CONTRIBUTION OF NON-WOOD FOREST PRODUCTS TO HOUSEHOLD FOOD SECURITY IN MBOZI DISTRICT, TANZANIA

ROSEMARY BROWN NYINGILI

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE DEGREE OF MASTER OF SCIENCE IN MANAGEMENT OF NATURAL RESOURCES FOR SUSTAINABLE AGRICULTURE OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA

2003

ABSTRACT

A study was conducted to quantify the contribution of NWFPs to household food security in Mbozi district. Specifically the study aimed at, identifying the NWFPs available in the study area and assessing their seasonality; determining the contribution of NWFPs to household food security, investigating roles played by men and women in collecting, processing and preserving NWFPs and assessing the socio-economic factors influencing the collection and use of NWFPs. The study was carried out under two phases, phase one involved preliminary surveys and Participatory Rural Appraisals in Kilimampimbi, Hasamba and Ilyika villages. The second phase, involved mainly questionnaire survey conducted in Kilimampimbi, Ikomela, Msangano and Idiwili villages. PRA data were analysed with the help of local communities and results were communicated back to them for verification and custody. Questionnaire survey data were analysed by using both quantitative and qualitative methods. Statistical Package for Social Sciences (SPSS) was used for analysing quantitative data. Content and Structural-Functional analyses were used for qualitative data. This study revealed that NWFPs contribute about 13% by weight to total household food consumption and 7.5% to total household income. The study also found that about 59% of the income from NWFPs is used for buying food items. The study also revealed a clear gender division of labour in collection, processing and preserving NWFPs. Multiple regression analysis revealed that collection and use of NWFPs have been influenced by some socio-economic factors. This study concludes that the contribution of NWFPs to household food security in the study area ranges from direct supply of food to provision of cash and socio-economic factors influence collection and use of NWFPs. It is recommended that efforts be made to add value to NWFPs by developing and disseminating simple appropriate technologies for harvesting and processing NWFPs into different products to minimize wastage during peak seasons and

improve cash income earnings. This study also recommends that communities should be encouraged to plant desired tree species near homes and fields to reduce pressure in the forests and woodland.

DECLARATION

I, Rosemary Brown Nyingili, do hereby declare to the Senate of the Sokoine University of Agriculture that this dissertation is my own original work and that it has not been submitted for a degree award at any other University.

Signature:.....

Date: 8/10/2023

COPYRIGHT

ACKNOWLEDGEMENT

I would like to express my heartfelt gratitude to Training Fund for Tanzanian Women (TFTW) for the financial support without which my studies at SUA could have been impossible. I am indebted to my main supervisor Prof. G.C. Kajembe of the Department of Forest Mensuration and Management; and the co-supervisor Dr. J. Msuya of the Department of Food Science and Technology for their guidance, constructive criticisms and invaluable comments throughout the preparation and write up of this dissertation. Despite of each of them having tight schedule, they always had time for my work. I would also like to thank Dr. D. Nyange of the Department of Agricultural Economics and Agribusiness for his guidance in data analysis and Mr. D. Sango and Ms R. Abdallah for assisting in the data analysis. Thanks are due to Prof. R.P.C. Temu of the Department of Forest Biology, Mr. A. Mbwile of A.D.P. Mbozi, Mr. Uronu of National Tree Seed Programme and Mr. A. Mwansele of Beekeeping section Mbozi District, for plant species identification.

Thanks are also extended to the Mbozi District Administrative Secretary (DAS), Mr. A. Mwanyingili for introducing me to the Divisional Executive Secretaries and for providing transport to the study villages during the preliminary survey. I am indebted to Mr. G. Mwakatima, the District Natural Resources Officer, for providing transport during actual data collection, and Mr. Mushi the District Forestry Officer for providing field assistants. I would also like to thank Mr. A. Mwansele and I. Shebu of the Beekeeping Section for introducing me to village leaders and assisting in data collection. Thanks are also due to Mr. A. Kiwone and Mr. K. Mchomvu, the Msangano and Iyula extension workers respectively, for introducing me to the villagers. The hospitality extended to me by Mr. Mpandachombo, the Divisional Executive Secretary and his family, while in Msangano,

is highly appreciated. I would also like to thank all the drivers, village leaders and farmers who made the data collection exercise possible. To them I say *mwasalipa*.

Special thanks should go to my husband, Dr. Mohamed Msabaha for permitting me to undertake this course and all the hardships he faced during my absence. His moral support is highly appreciated. I am also grateful to my relatives whose support allowed the completion of this task. Thanks are also due to SUA staff and community members, my fellow students, and friends who in one way or another encouraged me. Last but not least, I thank the almighty Allah for protecting and keeping me to this moment.

DEDICATION

This work is dedicated to my late parents, Brown Nyingili and Subilaga Mmbungu who sent me to school in the first place, to my husband Dr. Mohamed Msabaha who was putting things together at home while I was putting words together and to my children Khalid, Kharafa, Abdullah and Amina with love.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

ABBREVIATIONS

ADP	Agricultural Development Project
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
ICN	International Conference on Nutrition
m.a.s.l	metres above sea level
MNRT	Ministry of Natural Resources and Tourism
NRC	National Research Council
NWFPs	Non-Wood Forest Products
PRA	Participatory Rural Appraisal
SAP	Structural Adjustment Programme
SPR	Subsistence Potential Ratio
SUA	Sokoine University of Agriculture
TFNC	Tanzania Food and Nutrition Centre
TFTW	Training Fund for Tanzanian Women
Tsh	Tanzanian shilling

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

According to FAO (1999) Non–Wood Forest Products (NWFPs) consist of goods of biological origin other than wood derived from the forests, other wooded land and trees outside the forests. This definition excludes all woody raw materials. Consequently, timber chips, charcoal and firewood as well as small woods such as agricultural tools, household equipment and carvings are excluded. Since plantations are also included in the FAO definition of forest, NWFPs that are obtained from plantations such as gum Arabic (*Acacia senegal*) or rubber (*Hevea brasiliensis*) are also included in the definition of NWFPs. Non-wood forest products are therefore derived from both natural forests and plantations. The term "product" corresponds to goods that are tangible and physical objects of biological origin such as plants, animals and their products. Forest benefits such as ecotourism, grazing, bio prospecting, soil conservation, and soil fertility and watershed protection are excluded. These forest benefits are more difficult to assess and quantify than NWFPs and have therefore already been excluded from most publications dealing with NWFPs. Traditional societies used various plants and animals for food both in times of bumper harvest and during food deficit (Zinyama *et al.*, 1990). For example hunters collected NWFPs before the technology to cut timber was developed (Chambelian *et al.*, 1998). Collection of wild foods is one of the strategies adopted for coping with food deficit in Dodoma rural district (Mwagile, 2001).

Non-Wood Forest Products are often associated with subsistence usage that are not widely known and/or they are linked to the problem of poverty. Timber-orientation of

forestry profession, and the bias of planners in favour of large-scale enterprises, often leaves NWFPs at a disadvantage. Their production, at best, was in the past considered incidental or subsidiary. A wrong perception still exists that forests that do not produce timber are of low or no value. Forests meant for timber production, non-timber plants are often treated as weeds (FAO, 1995a).

