

# Using Edible Tubers, Root and Bulbs as Drivers of Community Based Natural Resource Management in Zambia

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## Abstract

The forests offer various ecosystem services which the local communities depend on such as construction raw materials, medicine and indigenous food crops. Despite increasing knowledge on forest foods in southern Africa, little is known on edible tubers, roots and bulbs. Tubers, roots and bulbs such as *Dioscorea hittifolia* (busala), *Rhychosa* (mukoyo), *Satyrium atherstonei* (chikanda) and *Plectranthus esculentus* (imyumbu) have been used as major traditional wild food crop from ancient times in Zambia. This study was carried out in the central part of Zambia to determine the contribution of these edible tubers, roots and bulbs to community well-being and conservation of biodiversity in both forest and wetland areas. A total of 150 local community members were involved in interviews using semi-structured questionnaires and three focus group discussions. The study revealed that edible tubers and bulbs have the potential to contribute economically to the wellbeing of the local communities. Additionally, the study showed that these tubers and bulbs have the potential to be used as a tool for diversity conservation. Although the contribution of the tubers and bulbs is not at full potential, with public private partnership, they have the potential to contribute to both income generation and conservation of biodiversity especially if their value chains are developed and other management prescriptions are employed. Local communities can only realise enough benefits if issues of domestication, propagation, packaging and marketing are addressed. With the full potential of the edible tubers and bulbs, the attention on forest resource exploitation especially vices such as charcoal manufacturing and clearing of forest areas which are the major factors fostering deforestation and forest degradation will be diverted. Tubers and bulbs are important to the communities as they are a source of income; while to the ecosystem, tubers and bulbs save other forest components such as trees by reducing pressure from unsustainable harvest.

## Keywords

Edible Tubers and Bulbs, Non-wood Forest Products, Food Security, Biodiversity Conservation

## 1. Introduction

Ecosystems goods and services have been imperative to rural livelihoods since the history of human beings, thus different products such as food and medicine have a long history in rural livelihood (Kanungwe *et al.* 2013). To date, local communities adjacent to the forest and wetland areas use the forest resources in their day to day life in different ways which range from being a source of energy to a source of food. According to the Millennium Development Goals (MDG) report of 2005, more than 70 percent of Zambia's population use solid fuel in form of fire wood and charcoal for energy

(GRZ, 2005). In addition, the local community depends on the trees for construction of houses and animal shelters. On a bigger picture, the forest and wetlands provide the local population with food, medicines and other useful goods and services.

The forest sector in Zambia and many tropical countries is faced with a number of challenges; the prominent challenges being forest degradation and deforestation. According to Chidumayo (2009) more than 200, 000 to 300, 000 ha of forest cover is lost annually. The key drivers of deforestation are mainly land clearing for agriculture, wood extraction for energy, and uncontrolled bush fires. Syampungani *et al.* (2009) reported that two factors may be attributed to the rapid decline

in the forest sector in Zambia. Firstly, demand for fuel wood and charcoal has increased due to the relatively high cost of electricity and petroleum-based fuels as well as rapid human growth, particularly in urban areas. Secondly, there is increasing pressure on the woodlands arising from rapid human growth, particularly in urban areas. Beside these and many other challenges, there are still other non-wood forest products such as edible tubers and bulbs found in forest and wetland areas which have the potential to contribute to both community and biodiversity conservation (FAO, 2003; Vinya *et al.* 2011).

Tubers and bulbs such as *Dioscorea hittifolia* (busala), *Rhychosa* (mukoyo), *Satyria* (chikanda) and *Plectranthus esculentus* (imumbu) have been used as major traditional wild food crop, however, their current distribution, quantities and economic contribution is unknown and not documented in Zambia. These tubers and bulbs have direct and indirect benefits to the local communities and to the forest ecosystem at large. Additionally tubers and bulbs such as orchids are used as important medicine in most African community as indicated by Musharof Hossain (2011) below.

