

**ASSESSMENT OF EDIBLE WILD MUSHROOMS VALUE CHAIN AND ITS
CONTRIBUTION TO LIVELIHOODS IMPROVEMENT IN MBINGA AND
SONGEA DISTRICTS, TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE
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ABSTRACT

Tanzania is one of the countries endowed with high forest diversity in the world. Miombo woodland which influence availability of wild mushroom makes up 90% of all forested land in Tanzania. Despite advantages of edible wild mushroom in contribution to individual livelihoods there is insufficient information on actors and their linkages in edible wild mushroom value chain, and contribution of edible wild mushroom to livelihood improvement. This study assessed edible wild mushrooms value chain and its contribution to livelihoods improvement in Songea and Mbinga districts, Tanzania. The study identifies species of wild mushroom available in study area, mapped actors along edible wild mushroom value chain, roles of actors in value addition and assessed contribution of edible wild mushroom to livelihood improvement in the study area. Six sampled plots were used for inventory. 30 collectors as sample were randomly selected for the study. Data were collected through questionnaire survey, focus group discussions, mushrooms' inventory, and direct observation. Data were analyzed by descriptive and content analysis. In study total of 42 wild mushroom species were recorded and edible wild mushroom weighted. On average about 4.13 kg of mushroom were collected per plot in 1 hectare which means individuals are able to generate income of 4130 up to 10 352 TZS per plot. The prices per kg ranged from 1000 to 2500 for fresh mushroom while for dried mushroom 10 000 up to 12 000 TZS. The value chain of edible wild mushroom in study areas consists collectors and consumers as key actors. Generally, value chain is dominated by women (73.3%) while men comprise of only 26.7%. Collectors collect mainly *Amanita*, *Russula*, *Cantharellus* and *Lactarius* species. Collection of edible wild mushrooms is done one day up to seven days per week, selection of species to be collected depending on availability, preferences, and storage possibility. The mushrooms that were sold are fresh and dried, 60.0% of respondents sold

fresh mushrooms, 33.3% both dried and fresh and 6.7% dried. Edible wild mushroom contributes to livelihood for those engaged in collections and trade as it provides alternative income for accessing social services but also can boost others productive activities. Edibility of the mushroom was identified mainly using local indicators. Training on domestication and preservation was identified as key for increasing commercialization of the product.

DECLARATION

I, Dorice Clement Mavindi do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

Dorice Clement Mavindi
(MSc. Candidate)

Date

The declaration is confirmed

Prof. J. M. Abdallah
(Supervisor)

Date

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DEDICATION

This work is dedicated to my beloved family, my father Clement Frank Mavindi, my mother Marium Karata Maghembe and my older brother Edward Clement Mavindi for the immense sacrifices they made to build a good foundation for my career and my life in general, may God bless them abundantly.

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LIST OF ACRONYMS

FORVAC	Forestry and Value Chains Development Programme
NAFORMA	National Forest Resources Monitoring and Assessment
NWFPS	Non-Timber Forest Products
TZS	Tanzanian Shilling
VICOBA	Village Community Bank

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Mushroom is a delicious food consumed in many parts of the world. It is also called the future vegetable which guarantee food security, malnutrition problem and has medicinal value. Mushrooms are nutritious, medicinal and functional food (Getachew *et al.*, 2016). It is considered as a health food as it contains low calories, high protein, dietary fiber, vitamins, and minerals (Barros *et al.*, 2008; Kalac, 2013). According to Cheung (2010) different species of mushroom contains different amount of carbohydrates which usually ranges between 35- 70%.

The practice of wild foods gathering has been mankind since time-immemorial. Gathering of wild food has been practiced for many centuries by ancestors dates back to 900 BC and is still practiced in different parts of the world (Mlambo and Maphosa, 2017). Bharucha and Pretty (2010) testifies that around one billion people in the world are reported to consume gathered foods and three hundred million consume gathered food as the beginning of millennium. Global mushroom market has been segmented by product type, form, distribution channel and geography (Dublin, 2018).

Wild edible fungi are collected for food and to earn money in more than 80 countries (Boa, 2004). In Africa, over two thirds of the population rely on forest products, either in the form of subsistence or as a cash income derived from a range of Non-Timber Forest Products (NTFPs), including edible mushrooms (Rammeloo and Walley, 1993). Africa constitute at least 25% of the total mushroom biodiversity in the world which contribute up to 0.4% of the total mushroom sales and new mushroom products on the global market (Yongabi, 2014).

Tanzania is one of the countries endowed with high forest diversity in the world (Chamuya, 2016). The forest land cover about 48.1 million ha and contribution of woodlands to the total forest coverage in Tanzania is high (73.9%) compared to other biomes (NAFORMA, 2015). Miombo woodlands make a significant proportional of total forested land in Tanzania, and most of it is in general lands (Abdallah and Monela, 2007). The woodlands constitute the largest block of deciduous tropical woodlands and dry forests in the world, and are home to over 40 million people and the sources of products that serve the basic needs, and one of the products is edible mushroom (Abdallah and Monela, 2007). Miombo ecosystems provide high potential of indigenous mushrooms (Bloesch and Mbago, 2008). It has been documented that there are more than 60 edible mushroom species either domesticated or in wilderness which have been identified in Tanzania from the orders *Boletales*, *Cantharellales* and *Amanitales* (Bloesch and Mbago, 2008; Tibuhnwa 2013).

1.2 Problem Statement

The woodlands are important sources of wood for construction and energy, water retention, and Non-Wood Forests Products (NWFPs) such as mushroom. The non-wood forest products are harvested and used for food and income. The forest and woodlands coverage in Ruvuma region are about 74% (NAFORMA, 2015). Ruvuma has higher amount of forest and woodland coverage compared to other regions. That means availability of the non-wood forest products especially mushroom is high. Edible wild mushroom is one of sources of food and income in Ruvuma region, this forest product is considered to contain high amount of protein which can substitute meat (Ngaga *et al.*, 2006).

Despite advantages of edible wild mushroom in contribution to individual livelihoods little has been researched on value chain of edible wild mushrooms and its contribution to livelihood improvement in Ruvuma. Various researches have been conducted on edible wild mushroom (e.g., Karmann, 2000; Ngaga *et al.*, 2006; Bloesch and Mbago, 2008; Tibuhwa, 2013; Chelela *et al.*, 2014). Majority of these studies are on the biology of mushroom. This is one of the factors that made its utility value to be not sufficiently accounted and unavailability of statistics on contribution of the forest resources to the economy. Domestication of mushroom for increasing quantity and quality would depend on availability of various things, one of them is research information on the value chain development. Therefore, study assessed the value chain of edible wild mushroom in Mbinga and Songea Districts and its contribution to livelihood improvement.

