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Socio-economic factors influencing collection and use of the Miombo Woodlands in Western Province, Zambia

FINAL THESIS REPORT

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Declaration

I hereby declare that I have done this thesis entitled Socio-economic factors influencing collection and use of the Miombo Woodlands in Western Province, Zambia independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague 22.04.2023

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Moonga Mbozi

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Moonga Mbozi

Abstract

The role of non-timber forest products to livelihoods of households in especially the global south cannot be overstated. An estimated 2 billion people around the world rely on forests for their sustenance, either directly or indirectly for nourishment, health, and energy, among other things. In Africa, for example, over two-thirds of the population is believed to rely on forest products, either as a source of subsistence or as a source of monetary income from a variety of wood and non-timber forest products. It is for this reason that forests have received significant attention because of their importance in understanding their involvement in poverty reduction strategies. However, not only do high levels of deforestation mean that these important plant species and the benefits they provide are being lost but also very little is known about the socio-economic factors on the collection and use of NTFPs in Zambia. It is against this background that this study sought to examine the socio-economic factors influencing the collection and use of NTFPs by households in the Western province's miombo woodlands. To do this, 97 respondents from Mongu and Limulunga were selected for interview. A binary logistic regression was developed to examine the socio-economic factors influencing the collection and use of NTFPs by households in the Western province's miombo woodlands. The results indicate that distance to markets and forests as well as place of residence were statistically significant. Based on the findings of this study, it is recommended that policies that aim to support the marketing of NTFPs for households in rural areas should be implemented in so that households can reap the monetary benefits that NTFPs could generate

Keywords: logit regression, wild foods, commercialization, household resources, sustainable forest management

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Introduction

Forests are among the world's most diversified ecosystems. They are home to most of the world's plant, mammal, amphibian, and bird species, and they cover around 31% of the world's total land mass (Dumas-Johansen et al., 2018). According to Nesha et al. (2021), Europe is home to the majority of the world's forests, accounting for about 25% of total forests; South America accounts for 20.8%; North America accounts for 16.2%; Africa and Asia account for 15.7% and 15.1%, respectively.

Historically, much of the focus on forests and their management has been on the production of wood and wood products for their commercial value (Pelin, 2005; Ennos 2020). examples of this can be found in how forests were the primary source of fuel in the early stages of industrial revolution (Ennos, 2020). However, there is growing recognition of the importance of forests in the provision of products other than timber and other commercial uses (Mamo, Sjaastd & Veded, 2006; Rahman, Roy & Islam, 2021). As a result of this importance, forestry is increasingly being considered by development workers as a means of achieving rural economic development and enhanced livelihoods (Mulenga, Richardson & Tembo, 2012). The notion is that forestry projects will assist in poverty reduction, food and nutrition security, healthcare, and shelter. Forests could also generate revenue for households. For example, Mamo, Sjaastd & Veded, (2006) found in a study conducted in Ethiopia that, households generated about on average 39% of their incomes from forests was, which was only 1% less than the 40% generated from agricultural purposes. In addition to this, forests can help in generating income for national governments as well as aid in the adaptation and mitigation of climate change (Lopez et al., 2012). Other areas of influence provided by forests include management and conservation of biodiversity, water availability, and environmental sustainability (Epanda et al., 2020)

Forests have played an important role in human development with forests providing, among other things, raw materials for infrastructure, and food for nourishment (Ennos,2020; Sheppard et al., 2020). When it comes to human use of forests, archeological evidence suggests that humans have been using forest products for nourishment from around 6,000 B.C. (Emery, 2001). According to this study, Native American communities in the Upper Great Lakes Basin, for example, relied heavily on plant foods gathered from the region's forests, much as people elsewhere in the world did; even though Ennos (2020) suggests that early humanoids were already using forest products as a source of nourishment since they still lived in treetops. The

use of forest products for in the livelihoods of especially rural people remains the same to this day. An estimated 2 billion people around the world rely on forests for their sustenance, either directly or indirectly. Forests are a source of sustenance, health, and energy for these people (Coulibaly-Lingani et al., 2009; Broegaard et al., 2017).

In Africa, for example, the role of forests and their products to livelihoods cannot be overstated. According to Anderson et al. (2006), Africa has the highest percentage of people living on less than a dollar per day of any continent. Oksanen et al. (2003) further states that, poverty is more acute in Sub-Saharan Africa where about 60% of rural Africans live in poverty. When it comes to forest product use, over two-thirds of Africa's population is believed to rely on forest products, either as a source of subsistence or as a source of monetary income from a variety of wood and non-timber forest products (NTFPs) (Wunder, 2005). Forests have received significant attention as a result of their importance in understanding their involvement in poverty reduction strategies.

World Bank data (2023) estimates that about 26% of Sub-Saharan Africa is covered by forests. These range from rainforests to savanna woodlands and grasslands. Examples of African forests include the Congo basin, which is the largest on the continent, a forest that is important to the livelihoods of people is the miombo woodlands situated in Central and Southern Africa. The miombo woodlands are the most dominant woodlands in the region. It is estimated that about 150 rural and urban people in the region depend on it to supplement their livelihoods (Dumas-Johansen et al. 2018). These households derive various non-timber forest products (NTFPs) including food, firewood, medicine, and construction materials (Dewees et al. 2010; Broegaard et al. 2017).

However, the miombo woodlands are under threat. population growth puts downward pressure on land use and these changes to land use threaten the forests (Handavu et al. 2019). Additionally, the importance of NTFPs to rural households has frequently been overlooked. This undermines both their role in poverty alleviation and their contribution to the national economy. This study, therefore, seeks to examine the factors that influence the collection and use of NTFPs by households in the miombo woodlands of Western province, Zambia. This is because understanding these factors could not only aid policy formulation and help realize the potential of NTFPs but also the conservation of the miombo forest and biodiversity.

1.1. Literature Review

1.1.1 The History of Human-Forest interactions

Forests are among the earth's most diverse ecosystems (Costanza et al. 1997). and have played an important role in the development of the human species. Ennos (2021) claims that, early humanoids, despite having the ability to walk for about 2 million years, retained their ability to climb trees. This was largely because their diets primarily consisted of fruits which were found in treetops as well as the need for protection from predators (Pelin, 2005). However, as the tectonic plates moved, giving rise to mountains and valleys such as the Himalayas in Asia and the great Rift valley in Eastern Africa coupled with cooling temperatures, the continuous monsoon-like conditions gave way to more seasonal conditions (Ennos, 2020). These conditions had interspaced wet seasons with prolonged dry spells and new ecosystems, like Africa's savanna grasslands, were born. As a result, forests became scattered, trees had to adapt to these changes, and they did, by storing energy underground in their roots, corms, and fleshy bulbs for the prolonged dry spells (Ennos 2020).

This in turn incentivized the early humanoids to slowly abandon their lives in the trees. This is because had to supplement their diets by going in search of roots and other foods in the grasslands like honey, termites, and small mammals (Thorpe, Holder & Crompton, 2007; Raichlen et al., 2010; Ennos, 2020). Additionally, this gave rise to the use of early tools which were primarily made from wood, including chisels, spears, and probes. These tools were used to dig up tubers and roots of the plants they consumed as well as hunt, much like modern-day hunter-gatherer groups like the Hadza Tribe in Tanzania, who are one of the last hunter-gather groups remaining in the world living in similar conditions to early humanoids (Stibbard-Hawkes et al. 2022). Furthermore, during this period, humanoids also started to build up knowledge on useful plant species for not only food but also tools.

The transition from a hybrid life between land and the treetops to a more settled life on the ground was completed when early humanoids learned how to use fire, which enabled early humanoids to set permanent camps (Glickson, 2013; Ennos, 2020). In addition to this, fire allowed for the early humanoids to live in small communities, enabled them to deter predators as well as cooking foods which further expanded diets, while using less energy to digest the food (Burton, 2013; Gowlett, 2016). In addition to this, fire not only provided much needed warmth for cold evenings but also enabled the early humanoids to stay up late which was essential to developing practical and social skills including tool mending and development, information, and food sharing, enabling the rapid evolution of these skills (Ennos, 2020).

The neolithic age brought with it new developments in the interactions between forests and humans. First, as aforementioned, the taming of fire enabled humans to transition from a hunter-gatherer to a more settled lifestyle. The first place recorded to undergo a transition from hunter-gathering to farming was in Anatolia, in southern Turkey (Ennos, 2020). It was during this period that humans began to domesticate crops and animals, leading to the agricultural revolution (Allen, 1999). The domestication of plants shifted the focus of early farmers from collecting products from perennial plants to growing annual crops that did not require as much time to not only grow the required tissue but also to store the required energy to survive the longer dry spell (Allen, 1999; Ennos, 2020). This enabled the cultivation of predominantly the early ancestors to grasses such as barley, wheat, and various legumes (Glemin and Bataillon, 2009; Cox, 2009). Even during this time, wooden tools, joint to polished stone parts, such as hoes, axes and digging sticks were essential to planting and harvesting crops (Solheim, 1972).

In addition to this, human ingenuity began to have to impacts on the environment. Cutting down trees to clear land for farming, settlements as well as other uses such as carving boats, making furniture (beds, chairs tables etc.), kitchenware (jugs, cups, spoons etc.), farm equipment (carts wagons etc.), and fencing for their settlements and livestock required felling trees. On one hand, the result of this increased demand for wood - the Neolithic era had fewer forests than any era that preceded it (Ennos,2020). On the other hand, this era paved way for further developments including the creation of kilns to produce charcoal and ceramics, technologies still used today, as well as melting and smelting iron ore, which led to mining especially iron, and subsequently the industrial revolution which, in its early stages, relied heavily on wood as its main form of energy.

As cities across Europe grew, particularly in the Netherlands and United Kingdom, the demand for energy to fuel heating and the industry also grew. However, the forests had mostly been felled and wood was increasingly becoming an uneconomic source of energy. There were 2 major constraints. The first was the supply. Most of the forests in industrial cities had been cut down to fuel the energy demands of industry meaning that wood had to be transported over long distances which was expensive. The second was the price of wood. Because wood was becoming scarce, it became expensive and so, alternative sources of energy were sought.

In the Netherlands, for example, the peatland reserves became a viable source of energy Ennos, 2020). However, peat had some constraints associated with its use. The amount of energy produced was not as much as wood produced and peat had to be dried for some months before

it could be used (Ennos, 2020). In Wales and England, coal was increasingly being used as alternative to wood. As years went by, coal was being increasingly mined and the reliance on wood to fuel industries and as a source of heating was drastically reduced.

