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# EDIBLE MIOMBO WILD MUSHROOMS AND ITS POTENTIAL FOR IMPROVING LIVELIHOODS OF PEOPLE IN SONGEA AND TABORA DISTRICTS, TANZANIA

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## ABSTRACT

**Purpose:** The study assessed the engagement of people in the collection of the miombo woodland wild edible mushroom species for domestic and commercial uses as means of improving the livelihoods of the people in the Ruvuma and Tabora Regions.

**Design/ Methodology/Approach:** Cross-sectional research designs were employed where data were collected once in each selected village in Ruvuma and Tabora region. A sample size of 152 from fourteen villages in Songea and Tabora Regions was sampled. Questionnaires, focus group discussions and key informant interviews were used in collecting data. Descriptive statistics were calculated and used to obtain total scores, means, frequencies and percentages which were used to describe the key findings. Qualitative information collected using focus group discussions and key informant interviews were summarized using content analysis.

**Findings:** About 98% of the interviewed people are engaged in mushroom collection implying the importance of this activity to villagers and other stakeholders along the mushroom value chain. Of the 28 different edible wild mushroom species identified, only five species i.e. *ulelema* (*Amanita loosii*), *unguyugu* (*Cantharellus isabellinus*), *uhima* (*Clavulina wisoli*), *upowa* (*Lacturius edulis*) and *kansolele* (*Temitomyces microcarpus*) were most preferred by local communities.

**Research Limitation**: The study was conducted on a limited sample size, which may not be representative of the population in the Songea and Tabora districts in Tanzania. The results of the study cannot be generalized to the entire population, as the sample size was not large enough to capture the diversity and variability of the population.

**Practical Implications**: Wild mushroom businesses can contribute significantly to food security and poverty alleviation in many parts of Tanzania where miombo woodlands are dominant. Mushroom farming can be an important activity for adding value to the miombo woodland forests hence improving its conservation at the same time providing additional income to the people.

**Social Implications**: Commercial production of mushrooms and other Non-Timber Forest Products (NTFPs) along the miombo woodlands can contribute to the social welfare of the people within the communities adjacent to Miombo Woodland forests. This will also improve the engagement and participation of people in forest resources conservation activities.

**Originality/ Value/ Novelty:** The study highlights the potential of miombo wild mushrooms as an underutilized natural resource that could improve the livelihoods of people in Songea and Tabora districts.

***Keywords:*** *Deforestation. income diversification. land rights. medicinal plants. poverty alleviation*

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## 1.0 INTRODUCTION

Tanzania is among the Countries in the World endowed with diverse natural resources including forests. According to NAFORMA report, about half of Tanzania is covered by miombo woodlands (URT, 2015). The miombo woodlands are among the types of forest existing in Tanzania. These natural resources contribute significantly to the socioeconomic and ecological benefits of the local communities living adjacent to these forests (Qwarse, Moshi, Mihale, Marealle, Sempombe, & Mugoyela, 2021). According to Njouonkou, De Crop, Mbenmoun, Kinge, Biyé, and Verbeken (2016), edible wild mushrooms, medicinal plants and medicinal mushrooms are also important NPFPs which are valuable but not widely used. The miombo woodlands, therefore, provide a wide range of ecosystem services to local communities. Edible wild mushrooms are among the Non-Timber Forest Products (NTFPs) obtained from the miombo woodlands. On the other hand, Non-timber forest products (NTFPs) are important products that contribute significantly to the livelihoods of people. These products have been harvested for many years by the adjacent communities for subsistence use and in some cases for trading. There are many different types of NTFPs obtained from forests. According to Ticktin, (2004), NTFPs may include leaves, flowers, seeds, fruits, roots, bark, latex, resins and many others. However, due to the negligence of the mushroom species found in the miombo woodlands, its value chains are also not well developed. Sufficient traditional knowledge of the existing wild edible mushroom species for both commercial and domestic uses within the communities are therefore important. On the other hand, the continued habits and rates of deforestation, burning of forests and overexploitation of both NTFPs tend to threaten the wild mushroom diversity found in the miombo woodlands (Qwarse et al., 2021). Sustainable harvesting and use of these resources is therefore crucial and may contribute to forest conservation, especially in the miombo woodlands of Tanzania.

Currently, there is a growing consumption of many NTFPs including medicinal plants due to the increased demand for herbal products in the market (Kamau et al., 2016; Moyo et al., 2015; Vasisht et al., 2016). This increased demand has implications for the management and conservation efforts of the existing forest resources. Certainly, the growing commercial trade of natural products such as medicinal plants will result in increased harvesting volumes of these wild plant populations (Moyo et al., 2015; Schaafsma et al., 2014). In some places, there has been a concern about overexploitation leading to deforestation and forest degradation (Kyere-Boateng & Marek, 2021; Mushi et al., 2020; Kimaro & Lulandala, 2013; Chiesa et al., 2009). Empirical evidence indicates that the international trade of medicinal plant materials and their derived/related products including extracts, oils, phytopharmaceuticals, gums, spices, tannins and other ingredients used for making various cosmetics in 2014 contributed to about USD 33 billion in the global export (Vasisht et al., 2016) with the average global export of these medicinal plants being USD 1.92 billion for 601,357 tons per annum. This amount is significant and it needs close attention. These medicinal plant species are traded both locally and internationally. Medicinal plants are becoming more popular worldwide in different cultures and are being modernized to suit the current needs (Van Wyk & Wink, 2018). There is an increased rate of trade of these medicinal plants which are harvested from wild populations, scholars are worried that it may create problems related to overexploitation.