1.3 Justification of the Study

Besides playing wider domestic roles and income at local level, edible wild mushroom can also be a good source of foreign exchange earnings due to its significance. So, the findings and knowledge that generated from this study will also help to rescue forest resources, minimize degradation as it will reduce reliance on land and timber forest products but also contribute to better understanding of edible wild mushroom on improving strategies for reorienting value chain and market system for benefit at local level and national level.

1.3 Objectives

1.3.1 Overall objective

The overall objective of the study was to assess the value chain of edible wild mushroom and its contribution to livelihood improvement in Mbinga and Songea districts.

1.3.2 Specific objectives

The specific objectives were to:

- i. Identify species of wild mushroom that available in Mbinga and Songea districts;
- ii. Map actors involved and their roles in edible wild mushrooms in Mbinga and Songea districts; and
- iii. Assess contribution of edible wild mushrooms to livelihood improvements in Mbinga and Songea districts.

1.4 Research Questions

The study strove to answer the following questions:

- i. How many species of wild mushroom available in the Mbinga and Songea Districts?
- ii. Who are the actors involved and their roles in edible wild mushrooms value chain in Mbinga and Songea Districts?
- iii. How edible wild mushrooms contribute to livelihood improvements in Mbinga and Songea Districts?

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definition of Key Terms

2.1.1 Edible mushroom

Edible mushrooms are the fleshy and edible fruit bodies of several species of macro fungi (fungi which bear fruiting structures that are large enough to be seen with the naked eye). They can appear either below ground (hypogeous) or above ground (epigeous) where they may be picked by hand (Adam, 2015). Edibility may be defined by criteria that include absence of poisonous effects on humans and desirable taste and aroma. Edible mushrooms are consumed for their nutritional and culinary value.

2.1.2 Value chain concept

The value chain is defined by Kaplinsky as the full range of activities which are required to bring a product or service from conception, through the intermediary phases of production, delivery to final consumers, and final disposal after use (Kaplinsky and Morris, 2001), individuals or groups who involve directly in the chain to create and delivering the products are called chain actors.

2.2 Sustainable Livelihoods Approach

A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living; a livelihood is sustainable if can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long-term (Chambers and Conway, 1992).

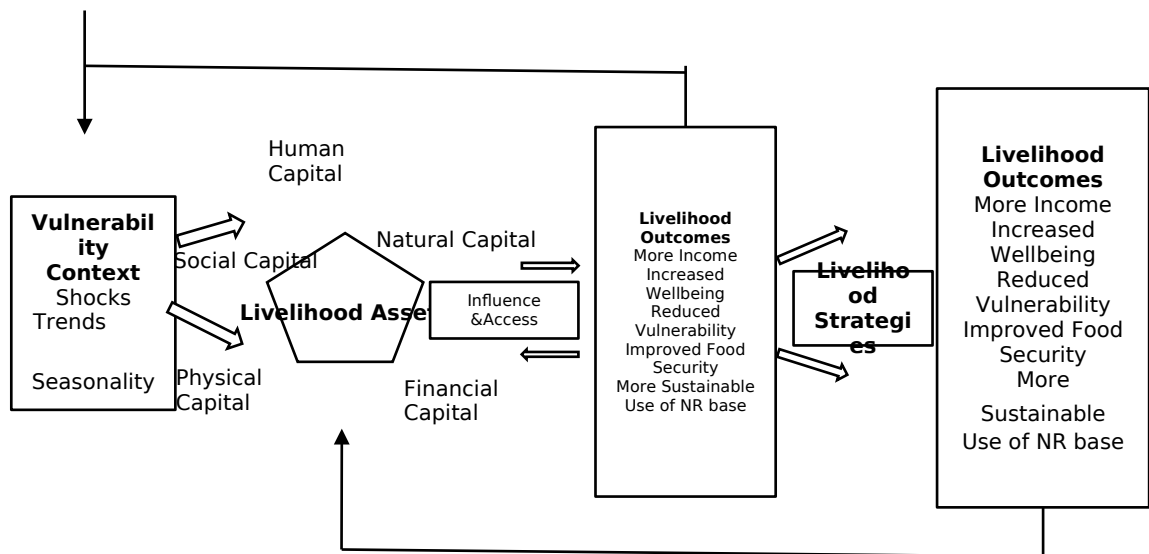


Figure 1: The Sustainable Livelihoods Framework

Source: Carney (1998)

The livelihoods framework helps to understand the economic strategies of men and women in the community and to identify people's activities in developing and sustaining their livelihood. The livelihoods activities begin with the concept of livelihood and progress through the forms of capitals, structures and processes which shape people's options. Its analysis the concept of vulnerability of people are exposed to different kinds of risks, shocks and stresses Carney (1998).

Livelihoods approaches based on the assets is relevant to analyzing the communities. Assets can be in the form of human, physical, financial, natural and social. Human capital refers to skills, one's labor, and good health. Physical capital refers to infrastructure and producer goods that are required to support livelihoods. Financial capital is the accessibility to cash, or its equivalent, for the quest of livelihood strategies. It includes savings in the bank, jewelry, livestock etc. Natural capital is the things obtained from the natural environment. Social capital is related to the relationship, networking, and co-operation among and between the members of the community Carney (1998).

Identifying these assets among the communities is very important because it provides an understanding of how communities are able to survive from forest resources especially edible wild mushrooms.

2.3 Value Chain of Edible Wild Mushroom

Kaplinsky and Morris (2000) defines value chain as a full range of activities which are required to bring a product or service from conception, through different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers and final disposal after use". These activities include designing, production, marketing and support to get the final product or service to the end consumers.

According to Gallman and Thomas (2012), value chain map shows the flow of products and services among the major actors from early supply of inputs and production up to consumption. It summarizes major value chain actors, enterprises (input suppliers) and value chain supporters. The value chain also illustrates the different market channels that a product passes before reaching the final consumers (Mesfin, 2012). Therefore, a value chain is an important tool use for identifying bottlenecks, as well as possible opportunities that may not be apparent otherwise. Mushroom value chain actors add value when the product passes from one actor to another. There are different actors in edible value chain includes the following

2.3.1 Traders

This group forms the middlemen of the chain; they get products from mushroom collectors and then sell to the final consumers without any modification of the product. Their main function is to facilitate the distribution of the mushroom products

(Fon *et al.*, 2013). The major actors in mushroom trade are categorized into collectors, suppliers and retailers. The activities of those actors are, collecting, sorting, packing and transporting to the next destination markets to either consumers or Supermarkets. Supermarkets tends to sell locally collected mushroom, their major activities are packaging, labeling and storing.

2.3.2 Processors

Processing is one of the mushroom value functions. According to Tibrichu and Buykusenge (2009), there is no special mushroom processing and packaging company to local and international market since mushroom sector is not well established. Rather, hotels, restaurants and cafeterias further process locally produced and imported mushroom into different dishes.