1.1.2 Forests in present day

However, despite this decrease in reliance on forests, they still play an important role in the lives of many people to this day. Today, forests cover about 31 percent of the earth's total land area (World Bank data, 2023). According to the FAO & UNEP (2020), forests are home to 80 percent of the world's amphibian species, 75 percent of bird species; and 88 percent of mammal species. In addition to this, they play an important role in combating climate change through carbon sequestration.

The role of forests further extends to human beings. Across the world, about 2 billion people depend on forests to meet their subsistence and income needs. Given that this figure represents about 30 percent of the world's population, it is no wonder that there has been increased interest in how households interact with forests (Ritter & Dauksta 2013). Another reason for this increased interest is because the world's forests are under duress. Changes in land use and climate change not only threaten the existence of forests but also the benefits they provide to animals, humans, and the environment alike (Costanza et al. 1997; Dumas-Johansen et al. 2018).

Land use changes accelerate forest degradation and deforestation. The largest driver of land use change is agriculture. As the world's population grows, demand for food also increases, putting downward pressure on agricultural producers to expand their production, often to the detriment of forests. For example, FAO (2020) reports that between the years 2000 and 2010, large-scale and local subsistence agriculture accounted for about 40 and 33 percent of world's total tropical forest deforestation, respectively; a combined total of 73 percent. The large-scale cultivation of crops such as palm oil and soybean as well as the production of livestock are the main drivers of forest loss arising from agriculture.

Various studies have highlighted the impacts of climate change on forests have found that it affects forests by altering various processes (Dale et al. 2001; Vinya et al. 2011; Dumas-Johansen et al. 2018). An example of an important forest process are wildfires that are required by some plant species every few years to allow for their regeneration. However, rising global temperatures have increased the frequency and intensity of wildfires which, instead of offsetting regeneration, destroys plant species (Dale et al. 2001). The destruction of species

affects the carbon and rain cycles causing changes in amounts of precipitation further affecting regeneration (Dumas-Johansen et al. 2018). In addition to this, the prevalence of droughts in recent years has increased. These droughts have been found to reduce the vigor of plants making them more vulnerable to pests and diseases (Dale et al. 2001). These changes contribute to forest and species loss.

1.1.3 Miombo Woodlands

The miombo woodlands are the most dominant forest type in central and southern Africa (as shown in Figure 1). They cover a total of 2.4 million km2 and are present in seven countries (Dewees et al. 2010). (Dewees et al. 2010) goes further to state that the forests receive an average of 700mm of rainfall annually, even though this amount varies across the region and classification. The differences in the amount of rainfall suggests that the type of vegetation varies throughout the forest, a claim supported by (Ali et al. 2020). The study further reports that there are about 8,500 plant species across the miombo woodlands, most of which are endemic to the forest. This highlights the not only the comparative advantage that the forest provides through various resources but also the need to protect and conserve the species to maintain its biodiversity and uniqueness.

As is the case with other forests in the world, the impacts of changes in land use and climate change adversely impact the miombo woodlands. In Zambia, for example, about 250,000 to 300,000 hectares of forest cover is lost annually (Vinya et al. 2011). Despite evident threats from forest loss, the miombo ecosystem still sustain the livelihoods of about 150 million rural and urban people (Godlee et al. 2020). For these people, the forests provide various NTFPs and a source of resilience by helping them recover from climatic and economic shocks. In addition to this, the forests contribute to resolving the causes of food insecurity and undernutrition by providing cheap sources of nutrition, which is why they have been identified as a key tool in poverty reduction strategies.

1.1.4 Non-Timber Forest Products (NTFPs)

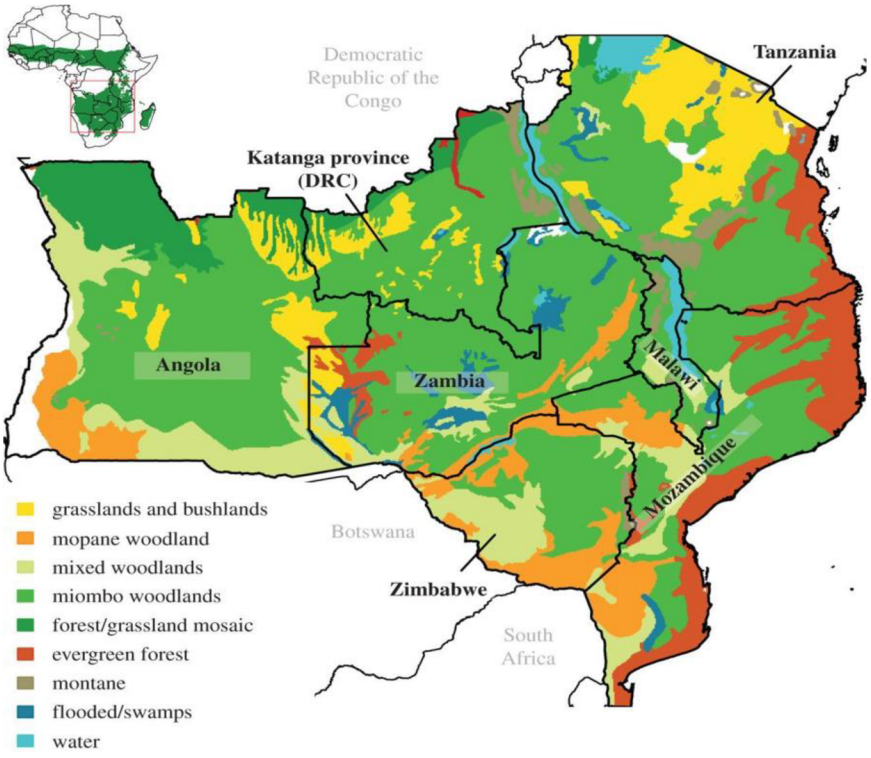
1.1.4.1 Charcoal and Firewood

While rural households derive various benefits from forests, some benefits are a double-edged sword that threaten their very existence. Each year, forest cover is lost across sub-Saharan Africa. One of the causes of deforestation is charcoal production. According to Chidumayo (2012), “charcoal is a fuel produced by the carbonization of biomass. The biomass in question is wood, which in most cases, is acquired by chopping down trees. Charcoal and wood are

consumed by both rural and urban households. It is used as fuel for cooking, warmth for humans. FAO (2020) reports that up to 90 percent of the wood obtained from Africa's forests is used as fuel and out of this, about 29 percent is converted into charcoal. With many countries undergoing urbanization, population growth and with the majority if its population classified as poor, charcoal is used by households as a cheap alternative to electricity.

The increasing demand for charcoal puts downward pressure on producers to meet this demand. This suggests that charcoal prices are high. As a result, more rural households are turning to charcoal production to generate income. Between 1998 and 2018, it is reported that wood charcoal production in Africa doubled (FAO, 2020). While this decision seems economically sound, the net effect of these decisions is detrimental to forests. While this cannot be attributed to only charcoal production, the vice does contribute to it. However, it is close to impossible to know how much charcoal production directly to deforestation in Zambia for various reasons. Chidumayo (2012), provides two; first, charcoal producers do not keep records of how much charcoal they produce; and second, the production of charcoal may not be the main reason for cutting down trees. The reason might be clearing land for agriculture or for infrastructural purposes and charcoal is produced from the trees that are chopped down. However, Chidumayo and Gumbo (2012), while examining the environmental impacts of charcoal production across tropical countries, found that, deforestation due to charcoal production contributed less than 7% to a country's' total deforestation but did warn that this number could increase beyond these levels if charcoal production remained unchecked.

Figure 1. Central and Southern Africa's Forest types



The study further notes that most of the areas in which treesare cut rely on the regenerative process of the forests to recover from deforestation. This entails that if the rate of forest loss outpaces regeneration, which appears to be the case (Vinya et al. 2011), then forests will not recover.

The use of charcoal by households produces negative externalities. For example, it directly affects the health of people that use it. A report by the World Energy Outlook (2017) estimated that around 3 billion people use solid fuels such as firewood and charcoal, producing high levels of pollutants and subsequently contributing to 4.3 million deaths from effects of air pollution in their homes. This increased health risk arising from the use of charcoal and firewood suggests not only an increase in the cost of health to the households but also affects human capital. Studies done by support these claims (FAO, 2020 and (Desai et al. 2004).

Another detrimental effect of charcoal production is forest degradation, changes in structure and composition of forests. One way to counter this was thought to be selective cutting of trees but even under this system, studies show that up to 76% of biomass is lost (Chidumayo, 2012). This creates a negative externality for local communities around which forests are depleted. Not only does loss of forest cover affect soil quality, which in turn affects agricultural

productivity, but also reduces the natural resource base from which rural communities can derive forest products.

1.1.4.2 Food

Food and nutrition are crucial components in proper functioning of human beings. Without good nutrition, a vicious cycle is created. Poor nutrition could lead to poor health, which in turn affects an individual's productivity and their income-generation abilities and subsequently, their ability to acquire good and nutritious food. This cycle is mostly prevalent in rural areas and Zambia is not any different. To overcome this, rural households turn to a mix of strategies and key among them is the collection and use of NTFPs.

Various studies conducted on the food products collected from forests have found that they provide a cheap source of food, supplement household income as well as diversify the diets of both rural and urban households (Broegaard et al. 2017b; Ali et al. 2020). This in turn increases household resilience to food insecurity by providing a safety net for households during tough times (FAO, 2020). Some of the NTFPs collected and used include fruits, mushrooms, vegetables, and honey. Forest food products have been found to be collected by mostly women, children, and older individuals. The main factors contributing to this are the gender roles assigned to women in rural areas and the lack of labor intensity associated with collecting these products.

Besides providing food for households, NTFPs have income-generating potential. A study conducted in Uganda found that wild foods contributed about only 0.7 percent to rural household income annually (Tugume et al. 2015). Interestingly, however, the study found that the wealthiest individuals in the study areas were more likely to generate more income from commercially exploiting NTFPs. A study by (Broegaard et al. 2017b) concurs with this by stating that wealthier individuals are more likely to invest capital while less wealthy households use the food products for their subsistence.

However, the poorer households are the ones that need a lot of help to improve their socioeconomic status. This is because these households are still the most vulnerable to especially drought-induced food shortages and nutrient deficiencies and have limited means, when compared to wealthier households, to change their plight (Garekae et al. 2017). An example of this is found in a study conducted in Laos found that the households could not afford to purchase the meat required to fill the protein insufficiencies they were experiencing (Broegaard et al. 2017b). In addition to this, the study further states that poorest households

have limited access to markets and roads, and this makes it challenging for them to market the NTFPs available to them to generate incomes to supplement their livelihoods.