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NTFPs are important to communities and a significant number of people in the world are deriving a substantial amount of their income through selling gathered plants and animal products from the forest (Balama et al., 2016; Posthouwer et al., 2018, Mhapa 2011; Giliba et al., 2010). Empirical evidence indicates that it is the poor income group who are the most economically dependent on these resources (Kabubo-Mariara & Gachoki, 2008; Rahut et al., 2016; Chhetri et al., 2016; Saifullah et al., 2018). It is important to note also that, the poor are the most vulnerable group when comes to food security. Therefore, sustainable harvesting of these resources is essential for the conservation of plant species as well as for the livelihoods of these people. Although some of these NTFPs are used for household consumption only, there are some, which are extracted commercially. It s therefore important to have a balance between the extraction of commercial NTFPs and the same time support strong environmental conservation to enhance its sustainability (Kusters et al., 2006). Once commercial extractions of NTFPs are positively linked with proper strategies for environmental and forest conservation, the forest sector will definitely contribute to the economic growth of both the urban and local rural peoples.

In Tanzania, population growth puts increasing pressure on the natural resources in the country (Schaafsma, 2012) resulting in deforestation which may in turn cause a lack of resources for the poor who rely heavily on forest resources for their livelihoods. There is therefore a trade-off between conservation and poverty reduction particularly in rural Tanzania where reliance on forest resources is high. Mushroom is among the important NTFPs which is consumed and traded by local communities in many parts of Tanzania. According to Schaafsma (2012), there are many studies on the economics of NTFPs in Tanzania with a wide range of findings and how data were collected and analysed. According to Tibuhwa (2013), mushroom collectors residing near the miombo woodlands can potentially collect about 20–30 buckets with a capacity 20 litres per annum. This amount of mushrooms can give this individual or household an annual income of about 400–900 USD. More economic valuation studies are therefore needed to assist policy and decision-makers to understand the importance of the NTFPs in Tanzania. This study, therefore, aims to assess the importance of the miombo woodlands wild mushroom species to the livelihoods of people in Songea and Tabora Districts.

NTFPs are important source of livelihood for the poor communities in Tanzania. Many people in rural areas collect different types of NTFPs for both household consumption and commercial purposes. Empirical evidence indicates that; most of the studies on NTFPs tend to focus on firewood, charcoal, poles and thatching grasses (Schaafsma et al., 2012). To the best of my knowledge, a few or none have assessed the contribution of miombo woodland wild mushroom species to the livelihoods of the people. Therefore, this study will focus on the potential of the edible miombo woodland mushroom species for contributing to the wellbeing of the people in the selected villages in Songea and Tabora Districts in Tanzania. The main objective of this study is to identify key stakeholders in the wild mushrooms value chains and asses the engagement of the people and the potential of the miombo woodland wild mushroom species for improving the livelihoods of the people in the selected villages in Songea and Tabora

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Districts. Specifically, the study aimed to identify the main mushroom species collected by the local communities in Songea and Tabora Districts, to examine the extent of mushroom collections in Songea and Tabora Districts, to assess the interactions between various actors along the mushrooms value chain in Songea and Tabora Districts.

This paper is guided by the value chain analysis theory. The concept of the value chain was developed and introduced in the 19th century and it is currently being used in various fields of study (Zamora, 2016). The value chain is the concept which describes all the activities undertaken in order to bring a product or service from conception, through the different phases of production, distribution to consumers, and final disposal after use. This implies a horizontal or vertical movement of a product from one player to another. As such a product makes those movements, its characteristics and value may also be changing. Studies by other Scholars have tried to link the value chain theory with the theory of internalization (Strange & Humphrey, 2019). Therefore, as any product moves from one player in the chain to another, it is expected that such a product will be gaining more value and quality (Hellin & Meijer, 2006). It is such an added value that distinguishes activities undertaken by various businesses along the value chain. Therefore, wild mushroom species are among the NTFPs with different products with different value chains. Understanding its value chain is crucial for developing business strategies to assist local communities and other stakeholders engaged in the business.

## 2.0 METHODOLOGY

### 2.1 Study area

This study was conducted in two districts, Songea and Tabora (Figure 1). The two Districts were selected because of its capacity to produce an abundance of wild mushroom species from the miombo woodlands. A total of fourteen villages were selected for data collection. These Villages are Amani Makoro, Ilolangulu, Ipole, Kabila, Kakola, Kikunja, Kitanda, Matimira, Mbinga Mhalule, Misha, Mpangula, Mpenge, Mtyangimbole, Sikonge and Madukani.