Recently, however, the significant environmental and economic roles of NWFs have come into focus through better understanding of their importance. The new market preference for natural products and emphasis on efficient and sustainable use of natural resources have helped this development. It has also become apparent that with sustainable use and proper husbandry, the NWFPs hitherto largely confined to subsistence use can also support sustainable and remunerative enterprises and increase the contribution of forestry to development. NWFPs received notable attention at the United Nations Conference on Environment and Development (UNCED) in 1992 (FAO, 1995a).

Foods from forests and other tree systems in Africa constitute an important component of household food supply. They include a wide variety of plant and animal products found in markets in both rural and urban areas. In many villages and small towns, the contribution of forests and trees to food supply is important for food security as they provide a number of necessary dietary elements such as minerals and vitamins that the normal agricultural produce does not adequately provide.

In many areas, dietary deficiencies and monotony of the agricultural diet are reduced or avoided through this "hidden harvest" (Sene, 2000).

Wild roots are widely eaten in Mtwara district (Missano *et al.*, 1994). About 31 species of the most common edible wild mushrooms contribute greatly to household food security in Tanzania (Harkonen *et al.*, 1995). Makonda (1997) identified 49 plant species used for food in Geita district. In the miombo woodlands of Tanzania, Monela *et al.*, (2000) found out that households derive more than 50% of their cash incomes from selling forest products including honey and wild fruits.

According to Sene (2000), trees and forests play a critical role in ensuring sustained agricultural production, including animal husbandry and in some cases fisheries. Indeed, forestry and agriculture are often mutually beneficial and even interdependent. Forests are the most important terrestrial gene banks. Many of the foods we consume today, particularly basic staples such as rice, originated as wild crops in the forests. Forests continue to serve as a gene pool repository, for present and future food crops.

However, despite variety, importance and richness of foods from forests in Tanzania, progress has been very slow in designing and implementing measures to increase the contribution of wild plants and animals to food security through proper policies and planning.

1.2 Problem Statement and Justification

Non-Wood Forest Products play an important role in the daily life and well being of millions of people worldwide. Rural, poor people in particular depend on these products as sources of food, fodder, medicines, gums, resins and construction materials. Traded products contribute to the fulfilment of daily needs and provide employment as well as income, particularly for rural people and especially women. However, most NWFPs are

used for subsistence and in support of small-scale, household-based enterprises (FAO, 2001). Despite their real and potential importance, national institutions do not carry out regular monitoring of the resources or evaluation of the socio-economic contribution of NWFPs as they do for timber and agricultural products (FAO, 2001). In many cases the importance of NWFPs to local or even national economies can equal or sometimes surpass that of wood or wood products, yet their worth and potential are rarely quantified and hardly ever factored into investment, or management schemes (FAO, 1996a).

In Tanzania, although a number of studies (Missano *et al.*, 1994; Harkonen *et al.*, 1995; Makonda 1997; Monela *et al.*, 2000) have been conducted concerning NWFPs, their focus has been on the role of NWFPs to the rural people's livelihood in general. There is particularly an information gap pertaining to the contribution of NWFPs to household food security as compared to agricultural produce. Also information about socio-economic factors influencing the use of NWFPs in coping with food deficit is lacking. This study sought to fill these gaps.

Mbozi district has three forest reserves and six proposed forest reserves covering a total area of 93,743 ha. The former covers 6,500 ha while the latter covers 87,243 ha. Miombo woodlands mostly cover the district (Planning commission, 1996). In miombo woodlands there are few comprehensive studies on the quantities and direct and indirect values of resources extracted (McGregor, 1995; Campbell *et al.*, 1997; Campbell *et al.*, 2000; Kundhlande *et al.*, 2000). The contribution of non-wood forest products to household food security in Mbozi district is unknown. It is necessary to investigate the importance of forests to the daily life of local communities in their struggle to make ends meet, a struggle which can sometimes threaten the forests (Kessy 1998).

It therefore seemed appropriate to identify the NWFPs available in Mbozi district, to determine the proportion they contribute to household food security, identify gender roles and assess the socio-economic factors that influence the use of NWFPs in coping with food deficit

1.3 Objectives of the Study

1.3.1 Overall objective

The overall objective of this study was to quantify the contribution of non-wood forest products to household food security, for the purpose of generating information, which will help in policy formulation and planning.

1.3.2 Specific objectives

i) To identify NWFPs available in the study area and assess their seasonality.

ii) To determine the contribution of NWFPs to household food security.

iii) To identify roles played by men and women in collecting, processing and preserving NWFPs.

iv) To assess socio-economic factors influencing the use of NWFPs in coping with food deficit.

1.4 Conceptual Framework

Conceptual framework helps to prevent fragmentation of knowledge into diverse segments of unconnected statements. According to Katani (1999), conceptual framework binds facts together and provides guidance towards collection of realistic data and information. Food deficit occurrences in the study area influence collection of NWFPs for subsistence and cash earning. The collection of NWFPs is influenced by socio-

economic factors. Figure 1 depicts a conceptual framework that puts in context the contribution of NWFPs to household food security.

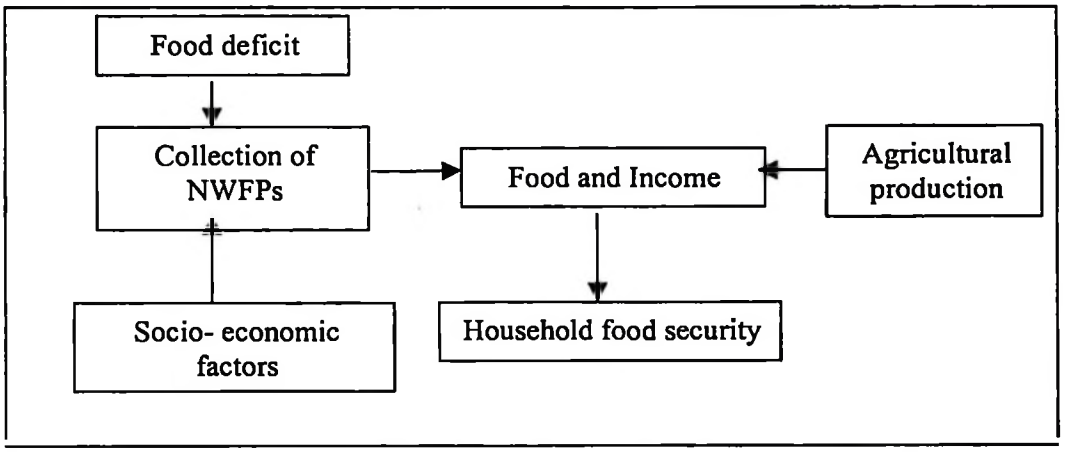

Figure 1: Conceptual framework depicting the contribution of NWFPS to household food security

1.5 Research Questions

(i) What are the non-wood forest products available in the study area?

(ii) What is the contribution of NWFPs to household food security as compared to agricultural production?

(iii) What is the gender division of labor with regard to collection, processing and preservation of the NWFPs?

(iv) What socio-economic factors influence the use of NWFPs in coping with food deficit?

1.6 Hypotheses That Guided the Study

- Non-Wood Forest Products contribute significantly to household food security.

- ❖ The use of NWFPs in coping with food deficit is influenced greatly by socio-economic factors such as age, education years, marital status, household composition, number of wives, farm size and income level.

