistically significant at 1%, indicating that there is a strong significant difference in the amount of income generated from non-timber forest products in the study area.

4.5 Chapter summary

This chapter discussed the descriptive results for socioeconomic characteristics, rural household's perception and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change. From the results, there is enough evidence to suggest that female-headed households were dominating in the study area. Female-headed households accounted for 57%, and the remaining 43% were accounted for by the male-headed households. The results determined that majority (67%) of sampled rural households were willing to participate in the socio-economic products of NTFPs. The results showed that a lack of access to capital needed to harvest equipment, packaging and transportation of these resources was the main reason for households' unwillingness to participate in the benefits of NTFPs.

CHAPTER FIVE

EMPIRICAL RESULTS AND DISCUSSIONS

5.1 Introduction

The purpose of this study is to give empirical outcomes of the model developed in Chapter 3. The binary logistic regression model was used in the study to examine factors affecting rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change in Bushbuckridge Local Municipality. The validity of the model is tested, and conclusions are drawn based on the findings. The chapter commences with diagnostic tests to the level of multicollinearity and heteroscedasticity using the variance inflation factor (VIF) and Breusch-Pagan/Cook Weisberg test. The significant variables are discussed in brief, followed by a simple discussion of insignificant variables and a summary of the chapter. The choices of the explanatory variables are based on data availability, economic theory, and the available literature.

Table 5.1: Diagnostic to assess the degree of multicollinearity problem of the sampled rural households (n=110)

Explanatory variable	Collinearity Statistics	
	VIF	1/VIF
Age	3.41	0.29
Gender	1.18	0.85
Marital Status	1.60	0.63
Level of education	2.57	0.39
Household size	2.06	0.49
Employment status	1.83	0.55
Market access	1.67	0.59
Credit access	1.49	0.67
Awareness	1.36	0.74
Distance	2.43	0.41
Experience	2.63	0.38
Transportation costs	2.67	0.37
Rainfall	1.32	0.75
Temperature	1.36	0.73
Mean VIF	1.97	0.51

Multicollinearity is a statistical phenomenon where some predictor variables in a regression model are highly correlated, making it hard to differentiate the individual effect of each predictor variable on the dependent variable (Lavery *et al.*, 2019). In this study, the variance inflation factor (VIF) is adopted to assess the degree of multicollinearity problem. According to Kyriazos and Poga (2023), the fundamental criterion is that a multicollinearity problem arises when the number of a variables exceeds 10. In this study, the VIF results in the table above indicates that all predictor variables do not exceed the value of 10, and the average VIF value is 1.97, with an average VIF value of 0.51. Therefore, this implies that there is no presence of a multicollinearity problem among the predator variables of this study.

Table 5.2: Results of heteroscedasticity test

Variable	$X^2(1)$	Prob>X^2	Tabulated
WTP	1.29	0.68892	3.84

Source: Survey data (Mid-December 2023-Mid January 2024)

According to the table above, the heteroscedasticity problem was not observed as the calculated χ^2 value (1.29) was less than the tabulated χ^2 value (3.84) at a 5% significance level with one degree of freedom.

Table 5.3 Binary regression model results

Independent Variables	Coefficient	St. Error	Wald	Sig.	dy/dx
Constant	-19.296	2.396	8.042	0.000	-
Age	0.095**	0.037	2.567	0.078	0.053
Gender	-0.092	0.643	0.143	0.886	0.040
Marital Status	-0.437	0.736	0.593	0.553	0.988
Level of education	-1.086***	0.101	10.752	0.001	0.042
Household size	0.570***	0.120	4.750	0.042	0.028
Employment status	1.030*	0.498	2.068	0.140	0.008
Market access	1.612***	0.219	7.360	0.001	0.037
Credit access	-0.067	0.718	0.093	0.926	0.003
Awareness	1.601**	0.623	2.569	0.023	0.120
Distance	0.169	0.151	1.119	0.264	0.273
Experience	0.089*	0.043	2.069	0.038	0.012
Transportation costs	1.594***	0.567	2.811	0.016	0.010
Rainfall	1.879***	0.335	5.608	0.002	0.062
Temperature	-0.692	0.434	1.594	0.464	0.084

Cox and Snell R square	0.632
Nagelkerke R square	0.719
-2 Log-likelihood	87.831
NB: ***,**,* represent 1%, 5% and 10% level of significance, respectively.	