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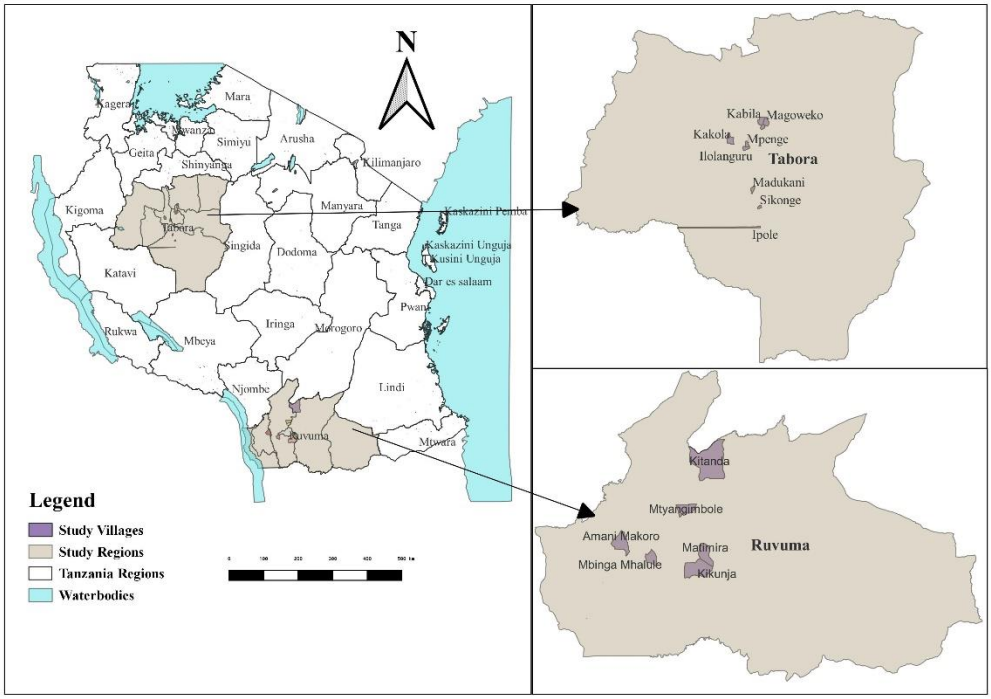


*Figure 1: A Map Showing the Location of the Study Villages*

## 2.2 Data collection

In this study, data were collected using a questionnaire, focus group discussion (FGD) and key informant interviews (KII). In the questionnaire, both qualitative and quantitative data were collected. The selection of villages for undertaking the miombo woodlands mushroom study was based on the existence of mushrooms and the rate of mushroom collection activities as reported by the Region, District Officials and empirical evidence from different scholars (Härkönen, 2001).

Socio-economic data and the local market surveys in the selected communities/villages were collected using a questionnaire. A total of fourteen villages were selected for data collection in this study. These Villages are Amani Makoro, Ilolangulu, Ipole, Kabila, Kakola, Kikunja, Kitanda, Matimira, Mbinga Mhalule, Misha, Mpangula, Mpenge, Mtyangimbole, Sikonge and Madukani. The villages were sampled purposively based on the pre-information from the Regional and District Officers regarding mushroom collection in the area. Purposive sampling was proper for this study because it aimed to get proper representations and also sufficient information on mushroom collection activities. A Total of 152 respondents were interviewed in which 74 were from Songea and 78 were from Tabora. During the respondent selection, the village leaders were told to identify households with different income levels in order to have a better representation of the population. Using the questionnaire, among others, information on education, age, household size, sources for mushroom collection, health insurance, mushroom consumption level, mushroom value chain, ethnicity and economic activities were gathered.

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In each of the selected villages, a focus group discussion was conducted. Each group comprised of about 5-10 people representing different categories of people in society. The focus group members were selected among the potential stakeholders engaged in the mushroom collection and forest conservation activities in the villages. The purposive selection of the participating members in the focus group discussion was conducted in collaboration with the Regional and District Officials from Ruvuma and Tabora Regions. The members involved in the FGDs included village leaders, village natural resources committee members, mushroom traders, special old people and youths. Focus group discussions are crucial for accessing valuable hidden information from the communities. A researcher will have time to talk to the group members and where deemed necessary he/she can engage in a detailed discussion. These local communities are thought to have strong indigenous knowledge regarding various issues in the community. During the meetings, various issues were discussed especially on the amount of mushrooms collected per month, who is responsible for the collection, time spent in the forestry, frequency of collection and access to the market.

Interviews with selected Key informants were conducted. In this study , KII were conducted to village leaders, Tanzania Forest Service Agency (TFS) Officials, mushroom traders, Hotel owners, District Forest Officers and Ward Executive Officers. These people are thought to have a clear understanding and comprehensive information regarding the mushroom trading system and its value chain. This technique is very important for gathering information used for triangulating with those captured using other techniques.

### 2.3 Data Analysis

Quantitative data collected using questionnaires were coded and processed using Statistical Package for Social Sciences (SPSS) version 22. Descriptive statistics were calculated and used to obtain total scores, means, frequencies and percentages which were then used to describe the key findings. Comparisons among different groups were made based on the reported figures. Qualitative information collected using focus group discussions and key informant interviews were summarized using content analysis, were analyzed by using content analysis. Other information obtained from secondary sources like policies and other existing literature were explored, reviewed, organized and combined into themes. The obtained themes were categorized according to the similarities based on the specific objectives and research questions. The verbatim quotations from respondents' views were considered and placed under the respective themes. This means that the analysis followed a pattern that matched the methods before conclusions were drawn from the findings. Results for quantitative data were summarized in graphs, figures and tables.