1.7 Limitation of the study

1.7.1 Use of local measurements

The farmers use local measurements such as heaps, cups, bowls and tins, small and big plastic containers and sacks/bags of different capacities. The researcher converted the local measurements into standard units through weighing.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 The Concept of food security

Different authors have defined food security differently: ICN (1992) defined food security as access by all people at all times to the food needed for a healthy life. Cohen *et al.*, (1989) defined food security as the ability of a country to provide adequate amount of food for its population. Margen (1989) defined food security as a condition in which all people have access at all times to nutritionally adequate food through normal food channels. Busch *et al.*, (1984) defined food security as having three dimensions: availability, accessibility and adequacy. According to Campbell (1990) food security is access by all people at all times to enough food for an active healthy life. It includes at a minimum, the ready availability of nutritionally adequate and safe foods; and the assured ability to acquire personally acceptable foods, in a socially acceptable way. The World Bank (1986) defined food security as access by all people at all times to enough food for an active, healthy life. Thomson and Metz (1997) give two definitions of food security: Firstly, as availability of, stability of, and access to food by each human being. Secondly, as a situation where both food supply and demand are sufficient to cover food requirements on a continuous and stable basis.

According to the World Food Summit, food security means that: "All people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO 1996a). More simply, food security means access to food for a healthy life by all people at all times

(Barraclough, 1996, cited by Thrupp with Megateli, 1999). Embodied in the concept is the recognition that people's ability to consume food may depend on their own production as well as on their ability to purchase food, and that sufficiency, stability and continuity of supply are necessary to achieve food security. The definition also implies that food security entails meeting food requirements not only for current populations but also for future generations (Lipper, 2000). The FAO's World Food Summit definition is adopted in this study because it includes the aspects of physical and economic accessibility to food by all people at all times through own production and ability to purchase. The definition also adds food safety, nutrition and dietary needs and food preferences, which are important considerations.

Food security is considered a basic human right, which extends to the right to safe food and information about the content of food eaten (ICN 1992). Food security is more than producing sufficient volume of food in a given country or region; it is people's entitlement to available nutritious and safe food overtime. Implicit in this is the adequate distribution of food or purchasing power to obtain it (FAO 1996 cited by Thrup and Megateli, 1999).

2.1.1 Food security at different levels

The availability of food at national level is not necessarily translated into household food security or equal access among all members of the household. At household level food security entails having adequate supply of food. Adequate refers to quantity and quality; that is to say, there should be enough food to meet daily requirements of all members of household. However, food intake should be related, among other things to body size, weight, sex, and nature of work and physiological conditions such as pregnancy and

lactation status for women. More often, some of these aspects are never considered in most households' food budgets. Adequate food must mean that the food should supply energy and other nutrients for a healthy productive and reproductive life and be acceptable culturally and socially. The food should also be satisfying in terms of culinary practices and be safe from toxins and other harmful substances (Nyange, 2001).

2.1.2 Food entitlements

According to Thomson and Metz (1997), entitlements are defined as the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces. That is to say what a person can produce, buy or borrow, given what they own and what social and state regulations allow them to do with those bundles. They include trade-based, production-based, own-labour and inheritance and transfer entitlements. Trade-based entitlement describes what an individual can buy with the commodities and cash they own. Production-based entitlement describes the right to own what one produces with one's own resources. Own labour entitlement describes the sale of one's own labour power, and the resulting trade-based entitlements. Inheritance and transfer entitlement refers to the right to own what is willingly given by others as remittances, gifts or bequests, as well as transfers from the state such as social security, pensions and food distribution. All these entitlements give an individual control over resources, which they can use within the rules and regulations laid down by the society, to satisfy their needs, including the very basic need of food.

2.1.3 Dimensions of food security

According to Thomson and Metz (1997), food security has three dimensions, namely availability, stability and accessibility.

2.1.3.1 Food availability

Food availability is determined by the level of food supplies, composed of subsistence production and market supplies stemming from domestic production, food stocks and food imports. In subsistence societies, food availability would be equal to the food in stock plus what can be directly obtained from the fields and gardens as well as from collection of wild foods. In more market- oriented societies, the situation is more complex whereby agricultural produce can be sold and cash income be used to purchase food available in the market.

2.1.3.2 Food stability

Food stability refers to variations and the risk of shortfalls in food production, supplies and/or demand over time. In food stability, concerns are income distribution, effective markets and various public and informal support and safety nets. A society can be said to enjoy food security if it has developed an internal structure that will enable it to sustain the food norm in the face of crises threatening to lower the achieved level of food consumption.

2.1.3.2 Food accessibility

Access to food involves physical, economical and social aspects. It is the result of the ability to express food needs (beyond subsistence production) as effective demand.

Access to food concerns processes through which food reach the people. Physical access to food is related both to the adequacy of supply and to the efficiency of the distribution system involving storage, processing, preservation, transport and marketing. Economic access to food refers to the ability of groups of people to establish entitlement over a requisite amount of food, the ability to generate income, whether in cash or in kind and the proportion of income that is readily available for consumption purposes. Therefore factors related to food production such as availability of land, access to credit, availability of qualified labour force and agricultural practices affect the food security situation. Likewise factors that affect stability of the food available like storage conditions and processing, social sustainability (continuing functions that support social growth) and sustainable environment (continuing functions of environmental life-supporting systems), can play important roles in food security. Also conditions that determine food access such as physical, social and economic accessibility are important (Hubbard, 1995).

2.2 Household food security

The concept of household food security (HFS) for rural households in developing countries encompasses all factors affecting a household's access to an adequate year round supply of food. Thus it is concerned not just with the household's production of food crops, but also with the availability of income to the household with which to purchase food, where this is necessary. In examining household use of NWFPs, it is therefore important to identify their role in both providing gathered foods that contribute to food self-sufficiency, and marketable products that could supplement income needed to purchase food. In doing so it is also necessary to consider whether, and if so how, income-generating activities based on forest products affect other aspects of a household's capacity to contribute to its food self-sufficiency. Traditionally NWFPs have

always played a major role in the household economy of people living in or near forested areas (FAO, 1995a).

According to Nyange (2001), household food security concerns the microeconomics of the household. In particular, it describes the use of food in the household, access to it by various members in the household, household survival strategies and the role of gender. It therefore refers to the ability of a household to acquire, either through production and/or purchase/transfer/exchange, food that is adequate in quality and quantity to fulfil the nutritional needs of all members of the household. A household is said to be food insecure when it fails to command or acquire food to meet its dietary intake in terms of quantity, quality and safety. Household's accessibility to food is usually reduced by unavailability of food caused by poor harvests, increased market prices, loss of assets or other household production resources (TFNC, 1997).

2.2.1 Indicators of household food security

According to Nyborg and Haug (1994) choosing the best indicators of household food security is a difficult task, and many of the conventional indicators used have been shown to be inadequate in giving a true picture of the food security situation. Two of the most commonly used indicators for household food security include nutritional status and agricultural production levels. The two indicators are discussed below.

2.2.1.1 Nutritional status

This involves anthropometrical measures e.g. weight for age and height for age (Nyborg and Haug 1994). This is perhaps the most popular measure of food security. But it ignores the fact that nutritional status is also affected by other factors, such as poor health

and sanitation, level of individual activity and inadequate child and maternal care. There are additional problems which include the difficulty to accurately determine age in certain societies, the under representation of pastoralists in clinical data, and the fact that these measures may not recognize nutritional problems until at a very late stage in the process towards chronic food insecurity (Nyborg and Haug 1994).