Table 5.3 above shows the results of the binary regression model. In this study, binary regression model was used to determine factors influencing rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change. The statistical package of the social sciences (SPSS)

version 29.000 was utilised to obtain the empirical results. Out of the 14 independent variables that were logged in during the analysis, only 9 independent variables were found to be significant at 1%, 5%, and 10% levels. These independent variables include age, level of education, household size, employment status, market access, awareness, experience, transportation costs and rainfall. The Cox and Snell R-square of the model is 0.632, which indicates that 63.2% of the variation in rural households' willingness to participate is predicted by the logged independent variables, and only 32.8% of the variation is predicted by the error term. Furthermore, the Nagelkerke R-square was obtained at 0.719, approximately 72%. This implies that 72% of the variation in the dependent variable (willingness to participate) is explained by the model. Moreover, the model summary indicates that the (-2) Log-likelihood of the estimated model is 87.831, which indicates that the binary regression model can be relied upon for predicting rural households' willingness to participate in the socio-economic benefits of non-timber forest products.

5.2 Discussion on the significant independent variables

5.2.1 Age

Age, which was measured in the actual years of the sampled rural household's head, was found to be statistically significant at 5% level of significance. The sign coefficient parameter for age is positive, which implies that there is a positive relationship between the age of the rural household's head and willingness to participate. Therefore, there is enough evidence to suggest that as the number of years of the rural household's head increases by one year, this increases the probability of the rural household's willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change by 5.3%, ceteris paribus. The outcome of the study conforms with *prior* expectations as it was expected that increase in the age of the rural household's head would increase their willingness to participate in the socio-economic benefits of non-timber forest products. This result is not in line with the findings of Maua *et al.* (2018), amongst others, who revealed that the age of the household head negatively influenced the dependence on non-timber forest products. However, the findings of most studies on this variable are consistent with the results of this study Majority of these studies revealed that age positively influences a household's willingness to participate and adapt to climate change (Marie *et al.*, 2020; Mwinkom *et al.*, 2021; Zamasiya *et al.*, 2017).

5.2.2 Level of education

According to the empirical findings in Table 4.6, the variable level of education was found to be highly statistically significant at 1% level of significance, with a marginal effect of 0.042. The sign coefficient parameter for the level of education is negative, which indicates that as the number of years spent in school increases by one year, it decreases the probability that the rural household's willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change by 4.2%. This study hypothesised that the education level variable can either have a positive or a negative influence towards the dependent variable (Willingness to participate). The positive hypothesis was that as the level of education of rural households increases, they become more knowledgeable about non-timber forest products and their contribution to their livelihoods. This will then enhance their willingness to participate in the socio-economic benefits of these products. On the other hand, the study also considered that an increase in the level of education may influence the dependent variable negatively, in that as individuals get more educated, they are more likely to rely on employment opportunities for their livelihoods. Therefore, this means that they might be less willing to participate in the socio-economic benefits of NTFPs. This study's result is inconsistent with most studies. A study by Zhu *et al*. (2016), amongst others, found educational level to have a statistically significant positive influence towards farmers' and households' participation decisions.

5.2.3 Household size.

The empirical results above depict that household size was found to be statistically significant with a positive influence towards the dependent variable, which is willingness to participate. Household size was found to be significant at 1% level of significance, with a marginal effect of 0.028, and this implies that an increase in the household size by 1 member will increase the probability of rural households' willingness to participate by 2.8%, ceteris paribus. This finding is in line with *prior* expectations, as it was expected that the relationship between household size and willingness to participate in the socio-economic benefits of non-timber forest products would be positive. This finding is consistent with the findings of Suleiman *et al*. (2017) who found household size to have a significant positive influence on the harvesting of non-timber forest products. However, this study's findings contradict that of Mango *et*

al. (2014), who revealed that household size negatively influences food security among rural households. Similarly, a study by Mauna *et al.* (2018) revealed that household size had a significant negative influence on the dependency of non-timber forest products on rural households of South Nandi Forest in Kenya.

5.2.4. Employment status

Employment status, according to the empirical results above in Table 4.6, was found to be statistically significant at 10% level of significance, with a marginal effect of 0.008. Additionally, the positive sign coefficient indicates a positive relationship between employment status and rural household's willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change. There is sufficient evidence to suggest that an increase in employment by rural households will increase their probability of willingness to participate by 0.8% when other factors are held constant. This finding is supported by Anyanwu (2014), who found employment status as one of the variables that significantly reduced the probability of being poor in Nigeria. Similarly, a study by Kamwi *et al.* (2020) revealed a significant relationship between non-timber forest products reliance and employment status in a case of rural communities in Mukwe Constituency, Kavango East Namibia.