## 3.0 RESULTS AND DISCUSSION

### 3.1 The Socio-economic characteristics of the Mushroom Collectors

The majority (82.2%) of the interviewed people were female and only 17.8% were males. Although the mushroom collection was reported to be beneficial to the entire household this activity is dominated by the female group (Table 1).

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*Table 1: Socio-economic characteristics of the Respondents*

| Characteristic | Socio – economic Factor | Frequency (N) | Percentage (%) |
|---|---|---|---|
| 1. Sex | Male | 27 | 17.8 |
| | Female | 125 | 82.2 |
| 2. Education Level | No Formal Education | 18 | 11.8 |
| | Primary education | 117 | 77.0 |
| | Secondary education | 16 | 10.5 |
| | Tertiary education | 1 | 0.7 |
| 3. Highest education in the household | No formal education | 95 | 62.5 |
| | Primary education | 37 | 24.3 |
| | Secondary education | 14 | 9.2 |
| | Tertiary education | 1 | 0.7 |
| | No Responses | 5 | 3.3 |
| 4. Marital Status of the Interviewees | Single | 7 | 4.6 |
| | Married | 19 | 12.5 |
| | Divorced | 28 | 18.4 |
| | Widow/widower | 98 | 64.5 |
| 5. Household Size | Less than 3 people | 18 | 11.8 |
| | 3-5 people | 62 | 40.8 |
| | 6-10 people | 66 | 43.4 |
| | More than 10 people | 5 | 3.3 |
| | No Response | 1 | 0.7 |
| 6. Main occupation of head of household | No Forma Employment | 152 | 100.0 |
| | Farming | 132 | 86.8 |
| | Self Employment | 31 | 20.4 |
| | Pastoralism | 18 | 11.8 |
| | Mushroom collection | 42 | 27.6 |
| | Petty business | 16 | 10.5 |
| | Selling vegetables | 15 | 9.9 |
| | None of the mentioned | 39 | 25.7 |
| | Mamalishe | 10 | 6.6 |
| | Local brewing | 6 | 4.0 |
| | Beekeeping | 2 | 1.4 |
| | Others | 29 | 19.1 |
| 7. Residency (Years stayed in the Village) | Less than 3 years | 2 | 1.3 |
| | 3-5 years | 1 | 0.7 |
| | More than 10 years | 149 | 98.0 |
| **Total number of Respondents (N)** | | 152 | **100%** |

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Generally, the literacy level in the selected villages was lower. Findings indicate that there is a significant number of people who have not attained primary education (Table 1). Further, almost 83% of the people interviewed are either divorced, widows or widowers. On the other hand, about 98% of the respondents are born in the village or have stayed in the area for many years but with no formal employment. The majority are practising subsistence farming. Other occupations of the head of households included barbershops, carpentry, casual labour, driving/transport, fishing and fish selling, gardening, masonry, meat selling, milling machine, motorcycle, retired officer, stone breaking, street vendor, and tailoring.

The female dominance in the mushroom collection activities in the communities found in these two Regions seems to be not a surprise. The ethnic groups residing in both Songea and Tabora Districts which are in Ruvuma and Tabora Regions respectively are experiencing male dominant societies. In most communities in these regions, there are activities which are special for women and some for men. This, therefore, brings to attention that the development and facilitation of the edible wild mushrooms value chain will assist more females than males. Although the entire value chain may have a different composition of stakeholders we are certain that the mushroom collection activities are gender imbalanced. This, however, may be a positive thing in case one needs to focus his/her efforts in helping women. The majority in this value chain may need some assistance, especially on the best ways of organizing their activities and making the business more profitable to them. However, although men comprise of only 18% of the total interviewees, it could be interesting to collect data and compare the well-being of the two groups as well as their economic power in terms of resource ownership in the villages.

### 3.2 Edible wild mushroom species collected by the local communities from the miombo woodlands

About 98% of the interviewed people were engaged in mushroom collections (Table 2). The majority of the collectors are sourcing the mushrooms from the forest (80%) and from their own forest land (72%). All the respondents (100%) had some knowledge and understanding of the mushroom business in the villages. The top five widely known mushroom species are Uhinda (64.5%), Ulelema (58%), Usikowa (57.3%), Unguyugu (39.5%) and Umpalala (36.8%). These species were also favourable to most of the respondents and despite the offseason, dried mushrooms were available in the market. Results indicate that there were about 28 different mushroom species mentioned by the respondents. These species are cutting across the two regions indicating that similar edible wild mushroom species are found along the miombo woodlands.