The lack of markets suggests that a proportion of wild food products go to waste. This is a problem because not only is the income-generation potential lost but also vital nutrients go to waste. This is an area where population growth can be beneficial. Population growth brings with it changes in the supply and demand dynamics in the food industry. Population growth coupled with rapid urbanization means that there is increased demand for food from especially urban areas. While government policies are looking to meet this demand by promoting cultivation of monocultures, NTFPs can go a long way in supplementing and diversifying urban diets. The provision of markets and promoting NTFPs has multiple benefits. First, rural households would have the income required to participate in economic activities like education health and better nutrition. Second, food waste would be reduced as more food would be available in markets. Third, rural households would have the incentive to conserve forests because they would view them as being economically viable. Fourth, biodiversity would be preserved.

1.1.4.3 Medicines

Advance in human health is one of the major successes of human development. this development has seen humans not only become more productive but also lengthened human life. All across the world, the average life span of humans has been and is still increasing. This increase has allowed for humans to pursue education and even longer careers, increasing their productivity, as well as contributing to reduction in population growth in, especially the western world. In addition to this, development in medicine have also seen the eradication of diseases including smallpox in 1980 and more strides are being made to cure even more prevalent diseases that could have been incurable decades ago. This suggests that the pharmaceutical industry has been growing and expanding as it continues in its pursuits to discover new medicines to find cures to the diseases that plague humans.

Despite the advances in medicine, rural and communities indigenous across the world still largely rely on plant as a source of medicine (Roberson & Mccormack 2008). Some of these populations do not have access to modern medicine and as a result collect and use plants and their parts from forests to cure illness and maintain their health. Various studies conducted across Africa have found evidence of rural households utilizing forests as a source of medicine (Tugume et al. 2015; Ali et al. 2020). In addition to this, Lamxay and Dechaineux (2001), while

reporting on a regional overview of NTFP use across Africa, reported not only the collection and use of medicinal plants but also their trade. Within the Miombo woodlands, (Dewees et al. 2010a)32 plant species utilized for their medicinal properties. With regards to trade of medicinal NTFPs, FAO (2001) shows that at national level, Zambia, for example, gains at least 4.4 million USD annually from medicinal plants. This provides an avenue for financial gain for the households that collect medicinal NTFPs.

Medicinal plants play an important role in providing the pharmaceutical industry with a source of raw materials for the development of medicines. (Roberson & Mccormack 2008) estimates that about 50 percent of the medicines developed in the last 30 years are of plant derived, despite having only screened about 1 percent of tropical plants to test for their medicinal properties (Cole et al. 2015). This highlights the potential yet to be realized from using plants as a source of medicine. One way to counter this is by conducting research, like this one, to document plants utilized by local communities to fight illness and maintain their health. This approach has its advantages. First, indigenous knowledge on medicinal plants is preserved, second, modern medicine is advanced and third, income generation opportunities for actors along the value chain are realized.

1.1.4.4 Other Uses

There have been other documented uses of forest products. These include construction materials like poles and grass (Ali et al. 2020), tools and utensils such as cooking sticks and handles for agricultural equipment (Tugume et al. 2015; Broegaard et al. 2017b), fodder for animals and beeswax(Campbell et al. n.d.; Coulibaly-Lingani et al. 2009; Godlee et al. 2020). These products are mostly used for household subsistence but contribute to their everyday lives.

1.1.5 Socioeconomic factors influencing forest use.

There have been various studies that have been conducted to determine the socioeconomic factors that influence the collection and use of forest products (Coulibaly-Lingani et al. 2009; Tugume et al. 2015; Ali et al. 2020). This section will highlight some of the factors that have been identified to influence the collection and use of NTFPs. The table below highlights some of the factors.

Table 1. Factors influencing the collection and use of NTFPs

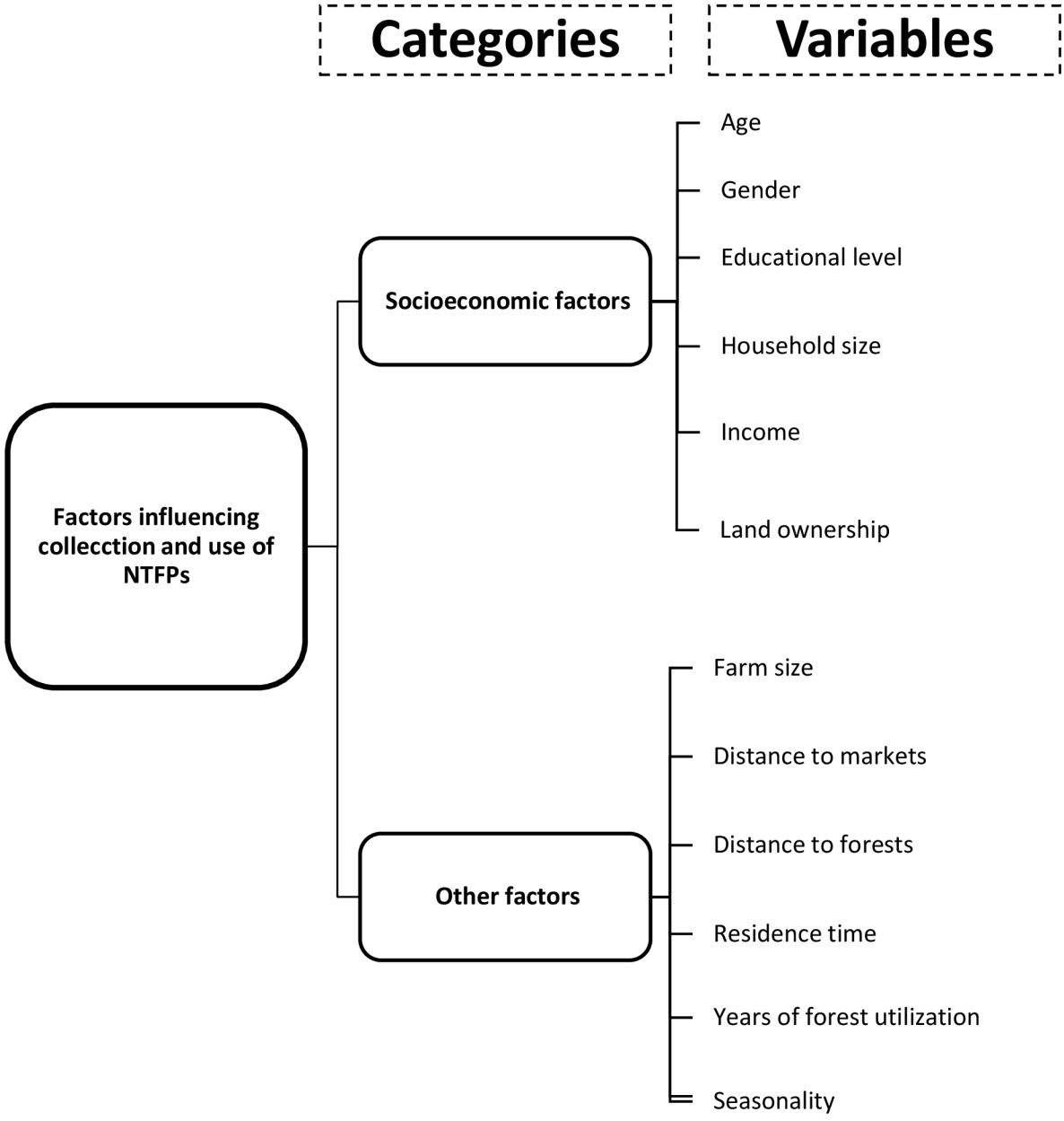
Factor	Author	Country	Description
Age	Coulibaly-Lingani (2009)	Burkina Faso	Influences the type of NTFP collected (e.g. older age groups more likely to collect NTFPs like medicinal plants)
Education level	Garekae et al. (2017)	Botswana	Educated individuals are more likely to exploit NTFPs commercially
Income	Timko et al. (2010)	Southern Africa	Poorer households more likely to depend on NTFP for subsistence than richer ones
Household size	Coulibaly-Lingani et al. (2009) Ali et al., (2020)	Burkina Faso Pakistan	Larger households more likely to use more NTFPs for subsistence than smaller ones
Gender	Garekae et al. (2017)	Botswana	Influences the type of NTFP collected. Women mostly collect food and medicine while men mostly collect construction materials

Land ownership	Ali et al., (2020) Tugume et al. (2015)	Pakistan Uganda	households having more land are expected to rely less on forests
Distance to forests	Timko et al. (2010)	Southern Africa	Households living close to forests are likely to use more NTFPs
Distance to markets	Timko et al. (2010)	Southern Africa	Households living close to markets are likely to use NTFPs for commercial purposes
Residence time	Garekae et al. (2017)	Botswana	The longer the time of residence, the higher the likelihood of collection
Seasonality	Timko et al. (2010)	Southern Africa	When products are in season, households collect the products

1.1.6 Conceptual framework

Based on the identified factors that influence the collection and use of NTFPs, Figure 2 presents a conceptual framework of this study.

Figure 2. Conceptual framework



Problem statement and aims of the study

2.1 Problem statement

The role of NTFPs in the livelihoods of especially rural households cannot be understated. They provide various NTFPs which are crucial to the households who utilize them not only for their subsistence but also their income needs. However, the high levels of deforestation mean that these important plant species are being lost and with them, the benefits they provide. In Zambia, for example, it is reported that around 300000 hectares of forest land is lost due to deforestation annually. Additionally, very little is known about the socio-economic factors on the collection and use of NTFPs in Zambia, hence the need to have a deeper understanding these factors is desirable. The rationale of this study is that understanding the factors that influence the collection and use of NTFPs will contribute to developing policies that govern forest use and management.

2.2 Objectives of the study

to examine the socio-economic factors influencing the collection and use of NTFPs by households in the Western province's miombo woodlands

2.2.1 Specific objectives

i. to document the household food security and income calendar
ii. to assess the perceptions of NTFPs by households in Western Province, Zambia
iii. to document the non-timber forest products collected and their use

2.3 Research questions

1. What are the socio-economic factors that influence the collection and use of NTFPs by households in the Western province of Zambia?
2. What pattern does the household income and food security calendar take up?
3. How do households in Western Zambia view NTFPs?
4. How do households use the NTFPs they collect?

Methodology

3.1 Study Site Characteristics

The Western province is located between longitudes 22º 30" and 25º 30" East and latitudes 13º 45" and 17º 45" south. It is Zambia's largest administrative region covering an area of 126,386km^2. The province is shares borders with North-Western, Central, and southern provinces from north-east to south-east and Namibia and Angola from south-west and west. Mongu town is the administrative center of the province and the whole province is divided into 16 districts. The province has a population of around 1 million people, with more than 85 percent of whom live in rural areas. Culturally, the major ethnic group are the Lozi, and they and 24 other ethnic groups are headed by the *Litunga* with the help of other traditional rulers under the highly centralized Barotse Royal Establishment (BRE).