5.2.5 Market access

Market access, which was measured as a dummy variable where (1 was allocated if the household head has market access; 0 otherwise), was found to be highly statistically significant at 1% level of significance. The sign coefficient of market access is positive, which implies that there is a positive relationship between market access and rural household's willingness to participate, with a marginal effect of 0.037. Therefore, there is enough evidence to suggest that a unit increase in market accessibility by the rural household increases their probability of participating in the socio-economic benefits of non-timber forest products by 3.7% when other factors are held constant. According to Abokyi *et al.* (2020), inadequate roads in rural areas make it difficult for farmers to reach their market, and this influences their level of participation in the market. This study's finding is in line with that of Tessema *et al.* (2013), who urged that market access, amongst other variables, significantly affects the choice of adaptation strategies in Eastern Hararghe Zone, in Ethiopia. In addition, Mayarni *et al.* (2023) also indicated that market access had an influence towards profitability and economic viability.

5.2.6 Awareness of the benefits of non-timber forest products

Awareness ,which in this study was defined as whether the rural households are aware or know about the different socio-economic benefits which they can derive from non-timber forest products, was found to be statistically significant at 5% level of significance and having a positive influence towards the dependent variable which is willingness to participate. The positive influence implies that an increase in awareness of the benefits of non-timber forest products will also increase rural households' willingness to participate by 12%, ceteris paribus. This finding is in line with *prior* expectations indicated in Chapter 3, as it was expected that an increase in awareness would result in an increased willingness to participate in the socio-economic benefits of non-timber forest products, as households will now be aware of how best to utilise the products to meet their own individual needs (Sharma, 2019). This is supported by Adeyonu *et al.* (2016), who urged that an increase in awareness resulted in increased willingness to participate in the national agricultural insurance scheme.

5.2.7 Experience

In the empirical results above, the sign coefficient of variable experience was found to be positive. The positive sign coefficient implies that the variable experience has a positive influence on the dependent variable, with a marginal effect of 0.012. Experience was found to be significant at 10% level of significance, which implies that when other factors are held constant, there is sufficient evidence to suggest that an increase in the number of years of experience by one year will lead to an increase in the probability of the rural household's willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change by 1.2%. The positive relationship/sign coefficient conforms to *prior* expectations, as it was expected that the more experience rural households acquire over the years, the more competent they will be in non-timber-related activities, which will result in increased participation. This finding is supported by Fasakin *et al.* (2022), who reported that experience was one of the key factors that influenced the youth's willingness to participate in agriculture. However, this research finding contradicts that of Ajah and Nmadu (2012), whose study revealed that farming experience was statistically significant but had a negative impact on maize productivity, indicating that each additional year of experience reduced a farmer's output by approximately 20 kg.

5.2.8 Transportation costs

The sign coefficient parameter for transportation cost is positive, as shown in Table 4.6 above and highly significant at 1% level of significance, with a marginal effect of 0.010. These results are contrary to *prior* expectations as it was expected that as transportation costs increase, the probability of rural households' willingness to participate will decrease as a result of increased costs of transportation. Abokyi *et al.* (2020) indicated that higher transportation costs decrease farmers' willingness to participate in the market for agricultural commodities. However, the empirical result of this study reveals that an increase in the cost of transportation by one rand will lead to an increase in rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change, ceteris paribus. This is due to the positive relationship that exists between transportation costs and rural household's willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change.

5.2.9 Rainfall Perception

The rainfall perception by rural households was found to have a positive influence on rural households' willingness to participate. The findings of this study are in line with *prior* expectations, as it was expected that rainfall perception would be positively related to rural household's willingness to participate. This is because rainfall plays an important role in the availability and quantity of non-timber forest products. Asamoah *et al.* (2023) stated that a decline in rainfall results in a decline in the availability and quantities of non-timber forest products in the forest areas. As indicated in the table above, rainfall was found to be statistically significant at 1 % level of significance. The positive sign coefficient implies that as rainfall perception by rural households increases by one-unit, rural household's willingness to participate will also increase by 6.2% when other factors are held constant. This study's finding is in line with that of Abid *et al.* (2016), who found rainfall perception by households to have a positive association with adaptation to climate change in rural Pakistan.