2.3.3 Consumers

Consumers are end users of mushroom in the value chain. Consumers purchase and use mushroom from producers, traders and processors (Getachew *et al.*, 2016). As in all products there is consumer preferences same applied to mushroom consumers, preferences in mushroom including color, shape, size while price influencing least. As color, shape and size of mushrooms represent the quality of mushroom it can be assumed that consumers preferred quality over price while purchasing mushrooms (Shirur *et al.*, 2014).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

This study conducted in Ruvuma Region, whereby two Districts Mbinga and Songea were covered. Ruvuma Region has an area of 63 670 km² and is located within the latitude of 10⁰ 45'00''S and between longitudes 35⁰ 40'00'' E. According to the Tanzania National Census, 2012, the population of Ruvuma Region is 1 376 891. Rainfall average in the area is 1169 mm per year.

The study area was selected since, its 65% of its forests it covered by miombo woodland (URT, 2010) which there is possibility of availability of abundant species of wild mushrooms since the miombo woodland provide high potential of producing indigenous mushrooms (Bloesch and Mbago, 2008). Mbinga and Songea districts were selected because are districts which its people engage more on edible wild mushroom activities. This study is very important to the area because it increase awareness about value chain of edible wild mushrooms as one of the forest resources and how people benefit from the forest resources.

3.2 Research Design

Proper design of a research work is important because it is helping researcher to carry out research smoothly and efficiently as possible (Kothari, 2002). This study was undertaken by using a cross sectional research design were data collected at single point in a time. Cross sectional research design has advantages of allowing direct observation by the researcher of the phenomena to be investigated, performing the information collection in a short time and produce faster result hence, it lower cost that other design (Raimundo *et al*, 2018).

3.3 Sampling Technique and Sample Size Determination

3.3.1 Socio-economic data

The study was undertaken in Mbinga and Songea districts where three villages from each district which are Litowa, Kikunja and Muhukuru-lilahi from Songea, Barabara, Kindimba Juu and Ndongosi from Mbinga District were purposive selected depending on population. The sampling frame of this study were actors involved in edible mushroom activities who are collectors, consumer and also two people from each village as key informants. The sample size of the study was determined according to Machumu (2008) whereby 30% of population engaged in edible wild mushroom activities was selected. List of actors who engaged in edible wild mushroom activities were prepared by chairman of each village and 30% of actors were selected as sample by systematic random sampling where every third individual from the list were selected.

Table 1: Sample size determination

Villages	No of people engaged in selling of edible wild mushroom	30% according to Machumu
Litowa	44	13
Kikunja	37	11
Muhukurulilahi	20	6
Total	101	30

3.3.2 Inventory data

Inventory for wild mushroom were conducted to identify species of wild mushroom. In every one ha a circular plot of 15 m radii was laid to collect required data as suggested by different authors (Munishi, 2015; Paudel and Mendal, 2019). The total sampled plots were six, one plot for each village. Sampling frame was the number of points where respondents usually go for collection of edible wild mushrooms in the forest. Respondents

were asked the total points that they are usually collecting edible wild mushroom. The researcher allocated numbers to the points, wrote the numbers in the separate pieces of paper, rolled it, and picked one at random. For each selected point, a circular plot of 15 m radius was laid down and the mushroom within it were examined for identification

3.4 Data Collection and Analysis by Objective

3.4.1 To identify types of wild mushroom available in the study areas

Researcher conducted inventory to identify types of wild mushrooms available in the study area. Inventory for wild mushroom was conducted so as to identify types of wild mushroom available including edible and non-edible wild mushroom, names, uses of the wild mushroom and weights were in each plot researcher picked available mushroom and its weight was measured. Researcher matched photograph picture taken during field observation with fungus books for identification, color, and other feature were used to guide identification process. Two people from each village as key informant assisted identification process in term of local names of mushroom species.

3.4.2 To map actors in edible wild mushroom value chain in the study areas

The actors along the chain were identified through the use of focus group discussion. 10 individuals from each village of different aged group were involved in focus group discussion. Focus group discussion involved five women and five men for each group and there was a checklist questions guided focus group discussion. Individuals for focus group discussion was expected to provide information on how actors participate in the edible wild mushroom activities from where she or he start and where she or he ended, the flow of product from one actor to another, their responsibilities and roles on value addition along the chain of wild edible mushroom, also types of wild mushrooms they know as edible, criteria for identification and its seasonality. All data collected was content

analyzed. The map illustrates the flow of edible wild mushroom from collectors to consumer was drawn.

3.4.3 To assess contribution of edible wild mushroom in livelihoods improvements in Mbinga and Songea districts

Data from actors involved in edible wild mushroom who were collectors, were collected on types of edible wild mushrooms they sell, quantity, price, and on how edible wild mushroom improve their livelihoods inform of financial capital, interview method was used to collect information includes how much they gain from edible wild mushrooms. Social capital respondents were interviewed on how edible wild mushroom contribute to social resources including, membership of groups, relationships of trust, access to wider institutions of society upon which people draw in pursuit of livelihoods. Human capital, information based on contribution of edible wild mushroom to the skills, knowledge, ability to labor and good health important to the ability to pursue different livelihood strategies will be collected from respondents through interview method. Physical capital, respondents were interviewed so as to get information on how edible wild mushroom contributes to the basic infrastructure includes transport, shelter, water, energy, and communications and the production equipment and means which enable people to pursue their livelihoods. Natural capital how individuals conserve forest in different ways.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Types of Wild Mushrooms Available in Songea and Mbinga Districts

Wild Mushroom are seasonal in different parts of Tanzania it's also observed in Ruvuma Region (Bloesch and Mbago, 2008), due to its seasonal nature not all species mentioned by respondents were found in the field. Individual do not collect edible wild mushrooms in different VLFR due to unavailability or just scanty availability. This is because mushrooms are influenced by type of vegetation cover which mostly of them is miombo woodland of natural occurrence as supported by Bloesch and Mbago (2008), Abdallah and Monela (2007). Consequently, individuals collect edible wild mushroom other random forest. Two people from each village as key informants guided researcher to the field and assisted identification process of the species in term of local names. Scientific identification was guided by Harkonen *et al.* (2003) to classify available species as edible or inedible and also for species which was unavailable during the survey due to its seasonality. Edible mushrooms were collected and weighted. The average weights per sample plot was 4.13 kg this means that, individuals are able to generate income of 4130 up to 10 325 Tanzanian Shillings (TZS) per plot.

Most of inedible mushroom species were unidentified by local names. This is because people concentrate on edible species, giving little attention on inedible (Chelela, 2014; Bloesch and Mbago, 2008). Table 1 shows local names and scientific names of wild mushrooms in the study area.