There are 2 main agroecological zones in the study area, i.e., lowlands, and uplands. The uplands boast a rich forest cover while the lowlands have abundant water resources which predominantly feature the Zambezi River and the Barotse floodplain. The Batotse floodplain covers an area equivalent to 550,000 km^2 and is said to be one of sub-Saharan Africa's most critical aquatic agricultural systems (Cole et al. 2015). The floodplain is closely linked to the cultural and economic lives of the households of western province. It is on these floodplains that not only the renowned Kuomboka ceremony, when the Litunga moves from his residence from the lowlands in Lealui to the upland palace in Limulunga, takes place but also activities including cattle production, fishing, and crop production (predominantly rice production) take place. On the other hand, the forests over about 80 percent of the whole province. These include the miombo and Kalahari woodlands. These forests are important to the households that derive both timber and NTFPs from them.

3.2 Sampling design and data collection

3.2.1 Site selection

The two study sites were purposefully selected based on a set of criteria that are used to represent various socioeconomic conditions. Firstly, the inhabitants of the selected areas exhibit evidence of NTFP use. Second, the selected areas would provide results that would be generalizable and from which a knowledge base on the collection and use of NTFPs in the area would be built. This selection criteria, in our opinion, covers key components that depict the intricate interaction between the forest and presence of local small farmers.

Figure 2. Map showing the location of the study areas.

3.3.2 Sampling

The first step involved selecting various villages from the selected study sites with evidence of NTFP use and depend on the forests to supplement their livelihoods. With the help of field officers from Caritas Mongu, six areas in Mongu and five in Limulunga were purposefully selected because of two reasons 1) Caritas Mongu has farmers who are cooperative members in these areas and 2) it was observed that inhabitants of these areas interact with forests frequently. Thereafter, a snow bow method was employed where cooperative members were approached and interviewed, and they would then point us to other households in the area who used NTFPs.

The household survey was conducted using a semi-structured questionnaire in 97 households across the two districts. (56 and 41households in Limulunga and Mongu, respectively). In each household, either the head of the household or the next of kin was interviewed. If no eligible people were found, or if the household refused to participate, another household was used selected. The definition of a household was adopted from FAO (2010) which states that "a household is a group of people living together, making common arrangements for food and other essentials for survival."

In addition to this, three/four focus group discussions were conducted in Mongu district. This was done in order to obtain extensive knowledge on especially the species used in the respective areas. Each focus group comprised of cooperative heads (who mostly influenced their members to participate in the survey), men and women of different age groups, who all provided their knowledge on the various NTFPs they use, which shed more light on how various groups interact differently with the forest. A total of 21 people in 5 focus participated in the study through focus group discussions.

3.3.3 Data collection

Focus group discussions and the administration of a semi-structured questionnaire were used to collect data. The questionnaire was written in English, and each question was orally translated into the local languages, Silozi (with the help of the field officers), Bemba, Nyanja or Tonga, before being administered to respondents who could not respond in English. Before conducting the interview, each respondent was informed about the purpose and objectives of the study. Furthermore, anonymity of responses was guaranteed.

The questionnaire was divided into four sections.

3.3.3.1 Free listing technique

The first section sought to identify the plant species from which households collected NTFPs and how they are used. Following Reyes-García et al. (2005), the free-listing technique was employed to obtain this data. This technique was used because "we can search for variation in the importance of plants among informants." Households were asked to name the useful plant species they knew as well as they NTFPs they used. The named species were then divided into four categories, food, medicine, energy, and other uses, which included tools and construction.

3.3.3.2 Household demographics and characteristics

The second section captured each respondent's demographic and socioeconomic characteristics. The socio-demographic variables included gender, age, education level, employment (farm and off-farm), length of residency, household size and proximity to forest and markets and farming experience, among other things.

3.3.3.3 Household calendar

The third section of the questionnaire assessed the seasonal nature of each respondent's food insecurity as well a lack of cash. This data was obtained by asking each respondent which months they faced the most hardships in not only obtaining food but also money. This information was then linked to the seasons that most NTFPs were collected. This was done to draw insights into how and when households relied the most on NTFPs.

3.3.3.4 Household perceptions on availability of NTFPs

The fourth section of the questionnaire was designed to assess the perceptions that households had on how the availability of NTFPs has changed over the last few years. To do this, the respondents were asked if they felt that the availability of NTFP in the last five years had 1) increased; 2) decreased or 3) remained the same. Next, based on the response, each respondent

was then asked to disclose what factors they thought attributed to the changes in availability (clearing of the forest, climate change, increased demand for NTFPs either locally or externally, etc.)

3.4 Data analysis

Quantitative data were analyzed using Statistical Package for Social Sciences (IBM SPSS) software version 28. The statistical approaches used to analyze the quantitative data were descriptive and inferential statistical procedures. Mean values, standard error of the mean, frequency counts, and percentages of observed attributes are the descriptive statistics that were used to explain the socio and demographic characteristics.

The levels of relationship between independent factors and frequency of usage of forest products were determined using Pearson's Chi-square test of association. Following Handavu (2019), a set of binary logistic regression models were created to analyze the socio-economic variables that were predictors of communities' consumption of forest products and perceived land-cover loss (see Coulibaly-Lingani et al., 2009; Kamwi et al., 2015). When the explanatory factors are continuous, categorical, or dummy variables, the logistic regression model is an appropriate statistical technique for identifying the influence of explanatory variables on dichotomous dependent variables (i.e., with just two categories or values) (Peng et al., 2002; Coulibaly-Lingani et al., 2009). Coulibaly-Lingani et al. (2009) states that "the logit is the natural logarithm (ln) of odds of Y, and odds are ratios of probabilities (π) of Y happening to probabilities (1−π) of Y not happening."

The model was specified as follows:

$$Logit\ (Y) = \ln\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n$$

where β0 is the intercept and β1, β2 … βk are the coefficients of the independent variables X1, X2 … Xk.

The response variables for the logistic regression applied here were collection of NTFPs, which were defined as binary variables with a value1 for respondents who collect NTFPs or 0 otherwise. This categorization follows that which was used by Coulibaly-Lingani et al. (2009)

Following the regression analysis, the model was scrutinised to ensure that it conforms to the assumptions of the Ordinary Least Squares (OLS) method (homoscedasticity, no endogeneity

and normal distribution of the errors). These tests were used to ensure that the estimates from the regression analysis were the best and unbiased.

Table 2. Overview and specification of explanatory variables used in the survey

Variable	Variable description	A priori expectation
NTFP collection	Whether a household collects NTFPs or not	
Gender of household head	Sex of household head (0 = male, 1 = female)	±
Age of household head	Age of the household head (number of years)	±
Household size	People living in a household (number of people in a house)	+
Education	Number of years spent in formal education	-
Farming experience	Number of years spent as an active farmer	±
Income	Monthly income of household head	-
Off-farm job	Household head having off-farm job (1 = yes, 0 = no)	-
Residence time	Number of years spent living in the study area (years)	±
Distance to forest	Distance from house to nearest forest (kilometres)	+
Distance to market	Distance from house to nearest market (kilometres)	±

4. Results and discussion

This section presents the results obtained from the data analysis.

4.1 Descriptive analysis

Table 3. Descriptive statistics

		Count	Frequency (%)
NTFP collection	Collector	78	80.4
	Non-Collector	19	19.6
Gender	Male	48	49.5
	Female	49	50.5
Cooperative membership	Yes	69	71.1
	No	28	28.9
Access to credit	Yes	16	16.5
	No	81	83.5
Location	Limulunga	56	57.7
	Mongu	41	42.3
Off-farm Job	Yes	44	45.4
	No	53	54.6
Whether a household receives subsidies/impements to aid with farming	Yes	41	42.3
	No	56	57.7
Whether the household head teaches their children about NTFPs	Yes	79	81.4
	No	18	18.6
Livestock ownership	Yes	58	59.8
	No	39	40.2
Land ownership	Customary	79	81.4
	Private	18	18.6

Table 1., which presents the descriptive statistics of the surveyed households, shows that out of the 97 households, 78, accounting for 80% collected NTFPs while 19 or 20% did not. The sample consisted of 48 (49.5%) male household heads and 49 (50.5%) female household heads. In terms of their location, 56 (58%) households were located across 6 villages in Limulunga while 41 (42%) were based in Mongu. Of the interviewed households, 71.1% (n=69) were members of a cooperative while 28.8% (n=28) were not. When asked about their access to credit from financial institutions, 16.5% (n=16) revealed that they did have access to credit while 83.5% (n=81) did not. The respondents were further asked if they received farming inputs to aid with their agricultural pursuits to which only 42.3% (n=41) said they did receive

agricultural inputs, while 57.7% (n=56) did not. Furthermore, 45.4% (n=44) respondents disclosed that they had an off-farm job while 54.6% (n=53) said their primary occupation is agriculture. The land ownership status of the respondents was also assessed, and the results revealed that only 18.6% (n=18) privately owned the land on which they resided while the majority, 81.4% (n=79) lived on customary land. Staying with the assets that the respondents owned, a question of whether they owned livestock or not was asked. The results reveal that most of the respondents, 59.8% (n=58) owned livestock while only 40.2% (n=39) said they did not have any livestock.