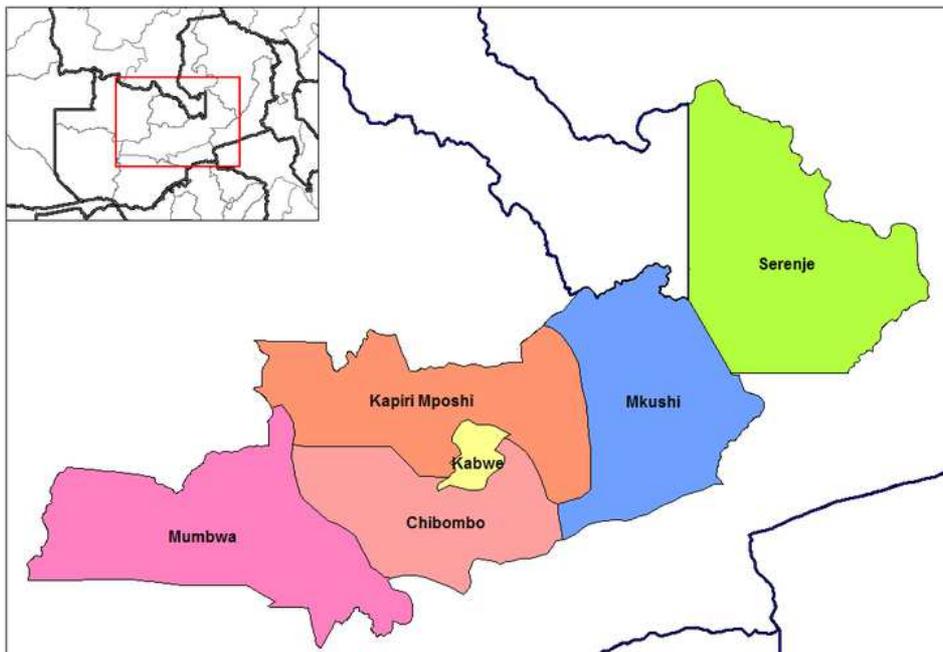
*“...Orchids have been used as a source of medicine for millennia to treat different diseases and ailments including tuberculosis, paralysis, stomach disorders, chest pain, arthritis, syphilis, jaundice, cholera, acidity, eczema, tumour, piles, boils, inflammations, menstrual disorder, spermatorrhea, leucoderma, diarrhoea, muscular pain, blood dysentery, hepatitis, dyspepsia, bone fractures, rheumatism, asthma, malaria, earache, sexually transmitted diseases, wounds and sores. Besides, many orchidaceous preparations are used as emetic, purgative, aphrodisiac, vermifuge, bronchodilator, sex stimulator, contraceptive, cooling agent and remedies in scorpion sting and snake bite....”*

As earlier mentioned, the communities consider these items as food and medicines (Ndangalasi *et al.* 2007; Kanungwe *et al.*, 2013; Van Wyk, 2011) while to the ecosystem, tubers and bulbs save other forest components such as trees by reducing pressure from unsustainable harvest. To be more exact, the communities that have lost such resources tend to concentrate solely on forest products such as charcoal and hence contribute to deforestation and forest degradation. It is from this background that this paper will focus on the role of these edible tuber and bulbs as a means of livelihood and the contribution towards biodiversity conservation in forest and wetland areas. Furthermore, this paper looks at possible techniques which can be used to enhance rural livelihood and forest conservation while complimenting the tubers and bulbs.

## 2. Material and Methods

### 2.1. Site Description

The study was conducted in Central Province which is one of Zambia’s ten provinces and is geographically located at 14° 32' 0" South and 28° 8' 0" East. The province is divided into six administrative districts; Kabwe, Chibombo, Mumbwa, Serenje, Kapiri-Mposhi and Mkushi of these, Kabwe, Kapiri-Mposhi and Mkushi were the study areas (Fig. 1). This study was done under the “Edible tubers and bulbs project” in the Central Province of Zambia. The total number of project implementation groups were five; one in Kabwe, two in Kapiri-Mposhi and two in Mkushi. Central Province is rich in natural resources as it has several National Parks, swamps, forest reserves, mountains and valleys. The area is dominated by Miombo woodlands and the local people are mainly subsistent farmers (Chidumayo, 2012).