Table 2: Species of wild mushroom available in Ruvuma Region

SN	Scientific name	Local name(s)	Storage	SN	Non-edible
1	<i>Amanita loosii</i>	<i>Ulelema</i>	Boiled and dried by solar energy	24	<i>Lactarius gymnocarpoides</i>
2	<i>Russula Cellulata</i>	<i>Uhinda</i>	Boiled and dried by solar energy	25	<i>Amanita muscaria</i>
3	<i>Cantharellus isabellinus</i>		Dried by solar energy	26	<i>Amanita phalloides</i>
4	<i>Cantharellus symoensii</i>	<i>Unguyugu</i>			
5	<i>Boletus pallidissimus</i>	<i>Linodo</i>	Boiled and dried by solar energy	27	<i>Cyptotrampa asprata</i>
6	<i>Termitomyces letestui</i>	<i>Mkufu /ukulu/lukuhu</i>	No means of storage	28	<i>Lactarius kabansus</i>
7	<i>Afroboletus luteolus</i>	<i>Mandongo</i>	No means of storage	29	<i>Lacatius luteopus</i>
8	<i>Russula aff. roseovelata</i>	<i>Perepesu /perepeta</i>	Boiled and dried by solar energy	30	<i>Lactarius medusa</i>
9	<i>Lukolombi</i>	<i>Russula sp1</i>	Boiled and dried by solar energy	31	<i>Lactarius tanzanicus</i>
10	<i>Auricularia polytricha</i>	<i>Mangaukau</i>	Dried by solar energy	32	<i>Lactarius pumilus</i>
11	<i>Termitomyces microcarpus</i>	<i>Mapuli</i>	Dried by solar energy	33	<i>Lactarius xerampelinus</i>
12	<i>Coprinus cinereus</i>	<i>Urundi</i>	Dried by solar energy	34	<i>Lactarius volemoides</i>
13	<i>Russula congoana,</i>		No means of storage	35	<i>Macrolepiota dolichaulaboletus spectabilissimus</i>
14	<i>amanita mafingensis,</i>				
15	<i>amanita tanzanica,</i> <i>amanita masasiensis</i>	<i>Magongolo/jongoo</i>			
16	<i>Cantharellus platyphllus</i>	<i>Kalungeya</i>	No means of storage	36	<i>Lactarius heimii</i>
17	<i>Not found</i>	<i>Uyoga behe</i>	Dried by solar energy	37	<i>Lactarius densifolius</i>
18	<i>Lactarius gymnocarpoides</i> <i>lactarius edulis</i>	<i>Upowa</i>	Boiled and dried by solar energy	38	<i>Lactarius denigicans</i>
19					
20	<i>Agaricus cf campesh</i>	<i>Ngowo/nguo</i>	No means of storage	39	<i>Chlorophyllum molybdites</i>
21	<i>Polporus moluccensis,</i>		No means of storage	40	<i>Agaricus bingensis</i>
22	<i>Armillaria mellea sensu lato</i>	<i>Uyoga miti</i>		41	<i>Agaricus cf campestris</i>
23	<i>Termitomyces aurantiacus</i>	<i>Viqong'ongo</i>	Dried by solar energy		

4.2 Edible Wild Mushroom Value Chain

Wild mushrooms are seasonal through the year where in Ruvuma Region it occurs from November up to March during rainy season with different species, some of species occur early when it starts rain season other occurs during the rains and other occurs in the

ending of rains season, the same also reported by Adedokun and Okomadu (2017). Wild mushrooms found include both edible and inedible.

Mushroom collectors in Ruvuma locally use color, weight, smell, taste and evidence of some special flies and other wild animals feeding on the mushrooms to identify edible and inedible mushroom. The evidence includes bite marks on mushrooms. Traditionally, they believe that inedible mushroom has a unpleasant smell and weighty compared to edible ones. Also, inedible wild mushroom has sour taste. Moreover, inedible wild mushrooms are not eaten by any kind of flies and other insects as edible species does, as reported by Chelela *et al.* (2014), Adhikari *et al.* (2004).

None of these approaches is scientific, and thus identification by non-native individuals and researchers become difficult. Individuals use vernacular names example '*mangaukau*' which in English it means 'ears' which it may be difficult for those who are not familiar with species of wild mushrooms because some edible and inedible species are belonging to same family, for instance, '*Amanita loosii*' and '*Amanita Phalloides*'. This contradiction may lead to complications to other edible wild mushroom that can increase income to collectors but interpreted as inedible (Harkonen *et al.*, 2003; Adhikari *et al.*, 2004; Tibuhwa, 2013). Some respondents learnt and imitate to separate edible and inedible wild mushroom from their relatives like mother, grandparents and aunts (Chelela *et al.*, 2014; Adedokun and Okomadu, 2017) and thus they do not have any reason in their consideration.

Different researcher reported about consumption and selling edible wild mushrooms in different parts around the world (Christensen *et al.*, 2005) this also observed in Songea District where most people collect edible wild mushrooms not only for their consumption

but also for sale while in Mbinga, mushroom are mainly collected for consumption this is because in selected villages at Mbinga every person in the village has free access to edible wild mushroom that available in every part of village but also lacking improved transportation system to sell their wild mushroom at different markets located at town where demand is high. Short and simple value chain of edible wild mushroom activities observed in different parts of Songea District which involve two actors. Value chain begins with collection from forests, transportation to the homeplace by using different carrying tools including bamboo baskets and plastic buckets. Collection, transportation, cleaning, drying and storage activities in value chain are mostly practiced by women and children.

At homeplaces some portion of collected edible wild mushroom is divided for consumption, other portion for selling fresh while the remained amount is for drying. Two actors, collectors and consumers were found as also reported previously by Jahan and Singh (2019). Fig. 2 shows the map of product flow from one actor to another their role in edible wild mushrooms activities and value addition.