2.2.1.2 Agricultural production levels

Agricultural production levels as indicators of HFS, only give an indication of how much food is available. They do not show the degree of access the poor may have to this production. Decrease in production levels are not necessarily a good measure of food insecurity, since this would also depend on the degree to which a household actually depends on this production. Thus even when reported per capita, production levels alone cannot measure food security status. In light of such problems, there have been several attempts to find new or improved indicators of food security which would be more useful in the design of development interventions. A number of such indicators are discussed below.

(i) Outcome indicators

According to Nyborg and Haug (1994), food security output/outcome indicators are used to measure the status of food security at a given point in time. They are mainly used to evaluate the food security status before and after intervention. Most outcome indicators use food consumption as a measure of food security. Food consumption can be measured either directly or indirectly through proxies. Direct outcome indicators include household budget and consumption data, household perception of food security, and food frequency assessments. However such data are not sufficiently accurate or available, which is a big

limitation of such indicators. On the other hand, indirect outcome indicators include storage estimates and subsistence potential ratio (SPR). The SPR compares the amount of food (in terms of energy), which a household can produce per year or month with the energy requirements of the entire household per year or month (Frankenberger, 1985). A more practical and simple form of the SPR is the use of a Household Food Security Card that has been designed by the Tanzania Food and Nutrition Center (Wagao, 1991).

While direct and indirect output indicators can offer a simple check of food security, they do not by themselves give any indication of vulnerability to food insecurity, and are thus not adequate for purposes of monitoring food security over time.

(ii) Process indicators

Process indicators are used to measure the changing status of food security. There are two main types of process indicators namely supply and access indicators. Supply indicators measure the availability of food. Most conventional assessments of food security, including famine early warning systems, have focused on indicators reflecting food supply, particularly at the regional and national levels. They include: rainfall data, information of natural resources (including grazing resources), agricultural production data (crops and animals), and agro- ecological models. Others include food balance sheets, information on pest damage, regional conflicts and market information (Nyborg and Haug, 1994).

Access indicators are used to measure people's access and entitlement to food, either through own production, purchase, or transfer/gifts. They reflect to a large extent people's responses to worsening conditions (threats to food access), often termed as coping strategies in literature. According to Nyborg and Haug (1994) examples of access

indicators include, risk-minimizing strategies (adjustment during and before a production season), which include land use practices and diversification of livestock. Access indicators also include loss-management strategies (response to lower production), which include dietary change, change in food source, diversification of income sources, and access to loans/credit, livestock sales, seasonal migration, sale of production assets and distress migration. Process indicators are used in this study. They include agricultural production data, grazing resources, pest damage information, dietary change and change in food source.

2.3 Contribution of NWFPs to household food security

The indigenous flora and fauna found in forests and bushland contributes to the local food systems in two ways. Wild products might be collected for direct consumption or wild products might be sold to generate income for food purchase or other expenditures. In this way forests play direct and indirect roles in food security systems (FAO, 1989). For example, people might rely on such forest products as raw materials for mats and baskets as the only available source of income generation. They may therefore use the proceeds from the sales of the items to buy foods, which is indirect contribution (Makonda, 1997). Forest foods are particularly important in predominantly subsistence economies in remote areas. They play a supplementary role in the diet, and rarely constitute staple foods. They contribute to diet diversity and flavour. Forest foods are eaten as snacks or relishes to complement the usually starchy staples (FAO, 1995a).

2.3.1 Direct contribution

Around 75,000 plant species are edible at global level, out of which 12,000 have been used for food but only 2,000 have been domesticated so far (Walters and Hamilton,

1993). Forest foods combine foods from plant and animal origin. Plant foods are often classified into fruits and seeds, nectars and saps, stems and tubers, leaves and mushrooms. Animal foods can be of invertebrate (insects and insect larvae) or vertebrate (bush meat or fish) origin (FAO,1995a).

2.3.1.1 Wild fruits

In Zimbabwe, Campbell *et al.*, (1987; as cited by Kajembe *et al.*, 2000) found that fruits are gathered mostly during the times of famine. Forests therefore provide important coping strategies for rural dwellers during times of food deficiency. Kajembe (1994) and Kessy (1998) argued that wild foods are as important to the diets today as ever before. There are many species of wild fruits consumed worldwide. Fruits are most commonly consumed raw (uncooked) as snack food, but some are cooked e.g. *Borassus aethiopum* mesocarp (Sene, 2000). Most fruits are valued as food for children and are collected by children. Hines and Eckman (1993) argued that, in Tanzania in places where exotic fruits such as *Mangifera indica, Carica papaya, and Mussa spp* are planted, little use is being made of forest fruits. Likewise where a large number of indigenous fruit trees have been retained or planted the variety of exotic fruits is small. FAO (1983) identified 40 food and fruit bearing forest species in Tanzania with the assistance of the Lushoto Silvicultural Research Station. Makonda (1997) identified 39 species of wild fruits that are consumed in Geita district.

2.3.1.2 Wild legumes

The seeds of the African locust bean *(Parkia spp),* a perennial tree legume, are consumed in Africa, South – East Asia and tropical South America. In Malaysia and Indonesia, the

whole pods, sometimes preserved by pickling in salt, are eaten raw or cooked as a vegetable known as *petai.* In West Africa, from Gambia to Cameroon, the beans of the Savannah species are widely fermented to the traditional *dawa dawa* or *Soumbara*, a nutritious protein (40% of dry matter) and fat (35%) rich food which keeps for over a year without refrigeration and is added to soups and grain porridges, while the Vitamin C rich pericarp called *dozim* is eaten by children raw or as a sweet drink. The beans mature in the dry season in February and March, providing valuable food in the middle of the traditional "hungry" season before the new harvest (FAO 1995b). It has been estimated that 200,000 tons of beans are gathered each year in Northern Nigeria. The fruit of the related *Carob* tree is made into flour or beverage in the semi -arid Chaco region in South America. Prepared as patay, it has a high content of absorbable calcium. The deep roots of *Parkia* trees that reach underground aquifers provide a reliable annual crop even in the lean, drought years where herbaceous plants and cultivated crops fail to grow (FAO 1995a).

2.3.1.3 Wild roots and tubers

Starch reserves in wild stems, roots and tubers usually constitute a major food source in forest areas. Forest yams, which constitute the tubers of lianas, are consumed in Africa, Australia and Asia (FAO 1995a). A survey in two villages of Mtwara region by Missano *et al.*, (1994) found out that wild starchy roots were being consumed widely by rural people and were being bought by town dwellers as snacks when traveling inland. The roots are known locally as *ming'oko,* which are wild yams believed to belong to the *Dioscorea* species. In Kenya, Kabuye (1986) found that roots and tubers were consumed only as snack while herding livestock.

whole pods, sometimes preserved by pickling in salt, are eaten raw or cooked as a vegetable known as *petai.* In West Africa, from Gambia to Cameroon, the beans of the Savannah species are widely fermented to the traditional *dawa dawa* or *Soumbara*, a nutritious protein (40% of dry matter) and fat (35%) rich food which keeps for over a year without refrigeration and is added to soups and grain porridges, while the Vitamin C rich pericarp called *dozim* is eaten by children raw or as a sweet drink. The beans mature in the dry season in February and March, providing valuable food in the middle of the traditional "hungry" season before the new harvest (FAO 1995b). It has been estimated that 200,000 tons of beans are gathered each year in Northern Nigeria. The fruit of the related *Carob* tree is made into flour or beverage in the semi -arid Chaco region in South America. Prepared as patay, it has a high content of absorbable calcium. The deep roots of *Parkia* trees that reach underground aquifers provide a reliable annual crop even in the lean, drought years where herbaceous plants and cultivated crops fail to grow (FAO 1995a).