**Fig. 1.** Location of the three districts (Kabwe, Mkushi and Kapiri-Mposhi) in Central Province of Zambia.

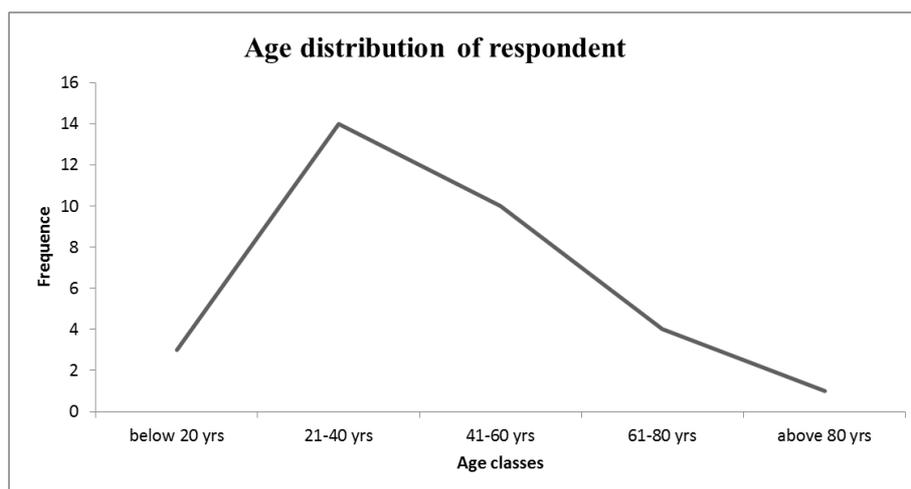


Fig. 2. Age distribution of respondents in the three project areas in Central Province of Zambia.



Fig. 3. Example of an edible tuber *Dioscorea hittifolia* (a) in the study areas, and cultivated edible tubers (b).

## 2.2. Social Economic Survey and Focus Group Discussion

In order to uncover more information relating to the edible crops (tubers and bulbs), questionnaires and focus group discussions were used in the study areas. The questionnaires were intended for the head of households and adults (18 years and above) and focused on topics such as the value chain of edible tubers and bulbs i.e., from the harvesting and marketing. Additionally, focus group discussions with key informants such as project local committee members and Forestry Department members of staff were used to discuss the policies and the interaction of the communities under different projects which had similar objectives. A total of 150 questionnaires were administered i.e., 50 questionnaires to each district. A focus group discussion was conducted in each district bringing together the community members, traditional leaders and government officers from the forest department.

## 2.3. Data Analysis

Data obtained from focus group discussion (FGD) and key informants was synthesised while that obtained from household interviews was coded and analysed using the Statistical Package for Social Sciences (SPSS) Version 17.

Several statistical approaches were used starting with descriptive statistical analysis then an analysis of such as descriptive analysis and chi-square were used to obtain an in-depth understanding of the data.

## 3. Results

### 3.1. Demographic Profile of the of the Study Area

The administered questionnaires indicated that of all the respondents, 48% were male and 52 % were female. The majority (45%) of these were between the age of 20 and 40 years while only 3% were above the age of 80 years (Fig. 2). In terms of education and literacy levels, many (40%) of the respondents attended primary school while very few (3%) people attend tertiary education.

The size of most of the households in the study area was between 5 and 10 people. About 53% of the households were in this category while few families were large in size (above 20 years). Only 10% of the households were above 20 people per family while 37% were between 1 and 5 people per family. Eight six percent (86%) of the families were headed by a male while 14% were headed by females. Among the heads of households, 96 % were not working while only 4% were

working in an informal sector. Considering marital status, the majority of the respondents (70%) were married while only less than 5 % were single. Few people were divorced and widowed as the respondents indicated that less than 15 % experienced these situation.

Farming is the major economic activity in the study area. According to the respondents more than 80% of the people are involved in farming directly and indirectly. The major crops grown are maize (77%), groundnuts (10%), sweet potatoes (5%) and other crops (8%). Most of the crops are consumed at domestic level while maize is sold to the Food Reserve Agency (FRA). The local community were also involved in irrigation (gardening) near the streams and dambos where there are growing different vegetables and many others crops.