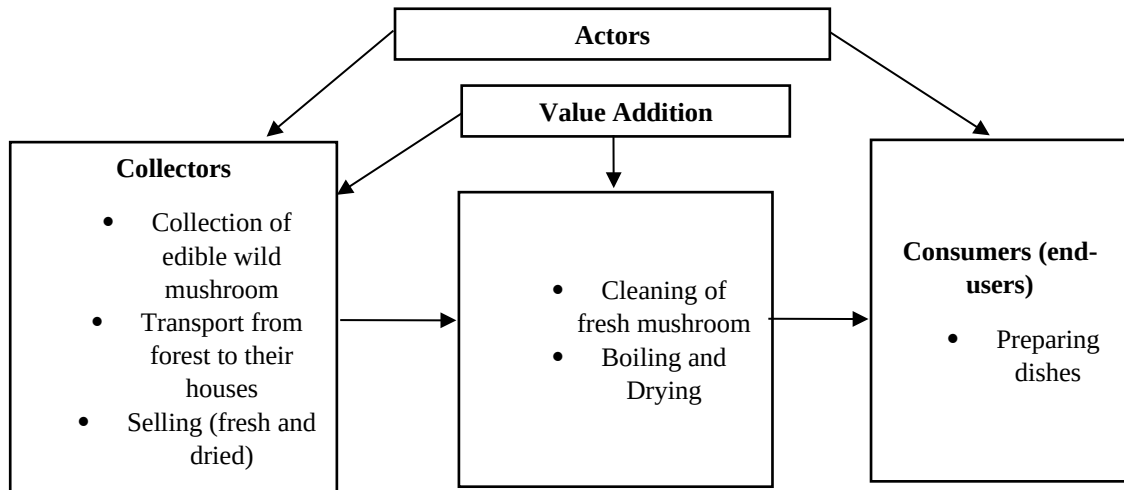


Figure 2: Value chain actors and their roles

4.2.1 Actors and value addition

Collectors

Collectors form the first actor in edible wild mushrooms value chain. They go to the forest to pick edible wild mushrooms and sell to the consumers. Their main activities are to collect edible wild mushrooms and sell, some of them sell either fresh or dried mushrooms and others sell both of them. In this first point of the chain, value is added to the collected edible wild mushrooms as they are cleaned and through drying since, when they are dried, it gives a long shelf life to edible wild mushrooms, even one to two years, where they can be sold during the season when there is a deficit of edible wild mushrooms. They are locally preserved by boiling followed by sun drying for some species, while others are just dried by solar energy without boiling. The same output is reported by Ngaga *et al.* (2006), Chelela *et al.* (2014), and Harkonen *et al.* (2003).

Consumers

This is the last actor in the edible wild mushrooms value chain, whose main role is to prepare dishes for their family depending on their preferences. Some of them adds oil, water, onions, tomatoes and salt while other may not add anything apart from salt and water. All these treatments add value to edible wild mushrooms since they are not using it as the way they got from collectors and can thus be termed as traditional value addition (Harkonen *et al.*, 2003).

4.3 Contribution of Edible Wild Mushroom to Livelihoods Improvement

4.3.1 Social capital

Mushroom value chain is dominated by female (73.3%) while (26.7%) counts for men (Fig 3). This is because, in Ruvuma Region main production activities is agriculture and practiced mainly by men. Women look for other activities to increase income for their families, one of the activities is selling vegetables and mushrooms (Ngaga *et al.*, 2006; Tibuhwa, 2013; Chelela *et al.*, 2014). Different age groups engaged in edible wild mushroom collection activities. Those engaged in the collections were 25 years age and maximum were 62 years old.

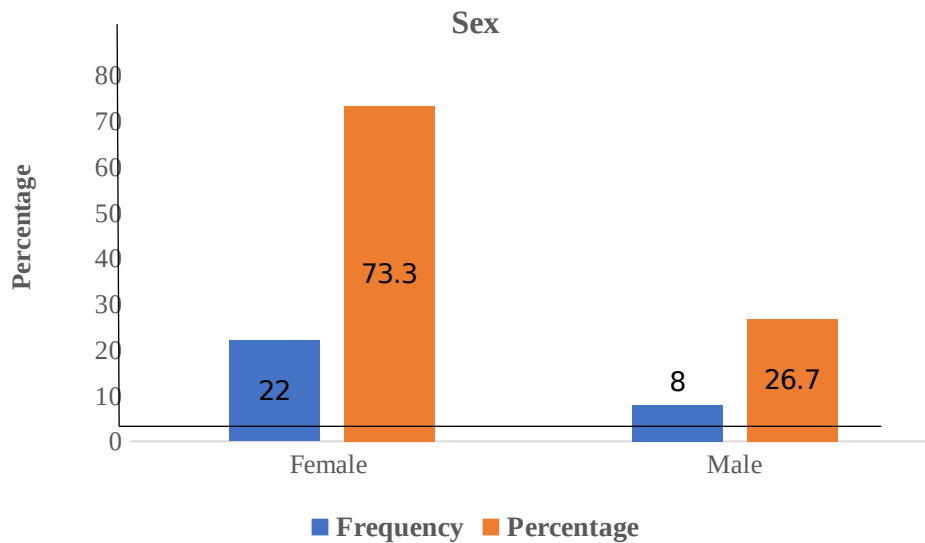


Figure 3: Involvement in edible wild mushroom activities

4.3.1.1 Mushroom species collection

The edible wild mushroom collection activities done one day up to seven days per week by collecting from one up to six species depending on the availability of species at the current time, preference of consumers, some of consumers have tendency of preferring some kind of species over others, and storage possibility since because boiling and solar drying does not work for all kind of species, so collectors tend to collect those species which can be preserved and those which are left behind in term of preservation are collected mostly for their own consumption (Apetorgbor *et al.*, 2005).

From Table 3, 29.7% collects *Amanita Loosii*, 26.4% *Russula Cellulata*, 18.7% *Cantharellus isabellinus*, 8.8% *Lactarius gymnocarpoides*, 6.6% *Cantharellus platyphllus*, 4.4% *Coprinus cinereus*, 4.4% *Boletus pallidissimus*, and 1.1% *Russula aff. Roseovelata*.

As respondent concluded that not all species collected are for sell but other are for household consumption due to consumer's preferences, respondents asked to rank the first up to last preferable species from one to three where one is high preferable, two medium preferable and three low preferable. *Termitomyces letestui*, *Amanita Loosii*, and *Cantharellus isabellinus* were ranked the first, *Russula Cellulata*, *Russula aff. roseovelata*, *Auricularia polytricha* were ranked second while *Coprinus cinereus*, *Boletus pallidissimus*, *Cantharellus platyphllus* and *Lactarius gymnocarpoides* ranked the third.

Table 2: Mushroom species collected

Mushroom species	Responses	
	N	Percentage
<i>Amanita Loosii</i>	27	29.7
<i>Russula Cellulata</i>	24	26.4
<i>Cantharellus isabellinus</i>	17	18.7
<i>Lactarius gymnocarpoides</i>	8	8.8
<i>Cantharellus platyphllus</i>	6	6.6
<i>Coprinus cinereus</i>	4	4.4
<i>Boletus pallidissimus</i>	4	4.4
<i>Russula aff. Roseovelata</i>	1	1.1
Total	91	100.0

4.3.1.2 Types of mushrooms sold

There are two kinds of edible wild mushrooms sold in Ruvuma Region in different markets which are dried mushrooms and fresh mushroom. About 60% of respondents sell fresh mushroom, 33.3, 6.7%, % sell both dried and fresh mushrooms and dried respectively (Table 3). The same reported by Chelela *et al.* (2014), Bloesch and Mbago (2008). In Ruvuma region it takes one day up to three to finish the collected edible wild mushroom, amount which remain after selling, it boiled and dried by solar energy for preservation (Ngaga *et al.*, 2006; Chelela *et al.*, 2014; Harkonen *et al.*, 2003).

Table 3: Types of mushrooms sold

Types of mushrooms	Frequency	Percentage
Fresh	18	60.0
Both (Fresh and Dried)	10	33.3
Dried	2	6.7
Total	30	100.0

4.3.1.3 Packaging tools

From Table 4, 40% of respondents use packaging tools (plastic bags) for the edible wild mushrooms they are selling. About 60% of respondents do not use any kind of packaging tools they only divide mushrooms in a bundle and waits for the customers to come with their carrying tools for mushrooms. All types of mushrooms, packed and unpacked are sold at the same price. In different markets around the world, edible wild mushroom had been reported to be sold either loose or packed in different tools like plastic films (Jahan and Singh, 2019).