2.3.1.3 Wild roots and tubers

Starch reserves in wild stems, roots and tubers usually constitute a major food source in forest areas. Forest yams, which constitute the tubers of lianas, are consumed in Africa, Australia and Asia (FAO 1995a). A survey in two villages of Mtwara region by Missano *et al.*, (1994) found out that wild starchy roots were being consumed widely by rural people and were being bought by town dwellers as snacks when traveling inland. The roots are known locally as *ming'oko,* which are wild yams believed to belong to the *Dioscorea* species. In Kenya, Kabuye (1986) found that roots and tubers were consumed only as snack while herding livestock.

2.3.1.4 Wild animals

Wild animals are another important forest food product that provides household food security through direct consumption. The range of species consumed includes rodents, insects, birds and eggs and other large game animals. For people living in close proximity to forests, wild animals offer an important part of their diet; in some cases they supply the only source of animal protein (Hamza, 1997). The nutritional value of bush meat is comparable to that of domestic meat. FAO (1989) pointed out that the most important game meat species are small animals like rodents, reptiles and insects; this is due to their naturally abundance and unrestricted hunting. Malaisse (1982; as cited by Kajembe *et al.*, 2000) reported that rodents are major food components for residents of Zambezian woodlands. Approximately 20 species are eaten and they contain 24% of protein and have high fat contents. In Mtwara and Lindi, consumption of some species of rodents is popular while in Kagera region a certain insect species locally called *senene* is widely consumed. Consumption of some wild birds is also common in central part of Tanzania particularly Singida and Dodoma regions (Hamza, 1997). In some parts of East Usambara, Katigula (1999) found that there were 21 species of wild animals, 10 species of birds and 8 species of fish, forming an important source of animal protein utilized by the local people.

2.3.1.5 Honey

Honey is most commonly consumed in its unprocessed state (liquid, crystalline or in comb). In households, honey is used as a substitute for sugar in tea or porridge, as supplementary food for lactating mothers, and as an appetizer (Mwakatobe, 2001). Raw honey is eaten as food and incorporated in various food preparations. In industrialized

countries honey is used as food ingredient in confectionery, baked products, candy, marmalades, breakfast cereals, beverages, milk products, snack bars, jam preparation and to spread on bread (Krell, 1996). Honey in Arumeru district is used as raw material for making local brew, which is used in traditional ceremonies and as source of income (Lema, 1997). Mwakatobe (2001) reported that in Arumeru district pure honey is used as sugar substitute in tea or porridge. It is also used as a flavouring agent in stiff porridge, cooked potatoes, cassava and beans and as bread spread. The Wamaasai use honey as a local preservative agent for meat, and meat preserved in this way, is known as *sandiko*. Kihwele *et al.*, (1999) reported that honey is a very important food for the Sandawe ethnic group in central part of Tanzania. Honey is mixed with cereals in the preparation of local brew known as *wanzuki*. Royal jelly is used as an important ingredient in cosmetic and pharmaceutical industries (Kajembe *et al.*, 2000).

According to Kihwele *et al.*, (1999), traditional healers use honey as an antibiotic. In conventional medicine, honey is used as a carrier for drugs. Traditionally, when honey is used pure or mixed with other ingredients, it cures coughs, stomachaches, ulcers, malaria and burns or scalds (Krell, 1996; Lema, 1997; Kiondo, 1998; Liseki & Mmbaga, 1998; Mwakatobe, 2001).

Honey is used to improve assimilation and its usefulness and effectiveness is shown in chronic intestinal cases such as constipation, duodenal ulcers and liver disturbances. Pure honey also helps against infections, promotes tissue regeneration and reduces scarring (Dumronglert, 1983). Salem (1981) reported successful treatment of various gastrointestinal disorders by using honey.

2.3.1.6 Wild vegetables

Herbaceous plants and young leaves are eaten as vegetables and provide essential vitamins. *Gnetum africanun is* a central African forest creeper. Its perennial foliage is consumed in large amounts as vegetable. The leaves are gathered and cut into thin slices. These can be eaten raw and green but are generally added to meat and fish dishes at the end of the cooking time. They constitute a significant source of protein, particularly essential amino acids and mineral elements. Women play an essential role in the gathering of *gnetum* and selling it in the markets.

In East Usambara, Mattila *et al.*, (1997) found out that many local people preferred wild vegetables to the cultivated ones. The most favored and important wild leafy vegetables in the area are *Ipomea spp* (ndelema), *Gynandropsis gynandra* (msangani) and *Pupalia lappacea* (Mshunga). Fleurent (1979) in Kajembe *et al.*, (2000) who reported that wild green leafy vegetables are an essential part of every diet, which accounted for 81.2% of all side dishes in West Usambara, also supports this argument.

A study, on the consumption of cultivated and wild vegetables and fruits, among the Luo in Tarime district, revealed that; leafy vegetables accounted for almost 23% of the total foods consumed during the months of June and July. This was found to be the highest contributor to the total overall frequency score in relation to the seven major categories of food in the study area. From a total of 31 different leafy vegetables documented, 19 are collected in the wild. Some examples of the edible wild leafy vegetables of Mara region include *Amaranthus spinosus, Asystasia schimperi, Cleome whirta, Corchorus triloculans* and *Crotalaria brevidens,* Uiso and Johns (1996) cited by Kajembe *et al.*, (2000).

2.3.1.7 Mushrooms

A survey of edible mushrooms in Tanzania by Harkonen *et al.*, (1995); showed that wild mushrooms are a delicacy. The survey also described 31 commonest mushrooms. These mushrooms contribute greatly to household food security of rural populations as direct food eaten as well as generating income (Harkonen *et al.*, 1995; Maganga, 1996). Picking wild mushrooms for home consumption or for sale is traditionally a small-scale activity and a form of outdoor recreation in many parts of the world (Arnold, 1995; Schlosser and Blantner, 1995). According to Vladyshevskiy *et al.*, (2000) mushroom collection is the most popular form of NWFPs gathering in Central Siberia where up to 40% of families collect mushrooms for home use, recreation or sale. About 15 to 18 species of mushrooms are collected regularly in the region. Zinyama *et al.*, (1990) reported that some non-toxic mushrooms are collected during rainy season when they are plenty, prepared and served together with the main dish. Surplus mushrooms are boiled, sun-dried and stored for use in dry season. The common species of edible wild mushrooms found in East, Central and Southern Africa include those belonging to the genera *Termitomyces, Rusula, Lactarius, Amanita, Armillaria, Macrolepiota, Agaricus, Tricholoma, Boletus, Xerocomus, polyporus, Suillus, Afroboletus and Pleurotus* (Chipompha, 1985). The miombo woodlands are the major habitat of most of the species. The miombo woodlands cover more than 32 million hectares, that is about 96% of the total forest area of Tanzania (MNRT, 1998). The woodlands therefore constitute an enormous reservoir of wild mushroom species. Most of the mushrooms in the miombo woodlands survive by forming myccorhizal association with tree roots, especially trees of the family *Leguminosae* in the sub families of *caesalpinoidae, mimosoidae* and *popilionoidae* (Munyanziza, 1994; Harkonen *et al.*, 1995).

Mushrooms are highly valued in many societies, and sometimes considered as "meat." Although they contain protein, carbohydrates, fats, salts, and fibres and are rich in Vitamin B, they are usually considered as gourmet foods rather than subsistence foods (FAO, 1995a).