**3.2. Edible, Tubers and Bulbs in Natural Resource Management**

The majority of the respondents (86%) indicated that they have access to the edible tubers and bulbs as they are collected from the wetlands near the villages. The most common of these crops were *Satyrrium atherstonei* locally called ‘Chikanda’ while *Plectranthus esculentus* (Fig. 3) is cultivated in the wetlands. Seventy eight percent (78%) of the respondents indicated that females are the most involved in the collection of these edible tubers and bulbs. When asked about the trading of these edible crops, the majority of the respondents indicated that they are mostly collected for home consumption, however, when the quantities are large enough, these are transported for sell in nearby road sides and then to

the major towns.

The major challenges in the value chain of these edible tubers and bulbs were processing, transportation and established markets. Sixty four percent (64%) of the respondents indicated that they earn income from these crops; however, they are usually in small quantities hence the need for domestication and commercialization. Furthermore the respondents indicated that they prefer dealing with these crops than charcoal production because of the extensive labour in the latter and the restriction from the forest department on charcoal manufacturing.

**3.3. Other Activities Enhancing Forest Conservation**

Edible tubers and bulbs are an important tool as they contribute to the wellbeing of the local community, however the contribution cannot be significant especially dual to the small quantity produced (collected) and the markets which are not fully established. It was clear from the focus group discussion that other complimenting programs should be running side by side in order to enhance forest conservation and community wellbeing. As a result of this, strategic management prescriptions were proposed. Agroforestry, establishment of woodlots, aquaculture and gardening were some of the programs prosed. These programs were proposed specifically for forest or wetland depending on how well they can perform. For instance, aquaculture was proposed for wetlands while establishment of woodlots and agroforestry was proposed for deforested area (Table 1).

*Table 1. Forest and wetland management programs to enhance edible tubers and bulbs in the management of Forest resources and contributing to Socio-economic development.*

Prescription/ Intervention	Objectives	Targets	Actions	Responsible
<b>FOREST RESOURCE MANAGEMENT</b>				
Management Objective No. 1: To promote the establishment and sustainable management of the forest resources				
Establishment of Woodlots	To increase the area under forest in the project areas	Household	Identification of individual household participating in the SNR-FD IEF project.	Forest Department (FD) and Households
	To promote forest establishment		Inventorying the actual sizes of land that each household own.	
Introduction of Beekeeping	To ensure continuous supply of fuel wood and poles	Household	Negotiating with the farm owners on how much of their agricultural land they may leave for the establishment of woodlots	FD and Community members
	To train small scale farmers on woodlot establishment and participatory forest resource assessment		Supporting those who have already reserved part of their land for forest regeneration.	
	To promote forest protection		Production of a participatory forest resources assessment manual for the communities	
	To enhance household income		Training of all the participating households in basic participatory forest resources assessment, record keeping and management	
	To train community members in beekeeping		Zoning of the farmland into various uses	
	To encourage community members to incorporate beekeeping in their current farming activities		Regular monitoring of the status of the forests within the project areas	
			Identification of areas where beekeeping can be started	
			Negotiating and encouraging farm owners especially those who have woodlots to start beekeeping	
			Supporting those who have already reserved part of their land for forest in beekeeping activities.	
			Production of a beekeeping manual for the participating communities	
			Training of all the participating households in basic beekeeping	
			Supporting participating communities with basic beekeeping	