Table 4: Packaging tools

Packaging	Frequency	Percentage
No	18	60.0
Yes	12	40.0
Total	30	100.0

4.3.1.4 Selling place

In selected six villages at Ruvuma Region, edible wild mushrooms are sold at different two places which are markets where collectors take their collected edible wild mushroom to the market this accounts for 33.3%. some sell at their home place by door to door while sometimes consumer tend to go for the edible wild mushrooms for themselves at collector's houses and account for 66.7% (Table 5) where main customers are end users.

For those who sell their edible wild mushrooms in different markets said that there is availability of transportation means to the selling point where the most used transport is motorcycle. Many people are interested to sell their collected edible wild mushroom town in different markets but they are lacking transportation means. In different parts of Tanzania, edible wild mushrooms tend to be sold at markets and homes by door to door but also along the road (Dougill *et al.*, 2013; Chelela *et al.*, 2014; Tibuhwa, 2013).

Table 5: Selling place of edible wild mushroom

Selling place	Frequency	Percentage
Home place	20	66.7
Market	10	33.3
Total	30	100.0

4.3.1.5 Organization membership

50% (Table 6) of respondents had membership of different organization including Non-Governmental Organizations (NGO's) and different cooperative organization while 50.0% belonged to none. Being in different social organization means that they gain trust from their surrounding society and they can have contribution when it comes to community development (Rudd, 2000).

Table 6: Organization membership

Organization membership	Frequency	Percentage
Yes	15	50.0
No	15	50.0
Total	30	100.0

4.3.1.6 Money borrowing

Edible wild mushroom collectors were also able borrowing money from different people surrounding them for the different purpose. Respondents borrowing from 2000 TZS up to 100 000 TZS. The main source is from community organization and other source which were neighbors and cooperative society, the same about financial support also reported by Apetorgbor *et al.* (2005). By selling edible wild mushroom they are trusted by their surrounding society but also, they ensure themselves that if there is any emergency, they can be able to borrow money from other people and be able to return the loan after selling their products.

From the Table 7 below, 36.7% of respondent had a tendency of borrowing money while 63.3% they are not borrowing money. Respondent who has tendency of borrowing money they said they are able to return the money for one night up to month.

Table 7: Money borrowing

Money borrowing	Frequency	Percentage
No	19	63.3
Yes	11	36.7
Total	30	100.0

4.3.1.7 Purpose of taking loan

Different edible wild mushroom collectors take loan or borrow money from other people for different purposes. As shown in the Table 8, 27.3% borrow money for health care, 18.2% purchasing household assets while 54.5% for buying agriculture equipment and were able to return the loan within a month. Edible wild mushroom activities contribute to income generation which can help individual to be able to buy different assets and to get different services but also boost other economic activities such as agriculture where can

contribute to improve standard of life. Contribution of wild mushroom collection to livelihood also reported by Chen (2004), Wang and Hall (2004).

Table 8: Purposes of loan taken

Purpose of taking loan	Frequency	Percentage
Buying agricultural equipment	6	54.5
Health care	3	27.3
Purchasing household assets	2	18.2
Total	11	100.0

4.3.2 Financial capital

4.3.2.1 Edible wild mushroom collection and income generation

In the study areas, individuals collect edible wild mushroom in a range of about 2-35 kg per week. The collected amount differs from one person to another depending on the collection frequency per week. The price per kilogram of mushroom ranges from 1000 to 2500 TZS for fresh mushroom while 10 000 to 12 000 TZS for dried mushroom depending on species. Dried mushrooms are commonly sold in the season where there is unavailability of mushroom in the forest. This is the reason price of dried mushroom per one kg is high compared to fresh mushroom. In table (9) shows that collection of wild food especially mushroom provide income to individuals since in study areas individual are able to generate income of 40 000 up to 1 750 000 TZS for fresh mushroom while 100 000 up to 2 100 000 for dried mushroom per season as highlighted by Subedi (2001), Chen (2004), Degreef *et al.* (2016).

Table 9: Income generated for fresh and dried mushroom in TZS/season

	Fresh mushroom			Dried mushroom		
	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Collection of edible wild mushroom in kg/week	2	35	18.5	0.5	8.75	4.625
Price of mushroom in TZS/kg	1 000	2 500	1 750	10 000	12 000	6 500
Total income generated in TZS/season	40 000	1 750 000	895 000	100 000	2 100 000	1 100 000

4.3.2.2 Money saving

Table 10 below shows that 63.3% of respondent are able to save money obtain from the selling of edible wild mushroom while 36.7% do not save money after selling products. Those who save their money are saving daily while others save per week, this means that collection of wild mushrooms provide amount of money which can be used for different purpose and may be able the remains to be saved for future use (Dougill *et al.*, 2013; Tibuhwa, 2016).

Table 10: Saving Money obtained from selling edible wild mushroom

Saving Money	Frequency	Percentage
Yes	19	63.3
No	11	36.7
Total	30	100.0

4.3.2.3 Reasons for saving

The collection of edible wild mushroom provide amount of money which can satisfy the needs of individual also remain for saving for future use, respondent said that they are

able to save from 5000 up to 300 000 TZS, Table 11 shows the reasons why individual decide to save money, 78.9% are able to save money for the family security where the money can be used when there emergency to be solved, 15.8% they save money so that they can be able to take care of old age while 3.3% save money so that they can buy different assets like furniture, the same output reported by Apetorgbor *et al.* (2005).

Table 11: Reasons for saving

Reasons for saving	Frequency	Percentage
Family security	15	78.9
Taking care of old age	3	15.8
Bought assets	1	5.3
Total	19	100.0

4.3.2.4 Means of money saving

In Songea and Mbinga districts especially in different villages, financial services like bank are poor since only 21.1% of respondents save their money to commercial banks while others save their money to local cash box and VICOBA which counts for 36.8% and 42.1% respectively (Table 12). Some available ways of saving money like local cash box are not safe way as money can be stolen (Muganda, 2016).

Table 12: Means of money saving

Means of money saving	Frequency	Percentage
VICOBA	8	42.1
Local cash box	7	36.8
Commercial banks	4	21.1
Total	19	100.0

4.3.3 Human capital

People engaged in edible wild mushrooms activities are able to take care of their family of minimum 2 and maximum 9 members. This means that, engaging in collection of wild

food individuals are able to provide different human needs to his or her family (Ngaga *et al.*, 2006). Table 13 shows that 10.0% of respondents gained the knowledge they have regarding edible wild mushrooms from their neighbors while 90.0% gained from relatives including mother, grandparents. This means that the knowledge is transferred from generation to generation which may lead to collection of wild food including edible mushroom to be practiced from generation up to coming generations, as reported previously Chelela *et al.* (2014), Adedokun and Okomadu (2017). Also, all respondents agreed that they didn't receive any kind of training about edible wild mushroom, this may lead to limited information regarding edible wild mushroom.