4.2 Results of the household calendar

Figure 3. Household calendar

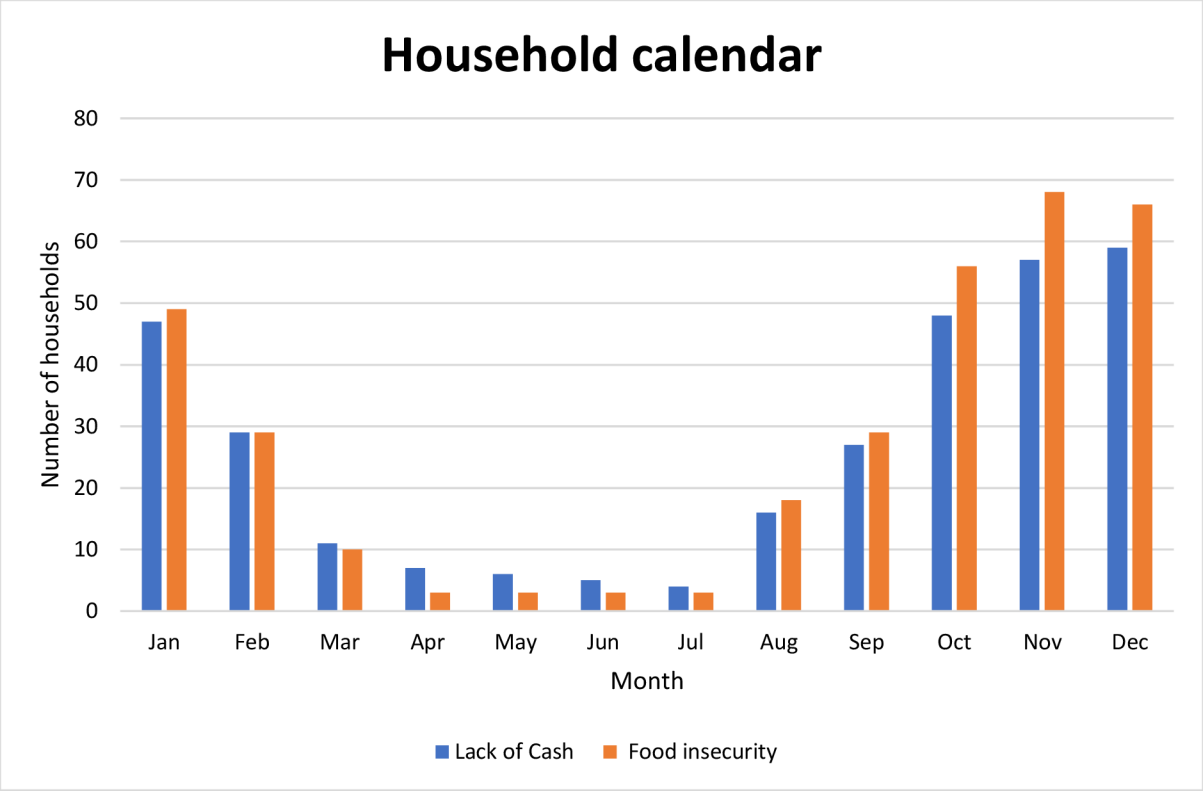
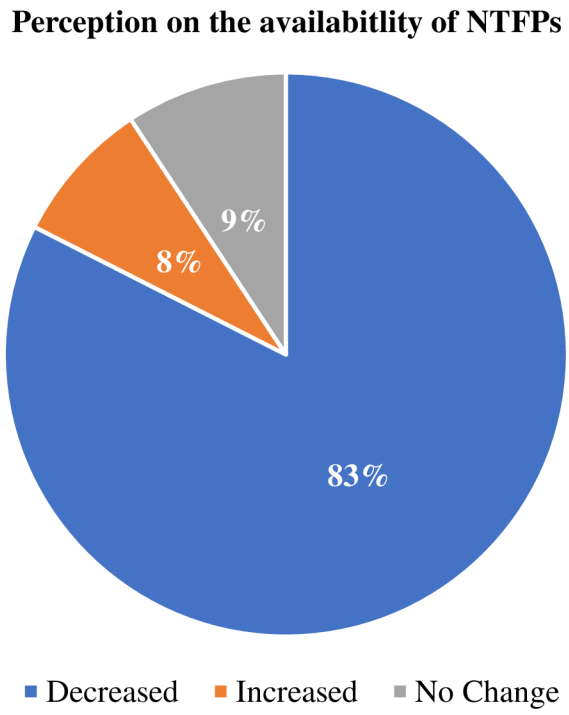


Table 2 presents the results of the household calendar. The respondents were asked which months they found food and cash hard to come by. The table shows that the period from October to January was the most strenuous for most households. To understand why this is the case, looking into the rainfall patterns in the country and their impact on agriculture play a major role could provide some answers. The study area, Limulunga and Mongu are situated in the agroecological zone 1, which receives around 600-800mm of poorly distributed rains between November and March. However, most farmers in the rural areas are dependent on rain for agriculture, meaning that the planting season coincides with the availability of rainfall.

Additionally, this suggests that most rural farmers have one harvest period, which serves, in most cases, as the source of food and income for the whole year. Linking this information to the table above, the months between April and July show that the households are both food and cash secure. This could be because they still have the harvested produce at their disposal to meet their food and cash needs. As the year progresses, however, the produce depletes and so they cannot meet their needs, hence the rise in food insecurity and the lack of cash between August to December. In January, however, this trend begins to reverse for two reasons 1) as the rains increases the availability of NTFPs also increases, and 2) some of the early yielding crops begin to get ready so some of the households begin to have food to consume and sell to supplement and sustain their livelihoods.

4.3. Results of perceived availability of NTFPs by households

Figure 4. Household perception of the availability of NTFPs



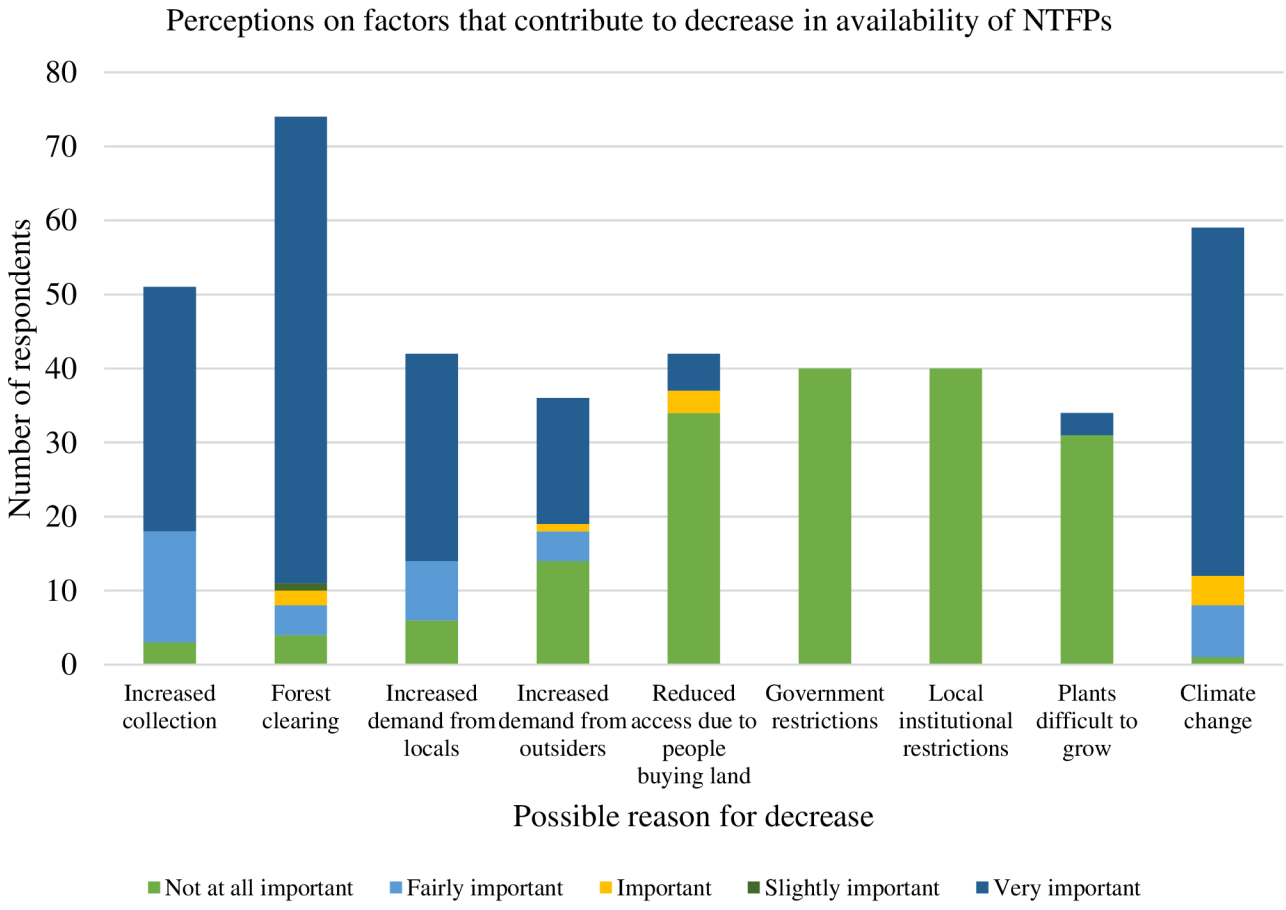
To assess respondent perception on the availability of NTFPs, each respondent was asked if they thought that the availability of NTFPs had increased, decreased, or exhibited no change over the course of the last five years. From the total of 97 respondents, 83% said that the availability of NTFPs has decreased over the last five years, while 8% and 9% said they had increased and no change, respectively.

Next, each respondent was asked, from a list of predetermined factors, what factors they thought contributed to the changes in the availability of NTFPs. Figure 5. below shows that,

from the factors that were perceived to contribute to the decrease in the availability of NTFPs in the last five years, forest clearing, climate change and increased collection were said to be the very important factors. When further asked about what factors drive forest clearing, one of the respondents said, *"it's the charcoal burners, they have no regard for the tree that are important to the households around here. They cut down everything so they can produce charcoal."* Another respondent said, while filling a bag with charcoal, *"the production of charcoal is finishing our trees, but it is the only way some of us make a living. If we had better alternatives to generate money, we would gladly switch to them."* While an elderly respondent reminisced, *"when I was younger, it was forbidden to cut down fruit trees because they are a source of food for families, but now, we have lost our morals and even the most important trees to our livelihoods are being cut down."*

4.3. Results of perceived factors that contribute to decreased availability of NTFPs by households

Figure 5. Perception on factors that contribute to the decrease in the availability of NTFPs



Regarding climate change, one of the respondents said, *"sometimes, we do not receive enough rains and the trees do not produce as much as they should which reduces the availability of fruits."* These sentiments are echoed by the UNOCHA (2020), who reported that the Western province experienced droughts in 2017, 2018 as well as the 2018/19 season, which was said to be the poorest since 1981. Additionally, trends in both temperature and rainfall have been changing. Separate reports from the UNOCHA (2020) and USAID (2016) both state that since 1960, there has been an annual increase in temperature by about 1.3˚C while rainfall, on the other hand, has been reducing by 1.9mm per month.

As for increased collection, one of the respondents said, *"the number of people collecting NTFPs is increasing. Sometimes you go the forest, and you cannot find any mushrooms or fruits because someone else has picked them."* The descriptive statistics in this study reveal that the average household size is around 7 people per household which is above the national average of 5. A larger household is expected to demand more resources such as food, energy, and medication. Linking this to forest products, the larger the household, the more NTFPs are required to satisfy household needs. The reason increased demand is linked to increased demand by locals.

Linking all the factors discussed above, increased collection and demand from locals, climate change and forest clearing, presents the intricate nature of the collection and use of NTFPs. The households look to the forests to supplement their livelihoods. On one hand, the unrestricted nature of forest use coupled with the large households means that there could be competition for these products. On the other hand, the changing climate, especially increased droughts, causes more issues for these households. Droughts reduce not only the availability of NTFPs but also the yields of the crops that are grown by the same households. In the event of drought and crop failure, households look to alternative ways to supplement their livelihoods. One way is charcoal burning. Which not only further reduces the availability of NTFPs available to households but also exacerbates climate change. This creates some cycle where the reduction in NTFPs increases the need to find alternative ways to supplement households such as charcoal burning and timber trading, which contributes to climate change, which in turn leads to more droughts.