Prescription/ Intervention	Objectives	Targets	Actions	Responsible
<b>FOREST RESOURCE MANAGEMENT</b>				
Introduction of Agroforestry	To intensify crop yield per hectare	Household/ Community	equipment Zoning of beekeeping areas	FD and Households
	To reduce the use of inorganic fertilizer		Identification of individual household participating in the SNR-FD IEF project.	
Forest Fire Management	To improve soil fertility	Household/ Community	Production of agroforestry training manual for small scale farmers	FD and Community members
	To contribute to climate change management		Training of community members in agroforestry	
Forest Fire Management	To prevent occurrence of late fires in the project areas	Household/ Community	Supporting all participating community members with agroforestry tree species and other incentives.	FD and Community members
	To sensitize the community members on the importance of controlling late fires		Regular monitoring of the progress on adoption of agroforestry practices by participating members	
Forest Fire Management	To train community members on basic forest and wetland fire management	Household/ Community	Conduct prescriptive and early burning	FD and Community members
			Establishment of basic fire breaks	
			Training in basic forest fire management	
			Support the communities on basic forest fire equipment	
			Sensitization of the members of the communities including those not participating in the project	
			Establishment of procedures and rules concerning burning of the forests in the areas involved	
<b>WETLAND RESOURCE MANAGEMENT</b>				
Controlled subsistence agriculture	To protect and conserve wetlands	Household/ Community	Zoning of areas (gardening general cultivation, grazing and water collection points)	FD and Community members
	To manage cultivation activities within the wetland		Negotiating and encouraging communities to participate in the conservation and protection of the wetlands in the area	
Wetland fire management	To protect biodiversity within the wetland	Household/ Community	Production of a wetland resource management manual for the participating communities	Community members
	To train community members on sustainable management of wetland resources		Training of all the participating households in basic wetland resources assessment and management	
Wetland fire management	To prevent occurrence of late fires in the project areas	Household/ Community	Encouraging communities to cultivate crops that are suitable for wetland	Community members
	To sensitize the community members on the importance of controlling late fires		Conduct prescriptive and early burning in the wetlands	
Wetland fire management	To train community members on basic forest and wetland fire management	Household/ Community	Training in basic wetland fire management	Community members
			Support the communities on basic wetland fire equipment	
			Sensitization of the members of the communities including those not participating in the project	
			Establishment of procedures and rules concerning burning of the wetlands in the areas involved	
Promotion of aquaculture	To contribute to income generation for the communities	Participating household	Identification of households to participate in aquaculture	FD and Community members
	To train communities in aquaculture activities		Production of aquaculture training manual for small scale fish farmers	
Sustainable cultivation and harvesting of Tubers and bulbs		Participating household	Training in basic aquaculture practices	Community members
			Support the communities with basic aquaculture equipment	
Gardening	To identify households to conducting gardening activities in the wetlands	Participating household	Assist the community in the establishment of basic fish ponds	FD and Community members
	To train community members in sustainable gardening within wetlands		Identification households who can venture into growing tubers and bulbs	
Controlled grazing	To zone areas for grazing	Participating household	Zoning of areas where to grow tubers and bulbs	Community members
	To encourage farmers to conduct controlled grazing		Provide growing incentives for growing these crops	
			Identify suitable market were these crops can be grown in order to realize maximum benefits	
			Identification households and individuals who can venture into gardening	
			Encourage individuals and households who are already in gardening	
			Training in basic gardening practices	
			Support the communities with basic gardening equipment and other incentives	
			Facilitate the marketing and selling of the products from the gardens to the supermarkets, shops and markets in town	
			Identification households with livestock (cattle, goats, etc)	
			Training farmers on controlled grazing practices	
			Zoning of grazing areas	
			Encouraging of controlled grazing	

## 4. Discussion

### 4.1. Contribution Under-Utilised Indigenous Food Crops Towards Social-Economic Development

The majority of the population in these areas have settled in the area in the last 5-10 years and the average size of households in this area is six (6) individuals per household and most of the adults in the areas married due to early marriages and not having enough access to education (Central statistical Office, 2010). Social economically, the forests and wetlands support economic activity within the open areas including hunting, fishing, tourism, gardening and other agricultural activities, all of which bring significant benefits to the local and national economies. Generally, the rural community depends on natural resources for their day to day life, today these products from the natural resources are commonly called ecosystem goods and services (Makunga *et al.* 2008; Kalaba *et al.* 2011). Va Wyk (2011) gave a detailed account on the potential of South African plants for food and beverage industry were different potential indigenous cereals, seeds, fruits, vegetables, sweeteners and alcoholic beverage were highlighted.

Edible tubers, roots and bulbs crops which are found in forest and wetland areas contribute to the social-economics in many ways. These crops are used as a source of food to the local communities hence contributing to food security. The use of edible tubers, roots and bulbs range from snacks, beverages and even components of major meals (Challe and Struik, 2008; Arnold and Perez, 2001). For example orchids (*Satyrium*), are commonly eaten as snacks popularly known as *Chikanda* in the rural community as well as urban areas in Zambia. Apart from food security, these products are collected and sold in different market starting from the nearby roadsides up until major towns. For example, the orchids are harvested and exported by the rural community of Makete district of Tanzania. Challe and Struik (2008) reported that these orchids are collected by venerable groups such as HIV/AIDS orphans; however, the continuous exploitation of orchids has contributed to the massive biodiversity loss in Tanzania.