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*Table 2: Mushroom Species and Sources of collection*

| Characteristic | Response | Frequency (N) | Percentage (%) |
|---|---|---|---|
| 1. Edible Mushroom collection | Yes | 149 | 98 |
| | No | 3 | 2 |
| 2. The main sources from where Mushrooms are collected from | Forest | 122 | 80.3 |
| | Own Forest Land | 109 | 71.7 |
| | Forest, anti-hills, cattle bomas | 26 | 17.1 |
| | Other sources | 3 | 2.0 |
| | Bushland | 1 | 0.7 |
| 3. People's understanding of the names of the different mushroom species collected | **Yes** | **152** | **100.0** |
| | Uhinda (*Russula celulata*) | 98 | 64.5 |
| | Ulelema (*Amanita loosii*) | 89 | 58.6 |
| | Usikowa (*Lactarius denigricans*) | 87 | 57.3 |
| | Unguyugu (*Cantharellus isabellinus*) | 60 | 39.5 |
| | Umpalala (*Lactarius kabansus*) | 56 | 36.8 |
| | Uyungwe (*Russula sp*) | 50 | 32.9 |
| | Kansolele (*Temitomyces microcarpus*) | 49 | 32.2 |
| | Upowa (*Lacturius edulis*) | 45 | 29.6 |
| | Mkukwe (*Cantharellus isabellinus*) | 44 | 28.9 |
| | Uhima (*Termitomyces letestui*) | 38 | 25.0 |
| | Katogwa | 27 | 17.8 |
| | Mbarakata (*Lactarius tanzanicus*) | 24 | 15.8 |
| | Utowa (*Cantharellus congolensis*) | 24 | 15.8 |
| | Unyuwang'ombe | 20 | 13.2 |
| | Kalungea (*Cantharellus CF. floridula*) | 18 | 11.8 |
| | Kilimbisi | 18 | 11.8 |
| | Ulundi (*Lactarius volemoides*) | 17 | 11.2 |
| | Kangautowa *Cantharellus congolensis* | 13 | 8.6 |
| | Kitindi | 11 | 7.2 |
| | Luhonyo | 5 | 3.3 |
| | Upelepeta (Termitomyces sp | 5 | 3.3 |
| | Ukufu (*Termitomycenes letstui*) | 4 | 2.6 |
| | Ukangarume (*Cantharellus isabellinus)* | 4 | 2.6 |
| | Mgwida | 3 | 2.0 |
| | Usangasanga | 3 | 2.0 |
| | Mgunda | 3 | 2.0 |
| | Undodi | 3 | 2.0 |
| | Mngaukau | 3 | 2.0 |
| **Total number of Respondents (N)** | | 152 | **100%** |

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Besides being dominated by females, the mushroom collection seems to be the potential for generating substantial income for these women. The fact that 98% of the interviewed people within the villages are engaged in the collection of edible wild mushrooms is an indication of the high importance of the activity/business in improving the livelihoods of the villagers. This, therefore, necessitates putting in place proper and strong value chains for the mushrooms for both poverty alleviation and livelihood improvements. Since forests are the main sources of these wild mushrooms collected, there is no way we can avoid linking the sustainability of these mushroom species with the conservation of the miombo woodland. For these communities to continue enjoying these ecosystem services and the business, the mushroom sources must be conserved and maintained.

However, research can also be promoted in order to develop modern means of producing similar mushroom species to feed the existing market. Making modern wild mushroom farming possible is the best option because it will reduce significantly the pressure on the natural miombo woodlands hence promoting conservation but at the same time increasing the income of the individual households and the regions in general. It will also increase the standard and quality of mushrooms produced which will in turn increase the possibilities of proper and quality marketing systems. Awareness creation among the community members engaged in the mushroom collection is crucial because of its potential not only in increasing household income but also to create employment for the people along the entire value chain. The Government, private companies and non-governmental organizations such as FORVAC, Mamaland and WWF could play a significant role in this task, especially, in conservation education, sustainable mushroom collection, processing technologies, marketing and value chain development.

Five species, *uelelema* (*Amanita loosii*), *unguyugu* (*Cantharellus isabellinus*), *uhima* (*Clavulina wisoli*), *upowa* (*Lacturius edulis*) and *kansolele* were found to be the most preferred in the study sites (Figure 2). These therefore could be the species fetching higher prices due to high preferences and demand among consumers. These five highly preferred species indicate that they can have a great contribution to the economy and welfare of households and society in general. Investing resources in developing its strong value chain is therefore important. A strong value chain for each of these mushroom species means that various stakeholders especially women will be engaged in the process. This will open more doors for more people to participate in the value chain hence improving the living standards of the people. Developing and promoting a strong edible mushroom species value chain is therefore important for ensuring a sustainable supply of mushrooms in the market throughout the year.