Table 13: Source of knowledge

Source of knowledge	Frequency	Percentage
Relatives	27	90.0
Neighbors	3	10.0
Total	30	100.0

4.3.4 Physical capital

4.3.4.1 House ownership

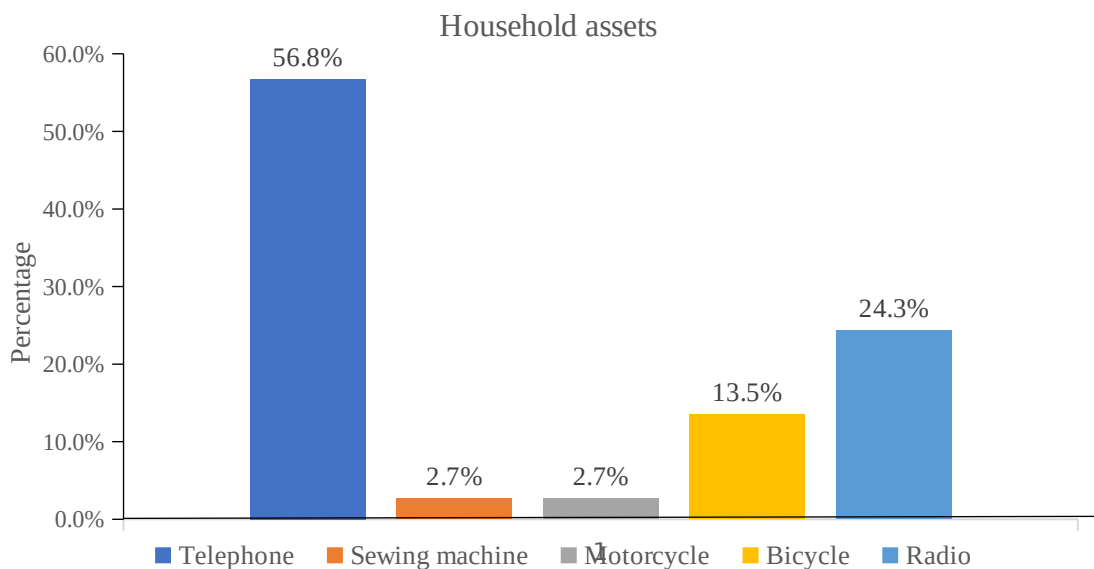
By engaging in different edible wild mushroom can increase economic generation so can improve livelihood of individual involved in those activities. Table 14 below shows that 93.3% of respondent own houses as among of human needs, 3.3% rent while 3.3% staying at free houses. This means that money from selling edible wild mushroom can enable individuals to own houses but also to pay house rent, similar to this also reported by Dougill *et al.* (2013).

Table 14: House ownership

House ownership	Frequency	Percentage
Owned	28	93.3
Rented	1	3.3
Free use	1	3.3
Total	30	100.0

4.3.4.2 Household assets

Edible wild mushroom activities also enable individual to increase their income which can help them to own different household assets, this means these activities contribute to better standard of living. Fig 4 shows that 56.8% are able to own telephones, 24.3% radio, 13.5% bicycle, 2.7% motorcycle while 2.7% sewing machine. This means that by engaging in these activities can lead to many benefits including owning different house assets this also testified by Dougill *et al.* (2013).

**Figure 4: Assets owned by individuals**

4.3.4.3 Accessibility of essential services

In different parts of the world, collection of wild food such as edible mushrooms generate income to individual. This ensure them to access different services which are very important to their lives. As observed in Ruvuma Region, individuals who engaged in edible wild mushroom activities are able to access service like education and health as shown in Table 15 below where, 63.6% of respondents access education services for their children where they are able to buy pen, uniform, exercise book and related issue while 36.4% respondent access medical services like treatment, medicine and different related issue the same reported by Apetorgbor and Mamun (2005).

Table 15: Access to essential services

Accessibility of essential services	Responses	
	N	Percentage
Education	28	63.6
Medical facility	16	36.4
Total	44	100.0

4.3.5 Natural capital

In order to ensure collection of edible wild mushroom exist generation to generation so as to improve livelihood of individuals, there is huge need of conserving forests. In Ruvuma Region individual are able to conserve forest for future generation by different ways as shown in Table 16. About 50.0% conserve forest by avoiding deforestation while 50.0% by avoiding forest burning. The similar ways reported by Subedi (2001).

Table 16: Means of forest conservation

Forest conservation means	Responses	
	N	Percentage
Avoid deforestation	22	50.0
Avoid forest burning	22	50.0
Total	44	100.0

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The study assessed edible wild mushroom value chain and its contribution to livelihoods improvement. The findings show that wild mushrooms occur during the rainy season which is November up to March. Individuals use color, weight, smell, taste and evidence of insects and other wild animals feeding on wild mushroom. Individuals do not have other reasons for classification and identification of wild mushroom as they didn't receive any kind of official training regarding wild mushroom. Rather than knowledge learnt from their relatives and neighbors accounts for 90.0% and 10.0% respectively to separate edible wild mushroom from inedible mushrooms. Also, using vernacular name for species of mushroom and most of people concentrate on edible wild mushroom and give little attention to poisonous species as result to unknown local names for inedible wild mushrooms.

Based on the study, findings show that there are two main value chain actors for edible wild mushroom who are collectors (seller) and consumer and their roles are collecting, selling and consuming. The study has shown that collection of wild foods especially edible wild mushrooms is dominated by large number of women accounting for 73.3% compared to men 26.7%. The study shows that collection of edible wild mushroom activities done one day up to seven days per week and individuals collect one species up to six species. Individual sells different types of edible wild mushrooms which are fresh and dried but others sell both accounting for 60.0%, 6.7% and 33.3% respectively. The most selling place is home and markets which accounts for 66.7% and 33.3% respectively.

The findings revealed that edible wild mushrooms can contribute to livelihood improvement this is because edible wild mushroom activities create job opportunities to an individual which provide money for them so as to be able to provide themselves with requirement they need. The findings indicated that individual collect 2-35 kg per week and are able to generate 4 0000 up to 1 750 000 TZS for fresh mushroom while 100 000 up to 2 100 000 for dried mushroom per season. Money obtained from selling edible wild mushrooms individual are able to save and also use for different purpose, respondents save money so as to ensure family security, take care of old age and buying household assets as shown in the finding 78.9%, 15.8%, 5.3% respectively.