In most rural areas during rainy season mushrooms are preferred to any other kind of food. Some of the mushrooms are cooked fresh, while some are preserved by sun drying or smoking for use in the dry season (Harkonen *et al.*, 1995; Laessoe, 1998). Mushrooms are recommended as alternative food for combating malnutrition particularly in tropical countries where cereals are staple food and meat may be rare or too expensive for low-income earners to afford (Harkonen *et al.*, 1995; Sene, 2000). Potentials of mushrooms in African forests and other landscapes are largely untapped. This may be due to the seasonal occurrence of mushrooms and lack of awareness and knowledge on palatability and nutritional contents of various mushroom species (Nsolomo *et al.*, 2000; Sene 2000).

2.3.1.8 Extracts

Traditionally, gum Arabic has been an important food for pastoralists and hunters. Mauritanian nomads consume it either fried or mixed with a sugary liquid. Gum Arabic is now used mainly in the confectionery industry. Nectars and pollens contribute to the production of honey and therefore constitute an important element of local food habits (FAO 1995a).

2.3.1.9.Wild grains

Wild species of grains are also consumed in most tropical countries. In Tanzania for example, a study conducted by Missano *et al.*, (1994) in Mtwara region found that household members were consuming a wild grain from bamboo locally known as "*mbuga*". Consumption of this wild bamboo grain was associated with poor crop harvests in that particular year leading to critical food shortages. Consumption of wild grains in many rural areas of Tanzania has not been sufficiently explored, though it is said that many other tribes consume wild grains available during food shortages (Kajembe *et al.*, 2000).

2.3.2 Indirect contribution

2.3.2.1 Hunting as source of income

Given the rising demand for bush meat, hunting has become in many cases more lucrative than agriculture. In forested areas of Gabon for instance, the recent economic recession and drop in cocoa prices have prompted the majority of village men to rely on wildlife exploitation as a primary means of generating revenue (FAO, 1995a).

2.3.2.2 Fodder and thatch grass

According to Makonda (1997), fodder from trees and shrubs are particularly important during dry season, when availability of grasses is markedly reduced. Feeding livestock inside forests therefore takes place during this season when resources within general lands have been exhausted. In this way, forests contribute to household food security indirectly by sustaining livestock, which are in turn depended upon for direct food and

income. Miombo woodlands are fairly rich in browsing species. Livestock prefer mainly new regrowth, which has been shown to contain high protein and other nutrients. Trees often play an important role in honey production as they collectively provide year round fodder for bees.

The importance of dry grass for thatching cannot be overstated. Most houses in rural areas of Tanzania are of grass thatch. Dry grass is used for thatching buildings and making fences around compounds. Thatch grass is obtained from the forests otherwise it would cost money to buy it; instead the money is used for other household expenditures including buying food items. Thatch grass is also sold to earn cash.

2.3.2.3 Plant fibres

Plant fibres are important both for domestic use and for sale. In Kondoa district, bark fibres of *Adansonia deviate* are used for making fillers, brooms and ropes (Nkana and Iddi, 1991). From East Usambara, Kessy (1998) reported a widespread use of the ropes by rural artisans to produce a range of women baskets and mats. These are made from palms, grass, bamboo or climbers. They are used for harvesting, drying, winnowing, grinding and storing agricultural produce. Basketry techniques and plant materials are also used to weave granaries, fish traps, stools and tables (Makonda, 1997).

2.3.2.4 Traditional medicine

Forests are good source of medicinal plants for many people in the developing world. According to Chandrasekharan (1993), 75% of the world's populations particularly in developing countries are dependent upon traditional medicine. NRC (1992), reported that

the people of India have for centuries been cleaning teeth by using neem (*Azadirachta indica*) twigs, treating skin disorders by smearing with juice of neem leaves, taking neem tea as tonic and placing neem leaves in grain bins, books, cupboards and beds to repel troublesome insects like bugs. In Tanzania vending of traditional medicine is very common. Kahatano (1997) reported a total of 98 plant species and 12 animal species being traded locally as traditional medicines. This implies that a good amount of income can be obtained through selling traditional medicine and this has a substantial contribution to household food security. Reliance on traditional medicine in Tanzania is significant, and there is no reason to suppose that it will decrease (Otieno, 2000).

Seeds of wild cardamom in Sri Lanka are harvested by large groups of villagers from August to September. Although these seeds are used as a spice in curries and cakes, and exported to the Middle East where they are used in flavouring coffee, they are also used as medicine. These seeds are given internally for the diseases of the liver and uterus, as a diuretic and to prevent excessive vomiting in children (FAO 1995a). A variety of indigenous food preparations (cooked into curries or as steamed salted or sweet dishes) are made with flour from the fruits of the shorrea tree. These are strongly recommended by local physicians for gastritis and other bowel ailments (FAO 1995a). There are a number of important links between forests, traditional medicine practices and nutrition (FAO 1989). In many societies of the developing countries, wild foods are said to have healing properties. In Kenya, Kabuye (1997) reported the use of *Gynandropsis gynandra* by Kisii mothers during and after birth, and the use of hyacinth beans *Lablab purpureus* among Kikuyu mothers, these are foods which, have healing properties. It was further reported that analysis of these food items revealed the presence of iron and protein essential for growing children and mothers recovering after delivery. According to

Kulkarni *et al.*, (1993) many plant species are used as tonic or medicine and are added to cooked food. *Tamarindus indica* is an example of such species; its pulp is used in many foods and as a medicine. The bark of this species is used as tonic and treats paralysis.

Medicinal plants also provide treatment of diseases in livestock, hence are useful in livestock keeping and production thereby improving food security. FAO (1984) documented that traditional veterinary practices are highly developed in Nepal.

2.4 Food insecurity

Food insecurity prevails if at any time (occasionally, repeatedly or permanently), either the volume of food supply, or food demand, or both fall short of requirements (Thomson and Metz 1997). Time is a very important factor in determining the nature of food insecurity. It is common to draw a distinction between chronic, transitory and emergency food insecurity. Chronic food insecurity occurs when individuals or groups of people suffer from food insecurity all the time. Transitory food insecurity is a situation described when households face a temporary decline in access to food. It is hoped that in the next period the situation reverts to normal. Transitory food insecurity can be further divided into temporary food insecurity and cyclical or seasonal food insecurity. Temporary food insecurity occurs when sudden and unpredictable shocks, such as drought, floods or pest attack, affect a household's entitlements. For urban households, sudden unemployment or the illness of a wage earner may also be a cause of temporary food insecurity. Seasonal food insecurity occurs when there is a regular pattern of inadequate access to food. This is often linked to agricultural seasons, particularly when it is difficult for households to borrow food items to even outflows of food over time (Thomson and Metz, 1997). There is another type of shock, which may initially lead to similar responses as drought.

However, here the situation does not revert to normal in the next time period and the household rapidly descends into chronic food insecurity. This is the effect of shocks such as asset loss, for example death of livestock, war, theft and civil conflict, and more recently the onset of HIV-AIDS (Thomson and Metz 1997). According to Temu *et al.*, (1997), emergency food insecurity is a situation of acute and unpredictable food shortage arising suddenly from incidences like floods, hurricanes, wars, earthquakes and other spontaneous natural disasters.