5.3 Discussion of insignificant Variables

The binary regression model results showed that certain factors like gender, marital status, credit access, distance to the forest, and temperature were not significant. Table 5.3 indicates that gender and marital status are negatively associated with

willingness to participate in the socio-economic benefits of non-timber forest products. This implies that married male-headed households had a lower likelihood of participating in the socio-economic benefits of non-timber forest products. However, these two variables were not found to be statistically significant, therefore, there is no sufficient evidence to conclude that gender and marital status have an influence on rural households' willingness to participate in the socio-economic benefits of non-timber forest products. Additionally, the findings also revealed that the variable credit access is negatively associated with rural household's willingness to participate. This implies that an increase in credit accessibility by households will decrease their likelihood of being willing to participate in the socio-economic benefits of non-timber forest products.

This study's findings contradict the findings of Sabasi *et al.* (2021), who found credit access to be positively correlated with both residual returns to resources and agricultural productivity. Furthermore, the temperature variable was found to have a negative influence towards rural households' willingness to participate, implying that an increase in temperature perception by households will decrease their willingness to participate. This result is not in line with *prior* expectations, as it was expected that an increase in temperatures would lead to an increase in rural household's willingness to participate due to the availability and quantities of the NTFPs. Beltrán-Sánchez *et al.* (2018) and Gurung *et al.* (2021) indicated that the availability and diversity of NTFPs can increase due to a rise in temperatures.

Moreover, the distance to the forest was found to have a positive influence on rural households' willingness to participate. This research finding is not in line with *prior* expectations. It was expected that an increase in the distance to the forest would likely decrease rural household's willingness to participate due to the fact that an increase in distance may increase transportation costs. However, the findings suggest that an increase in the distance to the forest by 1km will increase rural households' willingness to participate. While these factors may not be as important as the significant ones in the study, it does not mean they are irrelevant. These specific variables were considered insignificant because there is not enough evidence to suggest they affect rural households' willingness to engage in the socio-economic benefits of non-timber

forest products in the face of climate change in the Bushbuckridge Local Municipality in Mpumalanga Province.

5.4 Chapter summary.

This chapter provided an overview of factors influencing rural households' perceptions and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change in Bushbuckridge Local Municipality. Rural households' demographics, perceptions and factors influencing their willingness to participate were presented in this chapter. Furthermore, the binary regression model was used in this chapter to predict rural households' willingness to participate. The empirical results from the model revealed that factors such as age, educational level, market access, experience, awareness, rainfall, household size, employment status and rainfall perception were found to be statistically significant at predicting rural households' willingness to participate in the socio-economic benefits of NTFPs.

CHAPTER SIX
SUMMARY, CONCLUSION, AND POLICY RECOMMENDATIONS

6.1. Introduction

This chapter concludes the study by summarising its main points, including research aims, objectives, methods, and key findings. The focus here is to summarise important findings and make conclusions and recommendations based on the findings of the study. In addition, the study also points out areas for future research.

6.2 Research summary

6.2.1 Recap of research objectives and methodology

The study aimed at analysing rural households' perceptions and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change in Bushbuckridge Local Municipality, Mpumalanga Province of South Africa. The first objective of the study was to profile the socio-economic characteristics of rural households of Bushbuckridge Local Municipality. The second objective was to assess the level of perceptions of rural households towards socio-economic benefits of NTFPs and the third objective was to analyse the socio-economic factors influencing rural households' willingness to participate in the socio-economic benefits of NTFPs in the face of climate change, in Bushbuckridge local municipality. The results were analysed in line with the set objectives and aim of the study.

The study used a simple random sampling technique to select portions of an overall sample size of 110 rural households from the three selected villages of Bushbuckridge Local Municipality. In Mpenyatsatsi village, 38 rural households were interviewed, in Marite village, 40, and, in Masana village, 32. The sampled rural households of Bushbuckridge Local Municipality were all interviewed using a semi-structured questionnaire. The socio-economic characteristics of the sampled rural households are explained using descriptive statistics. The data pertaining to socio-economic characteristics was arranged according to minimum, mean, maximum, and standard deviation with the use of descriptive statistics. The Likert scale was used to assess rural household's perceptions of non-timber forest products in the face of climate change. Lastly, the binary logistic model was used to analyse factors influencing rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change.