The results also show that government restrictions, local institutional restrictions, and plants not being difficult to grow were not important factors that contribute to the reduction of availability of NTFPs.

4.4 Results of documented plant species used by households

Table 4. Plant species from which NTFPs are derived

Lozi Name	Common Name	Scientific Name	Parts collected	Mode of use	Primary Collector	Frequency of collection	Season of collection	Number of households collecting
Mahwahwa (Mahoahoa)	Spine-leaved monkey, orange	Strychnos pungens	Roots	Medicine	Men/Women	When required	All year	93
			Leaves	Medicine/Food	Women	When required	All year	
			Fruits	Food	Children	2,3 times a week	Rainy	
Mumbole		Vangueriopsis lanciflora	Roots	Medicine	Men/Women	When required	All year	92
			Fruits	Food	Children	2,3 times a week	Rainy	
Mahuluhulu		Strychnos cocculoides	Roots	Medicine	Men/Women	When required	All year	91
			Bark	Medicine	Men/women	When required	All year	
			Fruits	Food	Children	2,3 times a week	Dry	
Muzauli	African rosewood	Guibourtia coleosperma	Roots	Medicine	Men/Women	When required	All year	90
			Fruits	Food	Children	2,3 times a week	Dry	
Namulomo			Roots	Medicine	Men/Women	When required	All year	90

			Fruits	Food	Children	2,3 times a week	Rainy	
Mambongo			Roots	Medicine	Men/Women	When required	All year	89
			Leaves	Medicine	Men/Women	When required	All year	
			Fruits	Food	Children	2,3 times a week	Dry	
Mubula		Parinari curatellifolia	Roots	Medicine	Men/Women	2,3 times a week	Rainy	88
			Stem and Branches	Energy/Construction	Men	When required	All year	
			Fruits	Food	Children	2,3 times a week	Rainy	
Libowa	Amaranthus	Amaranthus spp.	Leaves	Medicine/Food	Women	2,3 times a week	Rainy	87
Mbowa	Mushrooms		Whole plant	Food	Women	2,3 times a week	Rainy	86
Sindambi	Hibiscus	Hibiscus spp.	Leaves	Medicine/Food	Women	2,3 times a week	Rainy	86
Muhamani	Velvet Tamarind	Dialium Engleranum	Roots	Medicine	Men/Women	When required	All year	79
			Stem and Branches	Energy/Construction	Men	When required	All year	
			Fruits	Food	Children/Women/ Men	2,3 times a week	Rainy	
Sishungwa	Cat's whiskers or African cabbage	Cleome gynandra	Leaves	Food	Women	2,3 times a week	Rainy	72

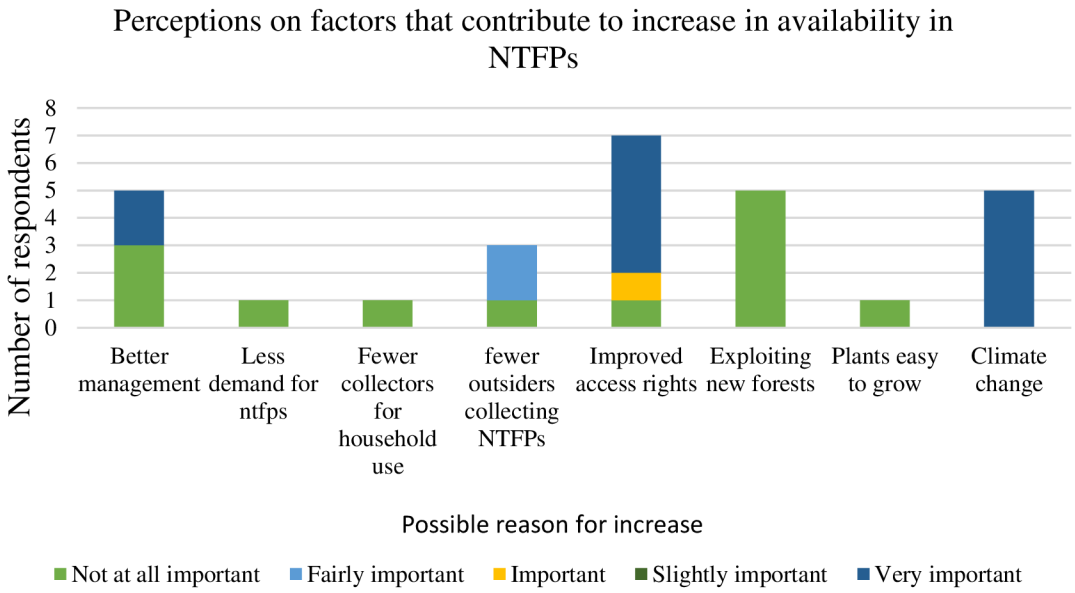
Lunembwe (Delele)	Wild okra	Ceratotheca sesamoides	Leaves	Food	Women	2,3 times a week	Rainy	72
Mutuya		Brachystegia spiciformis	Roots	Medicine	Men/Women	When required	All year	63
			Stem and Branches	Energy/Construction	Men/women	When required	All year	
Munyelenyele (Ndungunyu)		Ochna pulchra	Roots	Medicine	Men/Women	When required	All year	41
			Fruits	Food	Children	2,3 times a week	Rainy	
Mulombe (Mukwa)		Pterocarpus angolensis/Baikiaea plurijuga	Stem and Branches	Energy/Construction	Men/women	When required	All year	31
Musheshe		Burkea africana	Roots	Medicine	Men/Women	2,3 times a week		24
			Stem and Branches	Energy/Construction/Tools	Men/women	2,3 times a week		
Mukwe		Cryptosepalum exfoliatum pseudotaxus	Stem and Branches	Energy/Construction	Men/women	When required	All year	20
			Bark	Medicine/Fibre	Men/women	When required	All year	
			Leaves	Medicine/Food	Women	When required	All year	
Mubwengelenge			Fruits	Food	Children	2,3 times a week	Rainy	20
Mubako		Erythrophleum africanum	Stem and Branches	Energy/Construction/Tools	Men/women	When required	All year	19
Mungongo		Ricinodendron rautanenii or (Schinziophyton rautanenii)	Roots	Medicine	Men/Women	2,3 times a week		18
			Stem and Branches	Energy/Construction	Men/women	2,3 times a week		

			Fruits	Food	Children	2,3 times a week	Rainy	
Isunde	Jasmine pea or sand camwood	Baphia massaiensis	Roots	Medicine	Men/Women	When required	All year	17
			Stem and Branches	Energy/Construction	Men	When required	All year	
Munjongolo	Batoka jackal-berry or sand jackal-berry	Diospyros batocana	Roots	Medicine	Men/Women	2,3 times a week		17
			Stem and Branches	Energy/Construction	Men	2,3 times a week		
Muzinzila		Berchemia discolor	Roots	Medicine	Men/Women	When required	All year	10
			Stem and Branches	Energy/Construction	Men	When required	All year	
			Fruits	Food	Children	2,3 times a week	Rainy	
Mwinda		Securidaca longipedunculata	Roots	Medicine	Men/Women	When required	All year	10
Mawakaka		Cucumis metuliferus	Fruits	Food	Children	2,3 times a week	Rainy	9
Mulolo	Wild custard apple	Annona senegalensis	Fruits	Food	Children	2,3 times a week	Rainy	9
Munga	-	-	Roots	Medicine	Men/Women	When required	All year	9
			Stem and Branches	Energy/Construction	Men/women	When required	All year	
Mukusi	African teak	Baikiaea plurijuga	Stem and Branches	Energy/Construction	Men/women	When required	All year	9
Mulya		Diplorhynchus condylocarpon	Leaves	Medicine/Food	Women	When required	All year	8

			Fruits	Food	Women	When required	All year	
Mukekete	-	-	Fruits	Food	Children	2,3 times a week	Rainy	5
Icholwamuyandi	-	-	Stem and Branches	Energy/Construction	Men/women	When required	All year	4
Mufofo		Cassia abbreviata	Bark	Medicine	Men/women	When required	All year	3
Mubilo	-	-	Fruits	Food	Children	2,3 times a week	Rainy	3

4.5 Results of perceived factors that contribute to increased availability of NTFPs by households

Figure 6. Perception on factors that contribute to the increase in the availability of NTFPs



Of the 8% of the households that perceived that the availability of NTFPs had increased, climate change and improved access rights were the factors attributed to this increase. Interestingly, climate change was a very important factor for both the increase and decrease of the availability of NTFPs.

4.6 Results of perceived future use of NTFPs by households

Figure 7. Perceptions on future use of forests

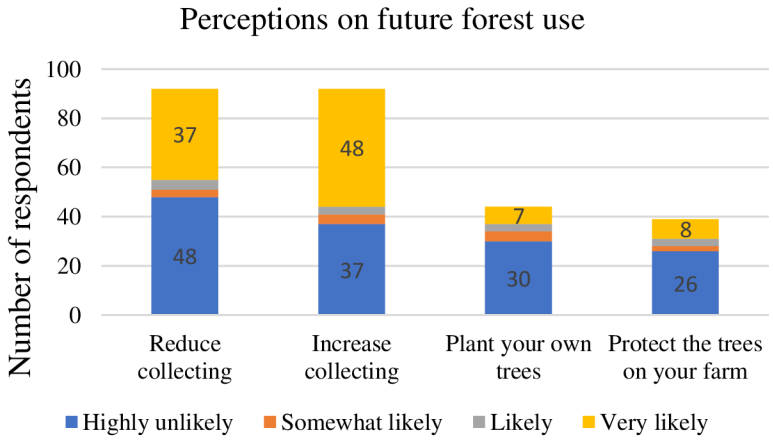


Figure 7 presents the results of the future perspectives on the use of forests. Here, the respondents were asked about how they perceive their use of forests in the next five years. The

results indicate that most respondents (n=48) in the study area will very likely increase their collection of NTFPs. The highly likely and very likely answers cancelled each other out because they were opposites of each other. One respondent from the very likely to increase collection of NTFPs said, *"I will increase collecting NTFPs. They are very important to my household. If I stop collecting, we will probably die."* On the other hand, a respondent who said they reduce collecting said *"I look to NTFPs to supplement my livelihood in times of difficulties. Right now, I am working on other alternatives and if they yield positive results, I will reduce my reliance on NTFPs."*