Individual engaged in edible wild mushroom activities are able to get loan from different source which able them to use it for different purpose like buying agriculture equipment 54.5%, health care 27.3% and purchasing household assets 18.2% and due to the income of edible wild mushroom they are able to return the loan from one night up to month. Also, through income gained from edible wild mushrooms, individuals are able to access different service like education services and medical facility account for 63.6%. and 36.4% respectively, and are able to own different assets like telephone 56.8%, radio 24,3%, bicycle 13.5%, motorcycle 2.7% and sewing machine 2.7%. To ensure that edible wild mushroom exist generation to generation individual ensure conservation of forest by practicing different ways like avoiding deforestation 50.0% and avoiding forest burning 50.0%.

5.2 Recommendations

Based on conclusions made, the study recommends the following,

(i) Preservation method

Different research needs to be conducted on proper preservation method for the collected mushroom. This will help to ensure that mushroom once collected are uniformly stored throughout all collectors for marketability purpose. As the study found not all edible wild mushroom species are able to be preserved by boiling followed by sun drying this means, contribution of edible wild mushroom for some species are not sufficiently accounted as mostly of them used for consumption than selling as they lack specific preservation methods.

(ii) Coordination of edible wild mushroom actors

Government at all level need to coordinate mushroom collectors together to ease finding solutions to some challenges. There is a need for registering actors involved in mushroom value chain so that they can be facilitated and have access to financial support and infrastructural connectivity among actors. But also, easy for them to be accessed in terms of challenges facing them and opportunities so as to ensure actors are working under conducive environment.

(iii) Education provision

Government and different NGOs are encouraged to provide education to mushroom actors on the proper ways of mushroom identification and classification. This is because, local communities use traditional ways to classify edible and non-edible mushrooms. Consequently, some edible mushrooms in one area are considered inedible and in the other way, leading to losing some values and utilities.

(vi) Infrastructure's improvement

Different stakeholders including governmental and non-governmental should invest on transportation facilities and networks from collection centers to the market where collectors will be able to sell at different markets where the demand is high and at high profit compared to their local areas. Shortage of proper transportation networks and facilities to connect collection points and market place makes individuals who collect mushroom to sell them at a lower price and sometime not selling at all regardless of the available high demand in market centers.

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APPENDICES

Appendix 1: Questionnaire for collectors

Part One: Respondent Profile (Please tick when appropriate)

Village

Sex

Age

Activity.....

1. How many times you collect edible wild mushroom per week?

.....

2. How many types of edible wild mushroom you collect?

.....

3. Mention them

i.

ii.

4. Why you sell those types of edible wild mushroom?

i.

ii.

5. Do you sell fresh edible wild mushroom or dried mushroom?

.....

6. Do you pack your edible wild mushroom for selling?

i. Yes () ii. No ()

7. If yes above, which kind of packaging tool you are using?

i.

- 8. If yes 6) where are the source of packaging tools
 - i. Buying ()
 - ii. Lending ()

- 9. From where do you sell edible wild mushroom you collect?
 - i. Market ()
 - ii. Home ()
 - iii. Along the road ()

- 10. If i) and ii) above, there is any transportation means to the selling area?
 - i. Yes ()
 - ii. No ()

- 11. If yes above mention two transportation means
 - i.
 - ii.

- 12. It takes you how many days to finish edible wild mushroom that have been collected?
 - i.

- 13. Amount which remains, how you preserve them for another day?
 - i.
 - ii.

Part two: Contribution of edible wild mushroom for livelihood improvements

Financial Capital

- 14. How many kilogram you collect per week?
.....

- 15. How much you sell fresh mushroom per kilogram
.....

- 16. How much you sell dried mushroom per kg?
.....

- 17. Who are your main customer?

- i. Wholesalers () ii. Retailers () iii. Processors () iv. End-users ()
- 17. Do you save money obtained from selling edible wild mushrooms?
 - i. Yes () ii. No ()
- 18. If yes, how often do you save money?
 - i. Daily () ii. Weekly () iii. Monthly () iv. Yearly () v. No specific time ()
- 19. Why do you save money?
 - i. Family security () ii. Takes care of old age () iii. Bought asset () iv. Others (specify)
- 20. Where do you save money?
 - i. Commercial Banks () ii. Local cashbox () iii. Others (specify)
- 21. How much is your household's savings exactly?

Social Capital:

- 22. Are you a member of any organization?
 - i. Yes () ii. No ()
- 23. If yes, which type of organization?
 - i. NGO () ii. Voluntary organization () iii. Cooperative organization ()
 - iv. Govt. org () v. Club () vi. School Committee ()
 - ii. Religious Committee ()
- 24. Have you or the members of your household borrowed money?
 - i. Yes () ii. No ()
- 25. When was the last time to borrow money?
- 26. State the sources of borrowing

Sources	Yes	No	Sources	Yes	No
Private bank			Friends and relatives		
Government Bank			Local trade union		
NGO			Community Organization		
Cooperative Society			Other (specify)		
Money lender					

27. What is the amount of loan that you have taken.....?

28. How did you make repayment?

i. Weekly () ii. Fortnightly () iii. Monthly () iv. Yearly () v. No ()

29. State the purpose of taking loan

Purpose of taking loan	Yes	No	Purpose of taking loan	Yes	No
Health care			Buying land		
Festivals/social obligations			Buying livestock		
Paying dowry			Buying agricultural equipment		
Purchasing household asset			Housing		
Children education			Repayment of old loan		

Human capital

30. How many household members do you have?

31. How did you obtain knowledge and experience about edible wild mushroom activities?

i. Neighbors () ii. Friends () iii. Relatives () iv. NGO () v. TFS expertise (Govt.) ()

32. Do you receive any training regarding edible wild mushroom?

i. Yes () ii. No ()

Physical Capital

33. House ownership

- i. Owned () ii. Rented () iii. Free use ()

34. Housing material used

- i. Low (made of bamboo, paddy straw, jute stick, leaves, Mud, etc.) ()
 ii. Medium (made of wood or galvanized metal) ()
 iii. High (made of blocks and galvanized roof) ()

35. What household asset do you own/have?

Items	Yes	No	Items	Yes	No
Telephone/mobile			Four wheelers		
Sewing machine			Motorcycle		
Electric fan			Bicycle		
Refrigerator			Cassette player		
Television					
DVD player					
Radio					

36. Accessibility of the following facilities

Facility	Yes	No
Medical facility		
Electricity supply		
Postal service		
Education		
Banking facility		

37. How do you conserve forest so as to ensure you benefits from it for the next time?

.....

Appendix 2: Focus group discussion questions

1. How you can separate those which are edible and those which are not
2. Where do you learn to separate those kinds of wild mushroom?
3. Are edible wild mushrooms seasonal?
4. If yes above how many seasons that there is availability of edible wild mushroom
5. Mention them
6. What are the stages of edible wild mushroom value chain?
7. Who are the main actors in edible wild mushroom value chain?
8. What are the roles of each actor?
9. There are any supporters of edible wild mushroom value chain?
10. If yes above, who are they?
11. What are the roles of each actor?