Furthermore, the significant variables were discussed in detail. The descriptive statistics results indicate that female-headed households are dominant within the study area as they accounted for 57%, while male-headed households accounted for 43%. The average age of the rural household was found to be 50.61, which is approximately 51 years. The empirical results indicated that majority of the sampled rural households were staying together but not married as opposed to those who are single, divorced, married and widowed. The sampled rural households who were classified as staying together but not married accounted for 41%, while those who were classified as single, married, divorced, and widowed accounted for 7%, 29%, 9% and 14%, respectively. The results also pointed out that the unemployment rate in the study area is high. The rural households who are unemployed accounted for 56%, which is the largest percentage as opposed to those who are employed and fall under the categories of full-time (14%), part-time(13%), and self-employed (17%). Regarding rural households' perceptions of climate change, most (69%) of the sampled rural households perceived climate change in the past 10/20/30 years.

The rural households who believe that there is no climate change accounted for 7%, and those who expressed uncertainty about climate change accounted for 24%. Moreover, in terms of rural households' perceptions of non-timber forest products, most (87%) of the interviewed households indicated that they are quite aware of the socio-economic benefits they can derive from non-timber forest products. From the sample of 110 rural households, 66 expressed that they consider non-timber forest products as extremely important for income generation. From the sample of 110 rural households, 66 expressed that they consider non-timber forest products as extremely important for income generation. Those who viewed them as just important, not very important, not important, and were undecided accounted for 35, 1, 1, and 5, respectively. In relation to the binary logistic model results, out of the 14 independent variables that were logged in during the analysis, only 9 variables were found to be statistically significant at 1%, 5% and 10% levels of significance. The variables which were found to be significant at influencing rural households' willingness to participate in the socio-economic benefits of non-timber forests include age, educational level, market access, experience, awareness, rainfall, household size, employment status

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and rainfall perception. The insignificant variables include gender, marital status, credit access, distance, and temperature perception by the sampled rural households.

6.3 Conclusion

6.3.1 Rural households' perceptions towards non-timber forest products

The first hypothesis of the study stated that there is no difference in the level of perceptions of rural households towards socio-economic benefits of non-timber forest products in the study area. Based on the results, this study rejects the stated null hypothesis and accepts the alternative. This is because results revealed that there were differences in the level of perceptions among rural households; some of them perceived non-timber forest products as extremely important for income generation, safety net and consumption purposes, whereas others perceived the non-timber forest products as not very important, not important, as just important and some were uncertain. Additionally, rural households also indicated different perceptions of climate change occurrences in the study area. Majority (62%) of the survey households indicated that they had noticed increase rainfall in the study area over the past 10/20/30 year's period.

6.3.2 Rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change.

The second hypothesis of the study stated that the socio-economic factors do not influence rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate in the study area. This hypothesis is also rejected by the study since the binary logistic regression model results revealed that variables such as age, educational level, market access, experience, awareness, rainfall, household size, employment status and rainfall perception have a significant association with rural household's willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change.

6.4 Policy recommendations

The following recommendations are based on the findings of this study. These recommendations are anticipated to address challenges surrounding the participation of rural households in the socio-economic benefits of non-timber forest products in the face of climate change.

6.4.1 Raise Awareness

Given the impact of awareness on rural households' willingness to participate, it is recommended that awareness programmes be implemented. These programmes should focus on educating rural communities about the benefits of non-timber forest products, emphasising their importance in income generation, consumption and safety net purposes. Additionally, these programmes should be designed to accommodate everyone starting from individuals with no formal education to individuals with the highest level of education. Based on the empirical results, the educational level variable was found to be negatively associated with rural households' willingness to participate in the socio-economic benefits of the NTFPs. This implies that as individuals get more educated, they become less interested in participating in the socio-economic benefits of NTFPs. This could be because the more educated individuals get, the more the chances of getting formal employment opportunities and deviating from other economic activities such as participating in NTFPs to improve their livelihoods. Hence these individuals with higher educational level should also be accommodated in this educational programme and campaigns so they can be aware of the benefits derived from NTFPs and be motivated to participate in the socio-economic benefits of these resources.