According to Thrup and Megateli (1999), the deeper roots of food insecurity are largely political, economic and social conditions that include unsustainable patterns of development, market inadequacies, weak institutional and legal capacities, demographic pressures, and socio-economic inequities and conflicts. Many analysts point to poverty as a cause of food and environmental problems (Thrup and Megateli, 1999). The problem of food insecurity is not simply one of agricultural output, but encompasses all factors affecting household's access to an adequate year round supply of food. For example in Tanzania a widespread hunger prevailing particularly in semiarid areas is not due to unavailability of food in the market but due to inadequate purchasing power among the rural poor. Consumer purchasing power has been declining over the years in Tanzania. The hardest hit population is the urban low wage earners and the rural poor who usually face food deficit and as such have to buy food.

Bagachwa *et al.*, (1996) documented that Structural Adjustment Policies (SAPs) have cut off funding for social services, e.g. education, and for rural credit, dismantled institutional support and social networks for rural people, and imposed austerity measures, while creating pressures to increase export production. SAPs have seldom led

to poverty/hunger alleviation; rather, food insecurity has continued or even increased in many countries, while debt remains high and the poor are displaced. In Tanzania, for example, after SAPs were established, input prices increased dramatically; debt became 28 percent of GDP while aid accounted for 75 percent of GDP. Deforestation increased in miombo woodlands up to 2 percent per year, after farmers expanded cash crop cultivation, to take advantage of market liberalization policies. At the same time, reforestation and agricultural extension programs were cut.

2.4.1 Responses to household food shortages

Households facing regular incidences of food shortage have developed some strategies as coping mechanisms. However, due to lack of resources and weak institutional support, these coping mechanisms are not always effective in offsetting the impact of shortfalls in production and market uncertainties (von Braun *et al.*, 1992). The coping strategies may differ due to variations in local conditions but there is a common pattern in the sequence of responses. Examples of coping strategies include, collection of wild foods, use of inter-household transfers and loans, use of credit from merchants and money lenders, rationing of current food consumption, sale of possessions, migration to other rural areas for employment, use of food distributed through relief programs, sale of productive assets, break up of the household, and distress migration, Corbett (1988) cited by Mwagile (2001). Other coping mechanisms include changes in cropping and planting practices, dispersed grazing and migration to towns in search of employment and petty commodity production. Gittinger *et al.*, (1996) gave three responses that households follow to cope with food shortage. They include changing the structure of income by diversifying sources of income by involving in multiple agricultural and off-farm

activities, raising income levels by labour selling and varying assets to smooth consumption. These are not different from those identified by FAO (1992).

2.5 Nutrients from forest foods

According to FAO (1995a), forest foods provide a wide variety of nutrients: carbohydrates, such as starches, fructose and other soluble sugars, protein, fats and micronutrients (vitamins and minerals). Different groups consume different parts of the same species as food. For example, local people consume products of certain palm varieties as cooked fruits, the hearts of palm as vegetable oil, the sap as palm wine (the sap is rich in protein, vitamins and iron). Another example is the baobab (*Adansonia digitata*) the leaves, either fresh or dried and ground to a powder, are added to the staple of grain crops, the fruit is also eaten. Processing techniques also vary from one society to another, determining the nutritional content and quality of the food eaten. Most wild fruits and berries are rich in carbohydrates (fructose and soluble sugars), and in vitamins (in particular vitamin C) and minerals (calcium, magnesium and potassium). Nuts are rich in oils and carbohydrates and as such play a key role in people's diets. Chestnuts have been for centuries a staple food of poor rural households in forested areas of Europe. The sheabutter tree (*Butyrospermum paradoxum)* follows the oil palm as the main source of fat in Africa. Herbaceous plants and young leaves are eaten as vegetables and provide essential vitamins. Extracts such as gums and saps provide proteins and minerals. Invertebrates include leaf-eating insects, caterpillars, snails and crabs. A total of 1383 species of edible insects have been identified to date, 63.6 percent of which live in tropical forests. Insects are very efficient into converting plant protein (9-10 percent) into insect protein (44 -70 percent). They are also an important source of fat in areas where local diets are poor in fats. Caterpillars are particularly rich in vitamin B 12. Vertebrates

include mammals, bird, and freshwater fish. In many parts of the world, hunting still remains an important subsistence activity and bush meat still provides a critical source of protein for both rural and urban populations (FAO, 1995a).

2.6 Processing and preserving NWFPs

Gumbo *et al.*, (1990) reported that there are various ways of processing NWFPs such as smoking, sun- drying, crafting and making of different types of beverages and other complex processing and preservation techniques. Drying and other methods of food preservation for consumption outside their normal season appear to be very common in some parts of Zimbabwe. The fruits of *Sclerocarya birrea* can be used to make an alcohol drink which is used in parties and can occasionally be sold. *Zizyphus mucronata* fruits can also be made into an alcohol drink, which is locally sold (Gumbo, 1993).

According to Campbell *et al.*, (1995), in Zimbabwe, processed (plucked and roasted) and unprocessed birds are sold in the villages or nearby towns. Processed birds sell at 50%-100% higher price than unprocessed ones. It was further reported that the *quelea quelea* bird hunters in Zimbabwe trap 10-20 birds on a bad day and trap up to 200 birds on a good day. On a bad day income would be less than USD 0.50 for unprocessed birds while on a good day the value of all birds sold would be between USD 3 for unprocessed and USD 5-7 for processed birds.

Clarke *et al.*, (1996) reported that in Kasungu National Park, Malawi, trade in insect caterpillars is made possible due to their ability to be stored for a relatively longer period after frying, grilling or drying. Honey is harvested and sold either unprocessed or pressed

and sold as semi-processed. Honey is also widely used for making local beer, which is an important source of income for rural people (Chihongo, 1994).

2.7 Socio-economic factors influencing the use of NWFPs

2.7.1 Gender roles

Gender is a cultural construct related to the behaviour learned by men and women; it affects what they do and how they do it within a specific social setting. Gender differentiation comes about as a result of the specific experiences, knowledge and skills which, women and men develop as they carry out the productive and reproductive responsibilities assigned to the (Fernandez, 1994). The degree of gender specificity attached to the knowledge and skills within a society depends not only on the way responsibilities are allocated among men and women, but also on the degree of flexibility men and women have to carry out the other's assignments. As a result of gender specialization, the local knowledge and skills held by women often differ from those held by men. The kind of relationship which exists between these two sets of actors affects hierarchies of access, use and control of resources, resulting in different perceptions and priorities for the innovations and use of technology by women and men (Appleton and Hill, 1994).

Men and Women have different roles in collecting, processing, preserving and marketing of NWFPs. A study in western Bengal reported that women are to a large extent dependent on NWFPs for self-support and income. The study showed that women are involved three times more than men in collecting NWFPs while the consumption is the same between men and women. It was further reported that processing is the task of

women; they are also involved in marketing of NWFPs. The study further revealed that women are responsible for 75% marketing of mushrooms, fruits, flowers and liquor while men are mainly responsible for marketing *Sal (Shorea robusta)* leaves, Ford Foundation, (1998) cited by Rijsoort, (2000).

Women do collection of wild vegetables in the East Usambaras on the days when collection of fuel wood is allowed in the forest reserves (Kessy, 1998). This trend has also been observed in Zimbabwe, where it was reported that a significant difference across gender exists in terms of different resource demands (Campbell *et al.*, 1991). Along the same line it has been found that widows and widowers, though both resource dependent, utilize quite different products, the former utilizing fruits and grass while the latter rely on hunting and fishing.