4.7 Results of transfer of knowledge to children

Figure 8. Transfer of knowledge

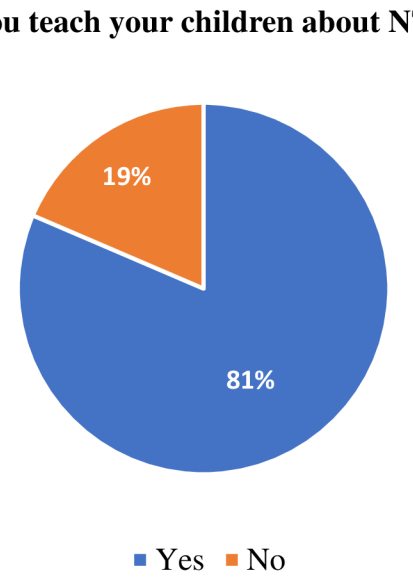


Figure 7. presents the results to the question "do you teach your children about NTFPs?" The results show that 81% of the respondents do pass on their knowledge to their children. This makes for good reading, implying that knowledge of the plant species, their uses as well as importance is being preserved. When asked if they teach their children about NTFPs, one respondent said, *"of course I teach my children about these products. They are a huge part of our livelihoods and culture, so they should learn about them."*

On the other hand, another respondent who revealed that they did not teach their children about NTFPs said *"I do not teach my children about NTFPs because I hope that they get an education and move away from this type of lifestyle. Besides, the trees will not be there by the time they are adults."*

4.8 Results of logit regression

Table 5. Results of the logit regression

	Coef.	St. Err.	t	P>|t|
Age	-0.0020708	0.0031242	-0.66	0.509
Gender	0.0064137	0.0827845	0.08	0.938
Residence time	0.0011223	0.0026068	0.43	0.668
Household size	0.0014549	0.0164188	0.09	0.93
Distance to forests	-0.0233424	0.0125913	-1.85	0.067*
Distance to markets	0.0095731	0.0041331	2.32	0.023**
Income	2.83E-06	0.0000117	0.24	0.81
Location	-0.2154581	0.0896616	-2.4	0.018**
Years of schooling	0.005503	0.0119092	0.46	0.645
_constant	0.845006	0.1960531	4.31	0.000
Number of observations		97		
F-Statistic		0.0134		
R^2		0.2059		

* Significant at 10%
** Significant at 5%

The results of the regression are presented in table 5. The table shows that there is a negative relationship between distance to forests and collection of NTFPs. This implies that the odds of collection of NTFPs reduces by 2% when the distance to the forests increases by 1 kilometer, holding all other factors constant. This relationship is significant at 10% significance level. Additionally, there was a positive relationship between the distance to markets and the of collection of NTFPs. The implication here is that the odds of collecting NTFPs increase by 1% the closer the household is to the market by 1 kilometer, *ceteris paribus*. This relationship is significant at 5%. Lastly, there was a negative relationship between the location of the household and collection of NTFPs, implying that the odds of collection of NTFPs reduced by 21.5% if the household lived in Mongu than if they were in Limulunga, *ceteris paribus*. This relationship was significant at 5%. Out of the other variables, age of the household head had a negative relationship with collection of NTFPs, implying that the odds of collection of NTFPs reduced as the age increased but this relationship was not significant; residence time, household

size, income and years of schooling all had positive relationships with the collection of NTFPs, implying that the odds of collection of NTFPs increased as these variables increased but all these relationships were not significant. When it came to the gender of household head, there was also a positive relationship, implying that the odds of collection of NTFPs increased if the gender of the household head was female, but this relationship was not significant.

The R^2 for the model was 0.2059, meaning that about 21% of the variation in the dependent variable is explained by the independent variables. The F statistic was 0.0134, which is significant at 5%, meaning that the overall goodness of fit of the model is good.

5. Discussion

5.1 Discussion of regression results

Statistical analysis showed that households closer to forests were more involved in NTFP collection. This implies that the odds of collection of NTFPs reduces by 2% when the distance to the forests increased by one kilometer, holding all other factors constant. This means that households located ten or twenty kilometers away from the forests depend on less on NTFPs by 20-40%. This could be because households closer to forests have the NTFP resources closer to them and it would take less time, when compared to households living further away from the forests to collect and use NTFPs. This was also found by Baiyegunhi et al. (2016) who conducted a study a similar study in South Africa and concluded that this relationship could be attributed to transactional and logistical issues which households would have to incur when moving NTFPs. However, the logistical and transactional challenges can be overcome if the benefits from collecting NTFPs are seen to provide economic benefits to the households. To achieve this, the economic benefits of the NTFPs should outweigh the challenges and one way this is possible is if the potential of NTFPs is realized. Processing and marketing of NTFPs is a way that would make NTFP collection viable. The second factor found to influence how much households were involved in collecting NTFPs was the location. This implies that the odds of collection of NTFPs reduced by 21.5% if the household lived in Mongu than if they were in Limulunga, *ceteris paribus*. This could be attributed to the closeness of forest of the households. It is no wonder that this variable had the largest magnitude effect on the decision to collect and use NTFPs. This finding is in line with those of Garekae et al. (2017) and Baiyegunhi et al. (2016) who, in separate studies, conducted in Botswana and South Africa, respectively, concluded that households in close proximity to forests are more likely to rely on forest products than those further away. Another factor influencing the collection of NTFPs by local households was the distance to markets and the collection of NTFPs. This implies that the odds of collecting NTFPs increase by 1% the closer the household is to the market by one kilometer, *ceteris paribus*. This finding was interesting because it would be expected that households closer to markets with good infrastructural links to markets would collect more NTFPs because of lower transactional and logistic costs. This could be because households that live closer to markets are more likely to be disincentivized to generate additional income from the trade of NTFPs because there could be more opportunities for off-farm employment. This finding concurs with that of Mohamed and Tesfaye (2020) who, in their study in Ethiopia,

concluded that households living further away from markets rely heavily on NTFPs and so marketing of NTFPs becomes a viable option to generate income to sustain their livelihoods.

Out of the other variables, the statistical analyses revealed the odds of collecting NTFPs reduced as the age increased but this relationship was not significant; the odds of collecting NTFPs increased as residence time, household size, income and years of schooling all increased. This implies that the odds of collecting NTFPs increased as these variables increased but all these relationships were not significant. When it came to the gender of household head, the odds of collecting NTFPs increased if the gender of the household head was female, but this relationship was not significant.

5.2 discussion of collected NTFPs

This study sought among other things to document the plant species utilized by households in Mongu and Limulunga. To do this, indigenous knowledge of the households was utilized. The respondents were asked to name the species that they frequently used on the condition that the species were found in their forests and not used for timber. Particular focus was placed on four main categories, food, medicine energy and construction. With this in mind, the respondents were asked to mention the parts of the plant they extracted and the useful products they utilized. It was found that roots, barks, stems and branches, fruits and leaves were the main parts that were utilized. As shown in Table 4, 33 species were used. In terms of how the species were used, there were similarities across the two study areas. However, it was found that 5 species, Munzinzila, Munga, Mukisi, Mulya and Icholwamuyandi were exclusively used in Mongu and only one, Mawakaka was exclusive to Limulunga.

When it came to collecting these products, it was evident that the whole household was involved. However, looking into the specific parts collected provided insights into how household roles were divided among different members of the household.

5.2.1 Food

Gender roles in most of rural Zambia dictate that it is the woman's responsibility to ensure that food is available for the family. This is evident in how vegetables are collected exclusively by women. The study identified three vegetables that were collected by households, sishungwa, libowa and delele. These vegetables are an important source of food and nutrition when they are in season. Some households mentioned that in some cases, these are collected on a daily basis because they are the only relish they can find during difficult periods of the year. Libowa (Amaranthus spp.) for example has been identified in a study by Nana et al (2012) as a potential

means of combating food insecurity in that it possesses some physical and nutritional qualities that could benefit households. These include resistance to drought, heat and diseases when planted outside their natural growing season as well as the abundance of nutrients including proteins, and micronutrients like zinc iron, calcium, and vitamins A and C. in addition to this, the leaves of Amaranthus have medicinal properties and this came up during the discussions. Other vegetables that were collected from the wild were sishungwa and delele. Biodiversity international states that the leaves of these vegetables are rich sources of nutrients such as vitamin A and C and minerals such as iron and calcium.

However, despite these vegetables having the potential to be grown, during the discussions with the respondents, none of them said they grew these vegetables and waited until they naturally occur during the rainy season before they collected them. One reason for this could be that traditional vegetables are often associated with backwardness and so people prefer to consume more exotic vegetables, so growing and marketing traditional vegetables might not be viewed as a viable venture. This could be seen as crop potential that is being missed. This is evidence that the lack of knowledge on the benefits as well as how to manage some NTFPs is hampering their potential utilization. Growing vegetables along with the major crops could enhance the food security and income opportunities that households have.

Figure 9. Vegetables collected for household use

Fruits are an important food source for households when they are in season. They provide nourishment and a source of food vital to the livelihoods of rural and urban households alike.

In the study area, fruits are collected mostly by children. This could be because households utilize the energy levels and agility of the young family members to climb trees to reach fruits that are in the treetops. Another thing to note is that knowing which fruits to collect requires knowledge. During the discussions, many respondents mentioned that kids are taught which fruits to collect from a young age while they accompany their mothers to the forests. Figure 8 showed that 81% of the household heads transfer their knowledge of NTFPs to their children and teaching them about edible fruits is one of the ways that this knowledge transfer takes place.

Figure 10. Wild fruits collected by households.

Fruits are utilized in various ways. The seeds of the Muzauli fruit, for example, are ground and mixed with cassava leaves to enhance the taste of the relish. Mumosomoso and mahululuhulu fruits are processed into alcohol that is sold at the farmgate or at small bars in the villages. The interesting cases are the munyelenyele and mubula fruits and their seeds that are processed into cooking oil and in some cases soap, products utilized mainly at household level. The oil produced from the munyelenyele fruit is solid at room temperature and so it is stored for use even after the trees have stopped producing their fruits. However, the harvesting of these fruits is not done sustainably in some cases. The fruits of this plant are small and collecting individual fruits would require a lot of time and so, entire branches are cut off. This might potentially reduce the productivity of the trees the following year, to the detriment of the households.

The potential of the fruits derived from forests remains largely untapped. Apart from a few fruits that make it to the market, most of the fruits are only consumed at household level. This suggests that there could be a lot of fruits that are left unpicked. This is a waste of resources that could be potentially used to not only enhance food security but also income generation through processing and marketing products that could be derived from these NTFPs. Examples of wild fruits whose marketing potential have been utilized include the Marula fruit which is processed into a liquor sold commercially. If studies are done to understand the composition of some of the fruits collected in Western province it would go a long way in unlocking some of the potential that these products have.