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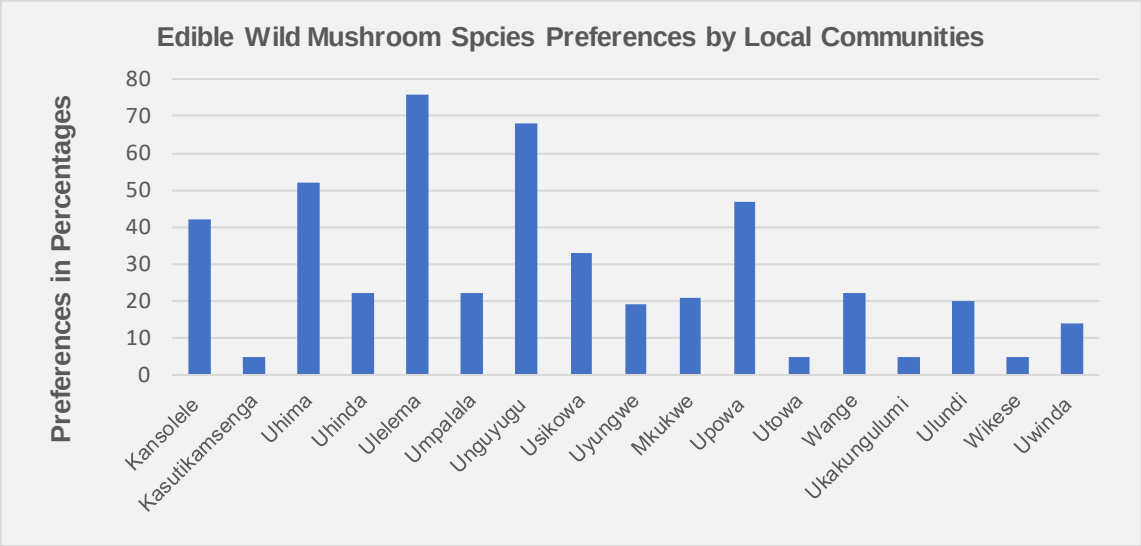


*Figure 2: Edible Wild Mushroom Species Prefered by Local Communities*

During focus group discussions, it was evident that in the miombo woodlands, there are several mushroom species which are not edible and some are seriously poisonous. However, most of the respondents (80%) had indigenous knowledge of differentiating edible and non-edible wild mushroom species (Table 3). About 78% of the respondents used colour to differentiate the two categories while other means of differentiating the species included growing place, smell, taste, latex coming out from the mushroom, size and using ants or other small insects. Indigenous knowledge is crucial to local communities because it assists them to avoid unnecessary deaths resulting from the consumption of poisonous wild mushroom species.

*Table 3: Multiple Responses on the Knowledge of differentiating poisonous and edible mushrooms*

| | **Characteristic** | **Frequency (N)** | **Percentage (%)** |
|---|---|---|---|
| How do you differentiate between edible and poisonous mushrooms? | Experience (indigenous knowledge) | 122 | 80.3 |
| | Colour and appearance | 119 | 78.3 |
| | Being eaten by insects and other wild animals | 70 | 46.1 |
| | Growing place | 52 | 34.2 |
| | Smell | 35 | 23.0 |
| | Taste | 30 | 19.7 |
| | Exudates/Latex/Sap | 29 | 19.1 |
| | Other Means | 25 | 16.4 |
| | Size of the mushroom | 10 | 6.6 |

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Middlemen and local community members are the main customers of the collected mushrooms (Figure 3) in the villages. Data show that very few mushroom collectors tend to sell the collected mushrooms to wholesalers and to truck drivers along the main road. Local consumers, therefore, take up a significant portion of the mushroom market in the two Districts. Based on the conducted focus group discussions, it was evident that most middlemen take the collected mushroom to the markets in urban areas where they fetch higher prices than in the villages. This gives them a higher chance of getting more profits compared to the collectors. As observed in figure 3, middlemen take a significant part of the market indicating the potential of the business along the value chain. About 18% of the interviewed people seem to be collecting the mushrooms for household consumption hence providing nutritional value to the community. Promotion of activities related to the edible wild mushroom collection and farming in the villages is therefore potential for both household income generations and enhancing conservation and food security among the communities.