### 4.2. Contribution Under-Utilised Indigenous Food Crops Natural Resources Conservation

Unsustainable harvest of natural resources has characterized most of the African countries. Forests in particular have been affected by deforestation due to the demand for land driven by agriculture expansion, urbanization and charcoal manufacturing (Fig. 4). More than 250, 000 ha forest is lost annually (Syampungani *et al.* 2011). With these challenges, there is need for perfect conservation strategies to save these forests. The utilization of edible tubers and bulbs in the conservation of natural resources such

as forest and wetland areas can be a big score in conservation circles. Edible tubers and bulbs are also a key component of water management as they reduce public and private costs by reducing flooding and runoffs, maintaining shallower well depths, enhancing water quality, and controlling erosion (Njovu, 2004). In as much as people will be striving to maintain high collection of these tubers and bulbs, the forest diversity which is found side by side with these tubers and bulbs will be conserved (Challe and Stuik, 2008; Reinten *et al.* 2011).

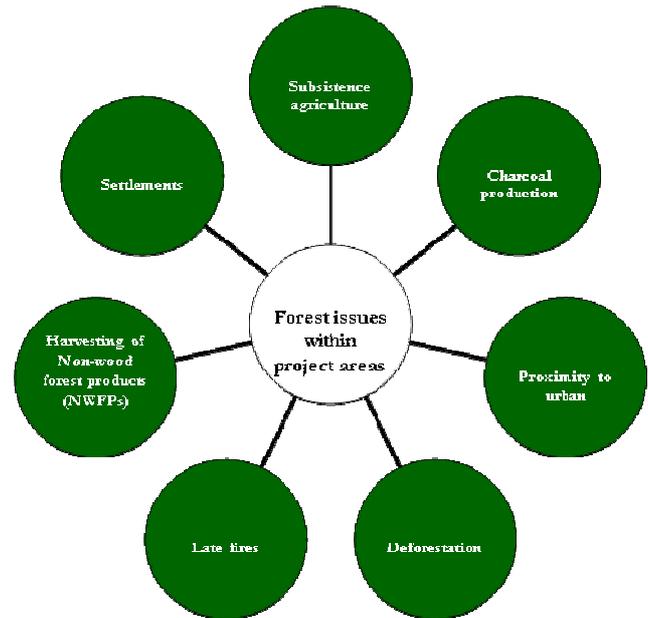


Fig. 4. Major challenges facing the forest sector in the study area.

In the study areas, land is under customary land (traditional ownership) where people do not have title deeds to the land (Kanungwe *et al.* 2013) and mostly the forest and wetlands where the edible tubers and bulbs are found are open access areas. Thus, people have full access to the natural resources available such as non-wood forest products including the edible tubers and bulbs. This full access to these resources results in low quantities of collected edible tubers and bulbs, this is one of the major threats to these crops cited (Challe and Struik, 2008). Hence the need for good management practices which will ensure sustainability.

The low quantities and the challenges in the marketing of these products require domestication and establishment of clear markets for these products. Just like other non-wood forest products such as edible fruits, there is a need for commercialisation which calls for value addition through processing, packaging and other means (Syampungani *et al.* 2010). Thus there is a need to have a balance between consumption and conservation of these resources in order to benefit both ecological and economical.

## 5. Conclusions

Edible tubers and bulbs have the potential to contribute to

rural economy and conservation of forest and wetland resources. The main idea is that the more the communities strive to increase the productivity of these edible crops, the more they conserve forests and wetland resources were they are found. However, concentrating on these edible tuber and bulbs alone, cannot bring full benefit to the community and the forest resources hence the need to bring in other activities such as establishment of woodlots, conservation farming, aquaculture and gardening. Furthermore, there is need of continuous collaboration between the community, authorities and traditional leaders in order to enhance sustainable management of these resources. Hence the forests will efficiently contribute to the wellbeing of the local people.

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