6.4.2 Enhance market access.

Improving market access is crucial. A significant number (25%) of surveyed rural households indicated that despite the increase in quantities of NTFPs, they are still not willing to participate in the socio-economic benefits of the NTFPs due to the lack of market access. Therefore, this study highly suggested that the government, along with other stakeholders, should invest in strategies that allow rural households to participate in non-timber forest product activities to be better connected to the market. This can be through supporting the local market, providing training on different marketing approaches and creating a network through which producers can be linked with the relevant buyers. The market access variable was found to have a positive influence towards rural households' willingness to participate.

It is also advisable that the government invest more in infrastructural capacities such as creating and fixing roads to allow smooth movement of the NTFPs from the forests. This will improve market accessibility and motivate those who are not willing to participate to participate. About 33% of households who reported that they were not

willing to participate indicated the lack of proper roads and access to reliable transportation caused by poor conditions of the roads are among the reasons for them not being willing to participate in the socio-economic benefits of the NTFPs. The lack of proper roads discourages transport for hire owners to transport these resources, and the lack of available transport leads to increased transportation costs. Transportation cost is another factor that was found to be associated with rural households' willingness to participate. Hence, it is recommended that the government invest in these infrastructural capacities, which will also lead to reduced transportation costs and allow a smooth household's participation in the socio-economic benefits of the NTFPs.

6.4.3 Enhance the ability to face climate change challenges.

Climate change is the other factor affecting participation in non-timber forest product benefits, hence, recognising that climate-related issues are prevalent, gaining more attention, and expected to require more work. It is imperative to make communities climate resilient. This study results indicate that the perception of rainfall correlates positively with rural households' willingness to participate. The reason is that the higher rainfall positively affects the availability and more efficient collection of NTFPs. Therefore, this study recommends that the government invest in supporting technologies capable of adapting to changes in the climate, disseminate information regarding the patterns associated with the climate, and coordinate training on sustainable practices. The government should also invest in designing and implementing training interventions for adaptation practices. The focus should be on helping rural families better handle challenges posed by the climate, such as those affecting non-timber forest products.

6.4.4 Promote sharing of experiences.

It is assumed that older ages are associated with more experience, and they are more likely to perceive climate change. According to the findings of the study, experience and age are some of the factors that influence rural households' willingness to participate. It is therefore important to encourage households with elders who have experience in harvesting and working with non-timber forest products to share their experiences amongst each other and young inexperienced rural household members. The study recommends that the government should intervene by establishing knowledge-sharing platforms that empower rural communities. The platforms could be in the form of community workshops, support groups and other platforms. This will

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enhance collective learning and adaptation, which will accommodate both young and old people.

6.4.5 Provision of financial support

The research finding revealed a significant positive correlation between employment status and willingness to engage in NTFPs activities. This can be due to the fact that when household members are employed, they have better access to necessities needed for participation in the socio-economic benefits of NTFPs because they are more likely to afford them than those who are unemployed. Based on the data presented in the results section, 33% of the surveyed participants mentioned their unwillingness to engage in NTFPs collection because of the financial hardships it creates. In particular, the costs of transportation, packaging of NTFPs, as well as harvesting and purchasing the needed equipment were deemed high. Hence, the current study suggests establishing new government-run initiatives in the form of financial aid for rural households. Essentially, they should target people willing to engage in the collection of non-timber forest produce but are prevented from doing so by their financial limitations. Particularly, funding should be aimed at the transportation, packaging, harvesting, and essential equipment. Such programmes can be organised in the form of grants, loans at a low-interest rate, or subsidies for NTFPs collection in rural areas.

6.5 Areas of further research

This study analysed factors influencing rural households' willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change. This study's focus was on every rural household member regardless of whether they were engaged in non-timber forest products or not. Future research may consider investigating factors that specifically affect households which engage in non-timber forest products for income generation purposes and consumption. Additionally, future research can also investigate factors influencing participating rural households' willingness to adopt climate change adaptation strategies, considering that non-timber forest products can be affected by it.