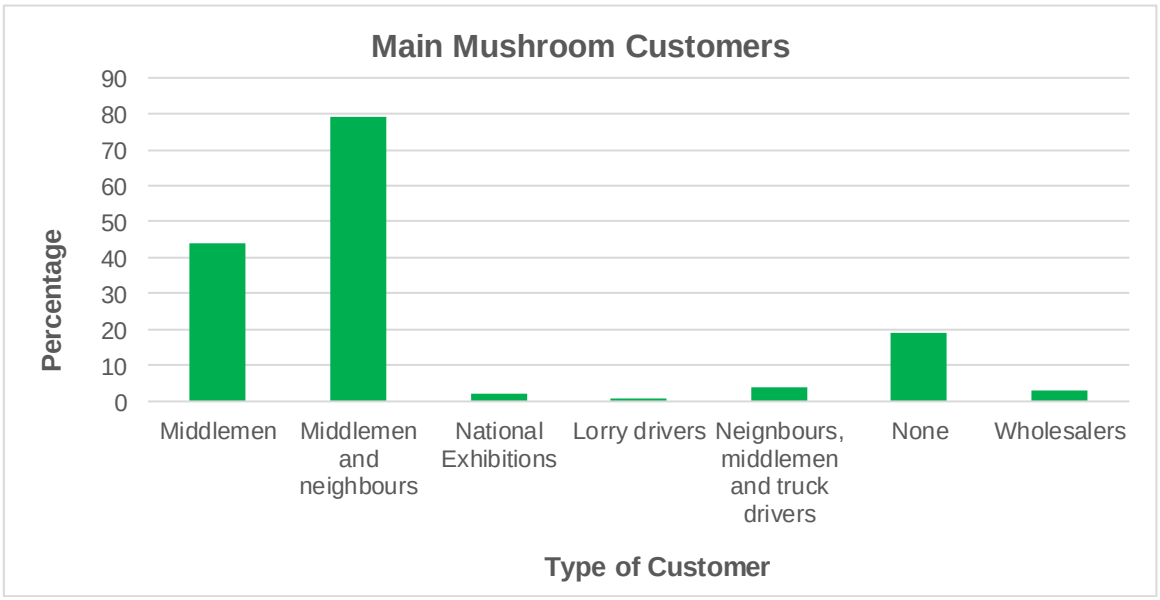


*Figure 3: Main Customers for the Miombo Woodlands Mushroom Species*

### 3.3 The Extent of miombo woodlands wild mushrooms collections and its conservation implications

The mushroom collection is a seasonal activity undertaken mainly during the rainy season. Results indicate that 35.5% of the households engaged in mushroom collection activity tend to do so at least three times and twice per week while 18% collect mushrooms at least once per week (Table 4). Very few households (3.3%) engage themselves in mushroom collection five times a week, every day (2.6%) or once per month (1.3%). It was evident during the focus group discussion that like beekeeping, edible wild mushrooms collection can be an important positive tool for promoting conservation by development agencies in their efforts to use forest resources for improving the livelihood of people hence contributing to poverty reduction

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among the people at the same time providing incentives for forest conservation. Therefore, households engaged in mushroom collection can still undertake other income-generating activities hence diversifying their income sources and increasing the chance of improving their livelihoods and living standards. The same miombo woodlands used for collecting mushrooms could also be used for beekeeping, butterfly farming or other ecologically user-friendly activities. With the current climate change and variability experienced in many places in Tanzania and globally, income diversification is among the potential techniques for adaptation and coping with such inevitable changes. Like other NTFPs, domestication and on-farm production of edible wild mushroom species could be an appropriate technique to deal with its over-exploitation in the miombo woodlands. A proper harvesting plan should be in place in order to control the collection and harvesting for enhancing sustainability. According to Senganimalunje et al. (2015), households living adjacent to Mua-Livulezi Forest Reserve relied on the forest for subsistence use only where its potential for income generation was very insignificant. In such a situation, income diversification using these other means could add substantial value to the miombo and other types of forests.

One of the important things to consider for enhancing sustainability in the supply and harvesting of edible wild mushroom species is land rights and ownership. A study conducted by Ahammad et al. (2023) in Bangladesh found that, among other things, the local ethnic community's land rights issue remained unresolved and the participant's land ownership influenced their willingness to participate effectively in any restoration programme. This is crucial at a community level especially when thinking about miombo woodland sustainability in the country. Local communities need to own or have a sense of ownership of the resources for them to engage fully in sustainable conservation and management. A household which has properly secured land rights will definitely have a more positive attitude towards participating in forestland restoration than those with unsecured land rights (Ahammad et al., 2023). Land ownership is therefore an important aspect of any restoration programmes and value addition to the existing forests.

*Table 4: Frequency of edible mushrooms collection*

| | **Characteristic** | **Frequency (N)** | **Percentage (%)** |
|---|---|---|---|
| How Many times do the family go to the forest for mushroom collection? | Three times a week | 54 | 35.5 |
| | Twice a week | 54 | 35.5 |
| | Once per Week | 27 | 17.8 |
| | Five times | 5 | 3.3 |
| | Four times a week | 5 | 3.3 |
| | Daily | 4 | 2.6 |
| | Once a month | 2 | 1.3 |
| | None | 1 | 0.7 |
| **Total number of Respondents (N)** | | **152** | **100%** |

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The majority of the respondents are selling the collected mushrooms in smaller package units. Results in figure 4 show that 31% are selling their mushrooms in less than one-Kilogram unit while 28% are selling in units weighing 3 to 5 Kilograms (Figure 4). This implies that, they are selling the collected mushrooms to small-scale consumers within their localities or villages. These findings correspond with those in figure 2 where local community members take up a significant size of the consumers in the market. Since the markets for wild mushroom species are localized, the management of these forests should also take into account the maximization of the NTFPs, which are important to the local communities. It has been common in many places in the world that the management of the forests focuses mainly on maximizing timber production only marginalizing valuable NTFPs like mushrooms. However, this trend could be reversed if there could be efforts to promote and expose edible wild mushrooms to the market by improving infrastructure to access the urban markets as a result of globalization and liberalization (Reta et al., 2020). Another study conducted in the USA recommended the formalization of the farming systems and domestication of the NTFPs such as edible wild mushrooms in order to improve the system transparency and increase credibility and the strong value chain of the products (Vaughan et al., 2013). As result, timber production has been the main priority in the management of the miombo woodlands and other vegetation types neglecting the important non-timber products consumed by the local communities. These findings indicate that the promotion of NTFPs can add a significant value to the miombo woodlands which take about 40% of the total forest areas in Tanzania. Proper utilization of this 40% land size can have a great contribution to changing the living standards of the people hence the national economy. The conserved areas where local communities are harvesting the edible wild mushroom species could also be a potential place for carbon sequestration and hence benefit from the current international carbon trade market.