Figure 11. Cooking oil making process from wild fruits

5.2.2. Energy

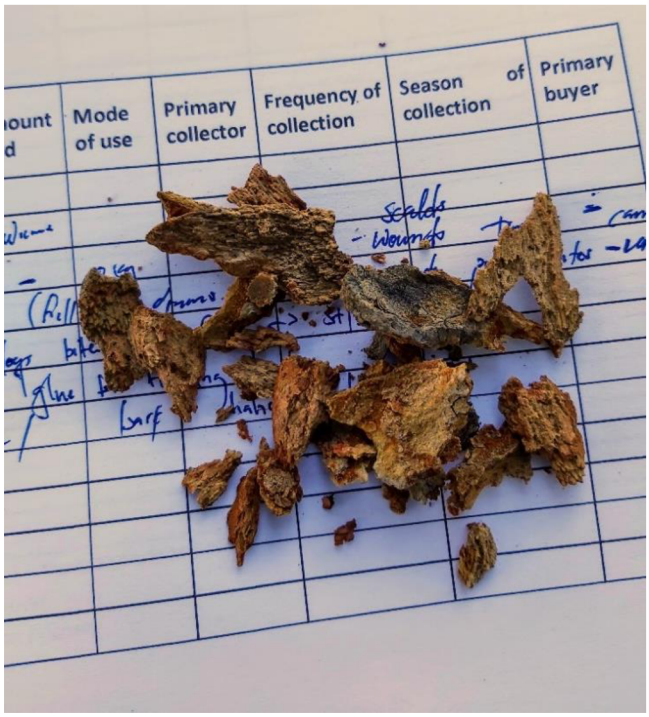
Firewood is relied on as the primary source of energy to meet cooking and heating needs. Men and women are the primary collectors of firewood used in rural households. In most cases, they pick up dry logs on their way home from working in the fields, collecting wild vegetables or other daily tasks they have to perform. This suggests that the impact of firewood use on deforestation is minimal. However, another source of fuelwood, charcoal, is the often the focus of studies (Zulu and Ricardson, 2013; Chidumayo, 2013; Sander, Gros and Peter, 2013)

because of the income generating potential and impacts on the environment. Despite household firewood extraction not having so much of an impact on forests, deforestation from charcoal production impacts on the availability of not only firewood but also fruits. This links back to figure 5 where forest clearing was attributed as one of the most important reasons for the decrease in the availability of NTFPs. Forest clearing for charcoal production is not without reason. The demand for energy in urban areas has increased due to rural-urban migration, population growth as well as high prices of electricity, forcing people to resort to looking for viable alternative energy sources.

5.2.3. Medicine

The main parts used for medicinal purposes were found to be roots, barks, and leaves. These medicines are used for household purposes to treat diseases such as wounds, coughs, stomach aches and headaches. These findings are substantiated by a study by Jumbe, Bwalya and Husseman (2008) found that rural communities in Northern province of Zambia use wild medicinal plants to treat a variety of illnesses, even sexually transmitted diseases. For more serious illnesses, however, the respondents said they visit the hospital, even though they complained that health centres were far away from their residences. These plants are collected mostly by elderly women and men who have knowledge of them. This knowledge is passed down from one family member to another and rarely with outsiders. This is another area where withheld knowledge hampers the potential of wild plants. With increasing rates of urbanisation by mostly the younger people, some of this knowledge is not passed down from one generation to another and as a result, is being lost. The respondents were happy to share some of this knowledge when asked about it and this could be one of the ways this knowledge could be preserved. This knowledge could also be used by pharmaceutical industries as a base to produce new medicines with far reaching economic and health benefits.

Figure 12. Wild medicines collected by households.



5.2.4 Construction

The major use of forests for construction relevant to this study are building poles used to build shelter for humans and animals when the need arises. The poles for construction are often collected by older men who have knowledge of the species. The respondents who listed poles as an NTFP they extracted from the forest mentioned that the trees used are carefully selected with future resource use in mind. The selection of these trees for household use suggests that households that use forests tend to be mindful, in the case of felling trees for construction, and this care is important in forest management and securing future resources. However, the future use of these resources is still at risk.

Figure 13. Example of how construction materials are used by households

Figure 5 shows that most respondents felt that NTFP availability was decreasing because of increased frequency of collection and further, figure 7 shows that most of the households intend to continue collecting NTFPs in the future. These factors coupled with expected population growth suggest that there is increased demand for shelter which exerts downward pressure on households to turn to the forest for the required building materials. This, once again, highlights the need to enforce forest management systems that secure the future of resource availability.

5.2.5 Other uses

Aside from the products discussed above, there are other ways in which NTFPs are utilized by households. These include handles for farming equipment, household furniture like tables, stools and chairs, cooking utensils like spoons and cooking sticks as well as crafts, which are sold at markets. These products are used to generate additional income in strenuous times.

Figure 14. Crafts made from wild plants

6. Conclusion

This study investigated the socioeconomic factors influencing the collection and use of NTFPs in Western province, Zambia. It highlighted some of the species that households utilize to supplement their livelihoods. In addition to this, not only was the importance of forests to the livelihoods of households in Mongu and Limulunga emphasized but also the perceptions of these households to various aspects to forest use. It was found that despite the importance of forests, factors such as forest clearing, increased collection and climate change are perceived to be among the factors that decrease the amount of NTFPs available to the households. In addition to this, most households feel that they will increase the collection and use of NTFPs in the next five years. This highlights the intricate nature of forest use as well as the emphasis which should be placed on sustainable forest management for households to continue to benefit from the forests. It was also found that knowledge of NTFPs is passed on to future generations and the children participate in the collection of especially fruits.

The results of the logistic regression reveal that distance to markets and forests as well as place of residence are significant factor that influence the collection of NTFPs. The major implication of these findings is that the importance of the miombo woodlands to the livelihoods of mostly the rural households cannot be overstated and that policy interventions should be geared towards ensuring that the forests are managed sustainably if the forests are to continue supporting the livelihoods of the households that heavily rely on them.

Based on the findings of this study, it is recommended that i) policies that aim to support the marketing of NTFPs for households in rural areas should be implemented in so that households can reap the monetary benefits that NTFPs could generate. ii) the benefits derived from the miombo woodlands should be quantified and weighed against the opportunity cost that land clearing for agriculture and charcoal burning bring and iii) the NTFPs should be incorporated into food security policy frameworks given their importance to especially rural communities.

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Appendices

Appendix 1 - Questionnaire for data collection

Faculty of Tropical AgriSciences, Czech University of Life Sciences, Prague

Collection and use of NTFPs Questionnaire

I am a student at the Czech University of Life Sciences Prague. The purpose of this questionnaire is to provide information on the socioeconomic factors that influence the collection and use of non-timber forest products among households in Western Province, Zambia. All responses are kept anonymous. Thank you for participating in this survey.

Section 1: Collected species and mode of use

Please list the species you collect from the forest

Local name	English name	Latin Name	Parts collected	Amount collected (kg)	Mode of use	Primary collector	Frequency of collection	Season of collection	Commercialisation	Amount sold*	Primary buyer
			Whole plant								
			Roots								
			Stem								
			Flower								
			Leaves								

			Fruits								
			Whole plant								
			Roots								
			Stem								
			Flower								
			Leaves								
			Fruits								
			Whole plant								
			Roots								
			Stem								
			Flower								
			Leaves								
			Fruits								
			Whole plant								
			Roots								
			Stem								
			Flower								
			Leaves								
			Fruits								
			Whole plant								

			Roots								
			Stem								
			Flower								
			Leaves								
			Fruits								

Mode of use: M – Medicine; E – Energy; F – Food; C – Construction; TU – Tools and utensils; O – Other uses
Primary Collector: M – Male; F – Female; C – Children*; E – Elderly people
Season of collection: R – Rainy season; D – Dry season; C – Cold season
Commercialisation: Y – Yes; N – No
Primary buyer: L – Locals; NL – Not locals

Section 2: Demographic and household characteristics

Household head characteristics:

Age	Gender (M/F)	Schooling (Years)	Farming experience (Years)	Residence Time (Years)	Forest utilization (Years)	Cooperative member (Yes/No)	Reception of Inputs (Yes/No)

Household characteristics:

- Household size: ……
- Number of female labourers: ……
- Number of men labourers: ……
- Number of elderlies: ……
- Number of children: ……
- Distance to forests: ……
    - Primary mode of transport:
        - Foot: ……
        - Bicycle: ……
        - Oxcart: ……
        - Motorcycle:……
        - Car: ……
        - Other(s): ……
- Distance to markets: ……
    - Primary mode of transport
        - Foot: ……
        - Bicycle: ……
        - Oxcart: ……
        - Motorcycle:……
        - Car: ……
        - Other(s): ……

Section 3: Diversification of farm production and income

What kind of land plot do you have?

	Customary
	Leased
	Privately owned

What is the size of your land? ……..

Do you own livestock?

Yes	No

What livestock do you own and how many?

Livestock	Number owned
Cattle	
Goats	
Sheep	
Others (Specify)	

Do you have a job besides farming and NTFP Collection?

Yes	No

If yes, please specify ……..

Sources of income

Source of income	Amount collected (ZMW)

Salary from other job	
Selling NTFPs	
Livestock	
crop sales	
Remittances	
Social benefits (Pension, social cash transfer)	
Fishing	

Section 4: Perceptions on forest use

How has the availability of NTFPs changed in the last 5 years?

	Increased
	Decreased
	No change

If availability of NTFPs has declined, what are the main reasons?

Factor	**Not at all important**	**Slightly important**	**Important**	**Fairly important**	**very important**
Increased collection					
Reduced forest area due to forest clearing					
Increased demand for NTFPs from local people for own use					
Increased demand for NTFPs from outsiders for own use					
Reduced access due to people buying land					
Reduced forest access by state/government					
Local restrictions on forest use					
Plants are difficult to grow					
Climate change (eg increased droughts or less rainfall					
Others, specify					

If availability of NTFPs has increased, what are the main reasons?

Factor	**Not at all important**	**Slightly important**	**Important**	**Fairly important**	**very important**
More availability due to better management					

Less demand for NTFPs for sale					
Fewer people collecting for own use					
Fewer outsiders collecting NTFPs for own use					
Improved access rights to NTFPs					
Exploiting new forests					
Plants are easy to grow					
Climate change (eg changes in rainfall)					
Others, specify					

In the next five years, how likely are you to;

Factor	**Highly unlikely**	**Somewhat likely**	**Likely**	**Very likely**
Reduce collecting NTFPs				
Increase collecting NTFPs				
Plant your own trees				
Protect the trees on your farm				
Practice agro-forestry or silvipasture				

Do you teach your children about NTFPs? Yes [ ] No [ ]