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APPENDIX A: ETHICAL CLEARANCE

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TURFLOOP RESEARCH ETHICS COMMITTEE
ETHICS CLEARANCE CERTIFICATE

MEETING: 31 OCTOBER 2023

PROJECT NUMBER: TREC/1611/2023: PG

PROJECT:

Title: Rural household's perceptions and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change, a case study of Bushbuckridge local municipality, Mpumalanga Province

Researcher: TL Theko
Supervisor: Dr MA Nkoana
Co-Supervisor/s: Dr MH Lefophane
Prof JJ Hlongwane
School: Agriculture and Environmental Sciences
Degree: Master of Science in Agriculture (Agricultural Economics)

PROF D MAPOSA
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

Note:
i) This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.
ii) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.
iii) PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

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APPENDIX B: QUESTIONNAIRE

TITLE: RURAL HOUSEHOLD'S PERCEPTIONS AND WILLINGNESS TO PARTICIPATE IN THE SOCIO-ECONOMIC BENEFITS OF NON-TIMBER FOREST PRODUCTS IN THE FACE OF CLIMATE CHANGE.

QUESTIONNAIRE NO:_____

Dear participant

My name is Taelo Theko, am student studying MSc in Agricultural economics in the department of agricultural economics and animal production at the university of Limpopo. I am conducting a survey on rural household's perceptions and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change. A case study of Bushbuckridge Local Municipality in the Mpumalanga province, South Africa. The survey is undertaken as part of data collection process for my research study. The study is aimed at analysing rural household's perceptions and willingness to participate in the socio-economic benefits of non-timber forest products in the face of climate change in Bushbuckridge Local Municipality.

I'd like to invite you to take part in this survey, which is completely voluntary; you are not obligated to participate. Information provided will be treated confidentially and used only for the purpose of this research. Should you feel uncomfortable feel free to withdraw.

Please mark with X to indicate consent for the survey.

I agree to complete the questionnaire and do so in a completely voluntary manner. I understand that my responses will be kept confidential. _____Signature_____

QUESTIONNAIRE

Please answer the following questions by marking (x) in the correct box or by filling in the underlined spaces.

SECTION A: SOCIO-ECONOMIC CHARACTERISTICS

1. Kindly provide your age as of today

☐

2. What is your gender?

☐ Male

☐ Female

3. What is your marital status?

☐ Single

☐ Married

☐ Divorced

☐ Widowed

☐ Staying together but not married

4. Please write the number of years that you spent in school.

☐

Please indicate your highest educational level.

☐ Never went to school.

☐ Primary education

☐ Secondary education

☐ Tertiary education

5. What is your household size i.e., the number of people that are eating form the same pot for six months?

☐

6. How do you describe your employment status?

☐ Full-time employed.

☐ Pat-time employed.

☐ Unemployed

☐ Self-employed

7. How many income sources to you have?_____

8. Please indicate if weather or not you are receiving the following source of income by putting a tick (√) in the correct box.

Income sources	Received	Not received
Employment Income		
Farm income		
Forest resources (non-timber forest products)		
Child-support grants		
Old age grants		
Remittances		
Other sources of income		

9. Estimated total household income per month_____

10. How much is the contribution of income generated from non-timber forest products to the household income_____

SECTION B: RURAL HOUSEHOLD'S PERCEPTIONS TOWARDS NON-TIMBER FOREST PRODUCTS.

1. Rural household's perceptions of socio-economic benefits of non-timber forest products.

1.1 Are you aware of the benefits that you can derive from the non-timber forest products?.......

1. Yes	0. No

1.2 How would you rate the importance of the following socio-economic benefits of non-timber forest products.

	1 Not very important	2 Not Important	3 Undecided	4 Important	5 Very Important
Income generation					
Consumption					
Safety Net					
Health and medicinal benefits					
Employment opportunities					
Cultural importance					

N: B A safety net refers to a mechanism that provides a level of support during times of difficulty or hardship.

2. Rural household's perceptions about climate change and its impact on non-timber forest products.

N: B In this study climate change is defined as the variety of general shifts in weather conditions (changes in the weather and the seasons) including temperature, rainfall, wind, and other factors (such as floods, drought).

2.1. Rural household's perceptions of change in <u>temperature</u> (cold and heat) on non-timber forest products over the last 10 /20 /30 years.

2.1.1. Have you noticed an increase in abnormal temperature in your area over the last 20 years?

1. Yes	0. No

2.1.2. Have the number of abnormal hot days increased, decreased, or stayed the same in your area over the past 10/20/30 years?

Increased	Decreased	Stayed the same

2.2. Rural household's perceptions of change in <u>rainfall</u> pattern on non-timber forest products over the last 10/20/30 years.

2.2.1 Do you think there has been more rainfall during rainy season in your area over the last 10/20/30 years?

1. Yes	0. No

2.2.2 Have the number of rainy days increased or decreased or stayed the same during rainy season in your area over the past 10/20/30 years?