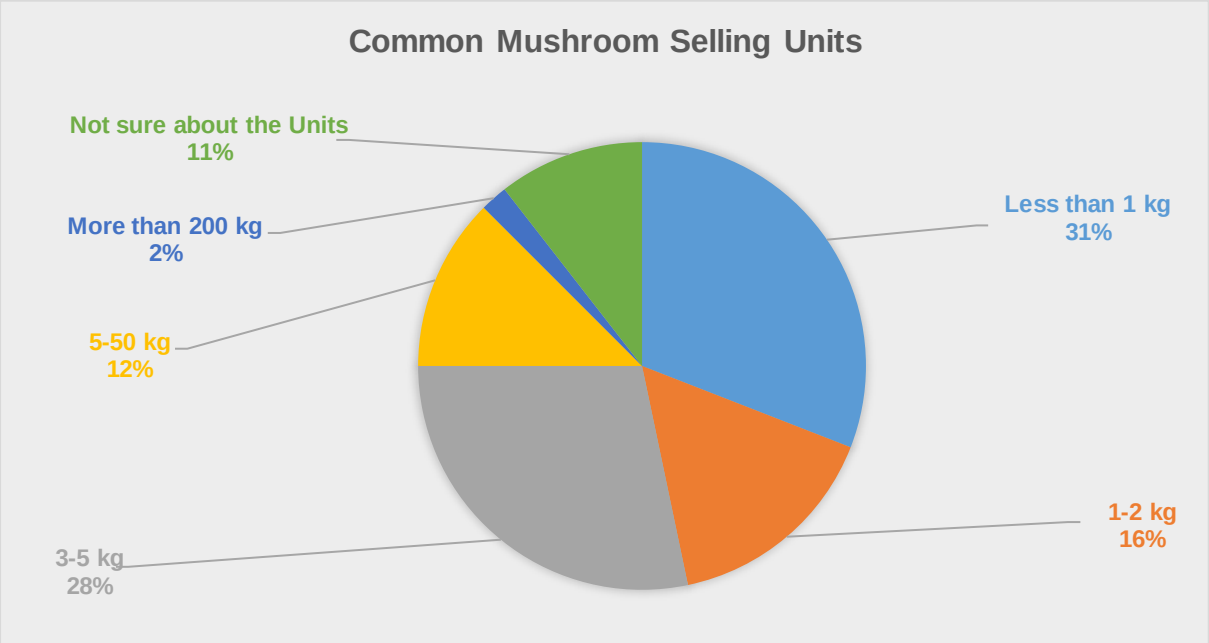


*Figure 4: Preferred Mushroom Selling Units*

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Wild mushroom collection can have significant impacts on the majority of rural communities if it is well managed and its value chain is properly developed and monitored. In a long run, it can be integrated with beekeeping activities hence increasing the monetary and biodiversity value of the forests. With an increased household income, the welfare of the communities will be improved as well in terms of living standards, environmental conservation, food security and education. This will in turn enhance a positive attitude towards forest conservation by local communities. With increased benefits accrued from the forests, local community members are expected to practice good stewardship in conservation and management activities.

## 4.0 CONCLUSION

The wild mushroom collection is an important seasonal income-generating activity for people in both Ruvuma and Tabora Regions. This activity is dominated by females and mostly those who are not privileged to have gone to school and lack formal employment. To these groups, the wild mushroom collection is therefore a potential income-generating activity. Although it is a seasonal income-generating activity the reliance of poor households on the activity is significant, especially in villages which are rich in different edible wild mushroom species. Despite the existence of non-edible wild mushroom species, local community members have strong indigenous knowledge of how to identify and differentiate edible from non-edible wild mushroom species.

The collected edible wild mushroom species have short value chains because mostly are sold in the same villages and nearby urban/town centres. Most of the collected mushrooms are sold to the middlemen who then take the mushrooms to the urban markets in Songea and Tabora Towns. This short value chain needs to be strengthened and managed more efficiently in order to increase the potential of the mushrooms in contributing to livelihood improvements in the communities. Proper organization and collection of the edible wild mushroom species can have a significant implication not only for poverty alleviation in the villages but also for environmental protection, forest conservation and food security among the local community members. With improved packaging, for instance, the packed mushroom will have a longer shelf life and higher value in the market signifying a higher value addition. This will result in the engagement of more people in the business and therefore positive implications for the national economy. Profitable mushroom collection business will have positive impacts on forest conservation because local communities will have positive attitudes toward maintaining the ecosystems and forest conditions in order to ensure a sustainable supply of wild edible mushrooms.

Further, it is important that local communities are trained and motivated on the importance of ecosystem conservation and the collection of edible wild mushrooms for both income generation and diversification in their localities. The government should initiate awareness programmes to educate local communities on the importance of conservation for a sustainable supply of wild mushrooms in the villages. However, more research should be conducted particularly on the domestication of edible wild mushroom species and strengthening its value

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chain so that local community members can benefit more from the business. The research will also come up with clear findings on the various factors and key issues that need to be addressed in order to strengthen the wild edible mushroom value chains.

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**Conflicts of Interests**

This study was funded by Sokoine University of Agriculture under the SUARIS programme. Therefore, the author declares that there are no conflicts of interest related to this study.

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