Increased	Decreased	Stayed the same

2.3. Rural household's perceptions of change in <u>drought</u> occurrences on non-timber forest products over the last 10/20/30 years.

2.3.1. Have there been more droughts in your area over the past 20 years? ……

1. Yes	0. No

2.4. Rural household's perceptions of change in <u>wind</u> occurrences on non-timber forest products over the last 10/20/30 years.

2.4.1. Have the number of abnormal windy days increased in your area over the past 10/20/30 years? **.....**

1. Yes	0. No

2.5. Rural household's perceptions of change in temperature, rainfall, wind, and other factors such as droughts and floods on non-timber forest products over the last 10/20/30 years. (See codes below the table)

Climate change components	a. Have these changes affected the forest? (1=Yes,0=No)	b. How have these changes affect your use of non-timber forest products?	c. What have you done to deal with these changes on non-timber forest products?
Changes in rainfall			
Changes in temperature			
Changes in wind			
Droughts events			

Codes for 2.5 b	Codes for 2.5.c
1= Low income	1=Engage in other income-generating activities.
2= Reduced consumption	2= Adapt harvesting practices (Change the timing of harvesting or target different species or products, or modify collection techniques)
3= None	3= Nothing
4= Other Specify………………………….	4= Build social networks
	5= Other Specify…………………………….

2.6 The perceived changes in the extraction of non-timber forest products.

In the table below indicate the changes that you have observed on the non-timber forest products which you know.

The non-timber forest products	Increased/ decreased/ remain the same
e.g Bushmeat	Decreased

SECTION C: RURAL HOUSEHOLD'S WILLINGESS TO PARTCIPATE IN THE SOCIO-ECONOMIC BENEFITS OF NON-TIMBER FOREST PRODUCTS

In this study Non-Timber Forest products (NTFPs) refer to a variety of goods and services that are derived from forests and forested landscapes, but do not involve the harvesting of timber. Examples of NTFPs include mopani worms, fruits, nuts, mushrooms, honey, medicinal plants, fibres, resins, and essential oils, among others. Rural households can benefit from NTFPs in several ways. Firstly, NTFPs provide a source of food and nutrition, particularly during periods of crop failure or when other food sources are scarce. Secondly, NTFPs can provide an important source of income (through harvesting and selling these products).

1. Do you have experience of harvesting non-timber forest   products? If yes, please provide the number of years of your experience.

1. Yes	0. No

_____

2. Do you have market access?

1. Yes	0. No

3. Do you have access to credit?

1. Yes	0. No

4. Are you familiar with the conditions of obtaining credit?

1. Yes	0. No

5. If you had to go to the forest from your home would prefer to walk or use transport?

Walk	Transport

6. How distant are you from the forest?

1= Very far	2= Far	3= close	4=Very close

7. Please provide an estimation of the distance from your home to the forest in Kilometres _____

8.   Rural household's Willingness to participate.

8.1 If you faced times of hardship in your household in terms of accessing food and, would you harvest the non-timber forest products for consumption? Yes [ ] No [ ]
8.2 If no in 8.1, Kindly state the reasons:
8.3 If did not have access to enough income to sustain your livelihood, would you sell the non-timber forest products to generate income? Yes [ ] No [ ]
8.4 If No, in 8,3 kindly state the reasons:
8.5   Are you willing to participate in the socio-economic benefits of non-timber forest products in the face of climate change? Yes [ ] No [ ] If No, kindly state the reasons:

THANK YOU, THIS IS THE END OF THE QUESTIONNAIRE

APPENDIX C: EDITORIAL LETTER

Registered with the South African Translators' Institute (SATI)

Reference number 1000686

06 June 2024

RURAL HOUSEHOLD'S' PERCEPTIONS AND WILLINGNESS TO PARTICIPATE IN THE SOCIO-ECONOMIC BENEFITS

OF NON-TIMBER FOREST PRODUCTS IN THE FACE OF CLIMATE CHANGE: A CASE STUDY OF BUSHBUCKRIDGE

LOCAL MUNICIPALITY, MPUMALANGA PROVINCE

This confirms that I edited substantively the above document, including a Reference list. The document was returned to the author with various tracked changes to correct errors and clarify meaning. It was the author's responsibility to attend to these changes.

Yours faithfully

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