There is no specialized trend on the roles of women and men with regard to collection of medicinal plants. Locally recognized traditional healers, whether men or women, frequently carry out the collection themselves in the forests partly to maintain secrecy of knowledge of relevant species (Kessy, 1998; Otieno, 2000). Katani (1999) revealed that, women collect firewood and wild foods (fruit and vegetables); hence women are knowledgeable about tree species suitable for fuel wood, vegetables and fruits. On the other hand, men are responsible for the collection of fodder for livestock; hence men are knowledgeable with different fodder plants for different animals (Katani, 1999). In Tanzania, information on gender-based local knowledge concerning collection, processing and preserving NWFPs is not readily available. It is often assumed that women are greatly involved in subsistence activities although evidence show that they are extensively involved in several forest-based gathering and processing enterprises.

Women often have little access to land and other capital resources, thus forests provide a source of raw materials and products for cash sale. In addition women often combine cash earning activities with forest- based subsistence activities such as food and medicine collection. Furthermore, many forest-based activities can be undertaken near homesteads, hence allowing women to combine them with domestic responsibilities (FAO, 1991). In general, differences in gender roles in the use of NWFPs for household food security is based on the way a particular product contributes to household food security. Products that contribute through direct consumption are under women's control while men hold control of products that have indirect contribution through income generation.

Commercialization of NWFPs has also shown some gender dimensions in that most of beekeepers are men while the majority of mat and basket makers are women. Evidence also shows that most hunters and wood carvers are men (Kajembe *et al.*, 2000).

2.7.2 Age structure and composition

Composition of household members in terms of age distribution has some implications for the household's ability to meet its food requirements. Household members who are capable of being involved in productive activities are only confined within certain age limits. For instance very young members (conventionally taken as below 15 years) and very old members assumed to be above 64 years) cannot participate in production activities due to their physiological incapability. Normally household members in these age groups are dependent on the economically active members to fulfil their needs. It is therefore important to consider household's age structures in assessing household food security.

2.7.3 Number of members in the household

The number of members in the household has an important socio-economic implication in household's ability to access enough food. A large number imply more mouths to feed and more people to share the household budget. The issue is especially relevant in the case of Tanzania where large family sizes are common because of extended family network (Mhinte, 2000).

2.7.4 Educational level

In both theoretical and practical terms, educational level of the head of household plays a significant role in enabling household's access to food. Skills and education increase working efficiency and productivity, making households with more educated heads more entitled to income and food.

2.7.5 Household income

Despite the fact that global estimates indicate that there is adequate food production; food deficit is still widely experienced (Pinstrup-Andersen *et al.*, 1997). The impressive increase in food production by many countries since late 1960's has proved that increase in production alone is not sufficient for achieving household food security. India for instance, produces surplus food but persistent malnutrition is observed in many households (Zeitlin and von Braun, 1992). Apart from food production at household level the ability to obtain food is related to the purchasing power, which in turn is related to the household income. Although income is a major determinant of household food expenditure, establishing a link between income level and nutrition in developing countries has not been easy, Morgan, (1986) cited by Mhinte, (2000). When disparities in

wealth are relatively large, per capita income or economic status is positively related to household food security, Becker, *et al.*, (1986) cited by Mhinte, (2000). But when the range of income is small, little or no relationship between income and food security is reported. However, Mahmoud (1983) and FAO (1980) cited by Mhinte, (2000) demonstrated some relationship between economic status and food consumption even in poor rural households. These researchers reported that when income is low there is inadequate portion of the income spent on food. But as income increases, it will, buy more food though a smaller proportion of that income is spent on food. There is also evidence that some forms of income do not lead to increase in food consumption. For instance large payments from cash crops or remittances are less likely to be spent on improving household food consumption patterns (Ishengoma, 1992). Such incomes are more likely to be spent on non-food items. On the other hand, farm income usually from small gardens has been positively related to nutritional status of children in India, Kumar, (1977) cited by Mhinte, (2000).

2.7 6 Population growth

Thomson and Metz (1997) narrate that at current rates of population growth, the population of the World is growing by approximately one billion people per decade. One of the major problems facing the global society is how to produce adequate food for these numbers without causing environmental degradation. The authors also point out that the population is growing fastest where people are poorest. For poor people high fertility may be a reasonable and logical choice. Labour is their main asset and children are valued for their hands rather than heads. The more quickly countries enter into the demographic transition; the more population growth will slow down. As food security increases, and poverty decreases, fertility rates decline. It is further pointed out that as women become

more educated and have more power within the household, then fertility rates fall, women's options increase and they are no longer valued primarily for their fertility. Reducing population growth is also important for environmental concerns. Population growth leads to decreasing per capita availability of fixed resources, such as land.

2.8 Deforestation and availability of Non-Wood Forest Products

Tropical forests are located in the areas of the world with the highest concentration of food insecurity. They are home to approximately 300 million people who depend on shifting cultivation, hunting and gathering to survive (FAO, 1996a); many are at risk of not consuming enough food to meet their daily energy requirements on a chronic, transitory or seasonal basis. In addition to these forest inhabitants, millions of people living adjacent to forest areas depend on forests for some aspects of their food security (Lipper, 2000).

Deforestation and forest degradation are impairing the capacity of forests to contribute to food security and other needs. Tropical forests are currently experiencing the highest rates of clearance and degradation. From 1980 to 1990,an estimated 146 million ha of natural forests in the tropics were cleared, with an additional loss of 65 million ha between 1990 and 1995 (FAO, 1997).

The full implication of the loss or deterioration of tropical forests for humankind as well as other life forms is not known. What is known, however, is that the loss of forest resources can lead to diminished income and food generating capacity for forest-dependent communities. Also, higher rates of soil erosion and siltation of waterways, loss

of species and genetic diversity and an increase in carbon emissions, which contribute to global warming (Kaimowitz, *et al.*, 1998).

In Tanzania, traditional medicine practitioners and vendors reported increased scarcity of certain species and hence the need to travel longer distances to procure supplies (Otieno, 2000).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

3.1.1 Geographical location

Mbozi district is located in the South Western corner of Mbeya Region. It lies at 914 to 2740 meters above sea level and located between 8°S to 9°3`S and 32° E to33° 5`E, (Planning commission, 1996). The study was conducted in four villages located in three divisions. The villages with their respective divisions in brackets are as follows Idiwili (Iyula), Ikomela (Vwawa), Kilimampimbi (Vwawa) and Msangano (Msangano). Figure 2 shows location of the divisions. Four proposed forest reserves were involved in this study. The forests and their respective villages in brackets were Fonera (Idiwili), Ntanzu (Ikomela), Longisonte (Kilimampimbi) and Isalalo (Msangano) in Iyula, Isandula, Vwawa and Msangano wards respectively. Figure 3 shows the location of forest reserves. Mbozi district covers 9,679 square kilometres, which is 15% of regional area. There are six divisions, 26 wards and 152 villages in the district. The district has a total arable land of 766,640 ha (Mgaya 1994).

3.1.2 Soils and vegetation

The characteristic vegetation of Mbozi district is miombo woodland. The lowland areas or the rift valley of Msangano and Kamsamba divisions which are 900-1400 m. a.s.l are characterized by deep well drained volcanic soils. The highland areas (1400-2750 m a.s.l) of Iyula, Vwawa, Igamba and Ndalambo divisions are characterized by loam and reddish soils with less of natural fertility.

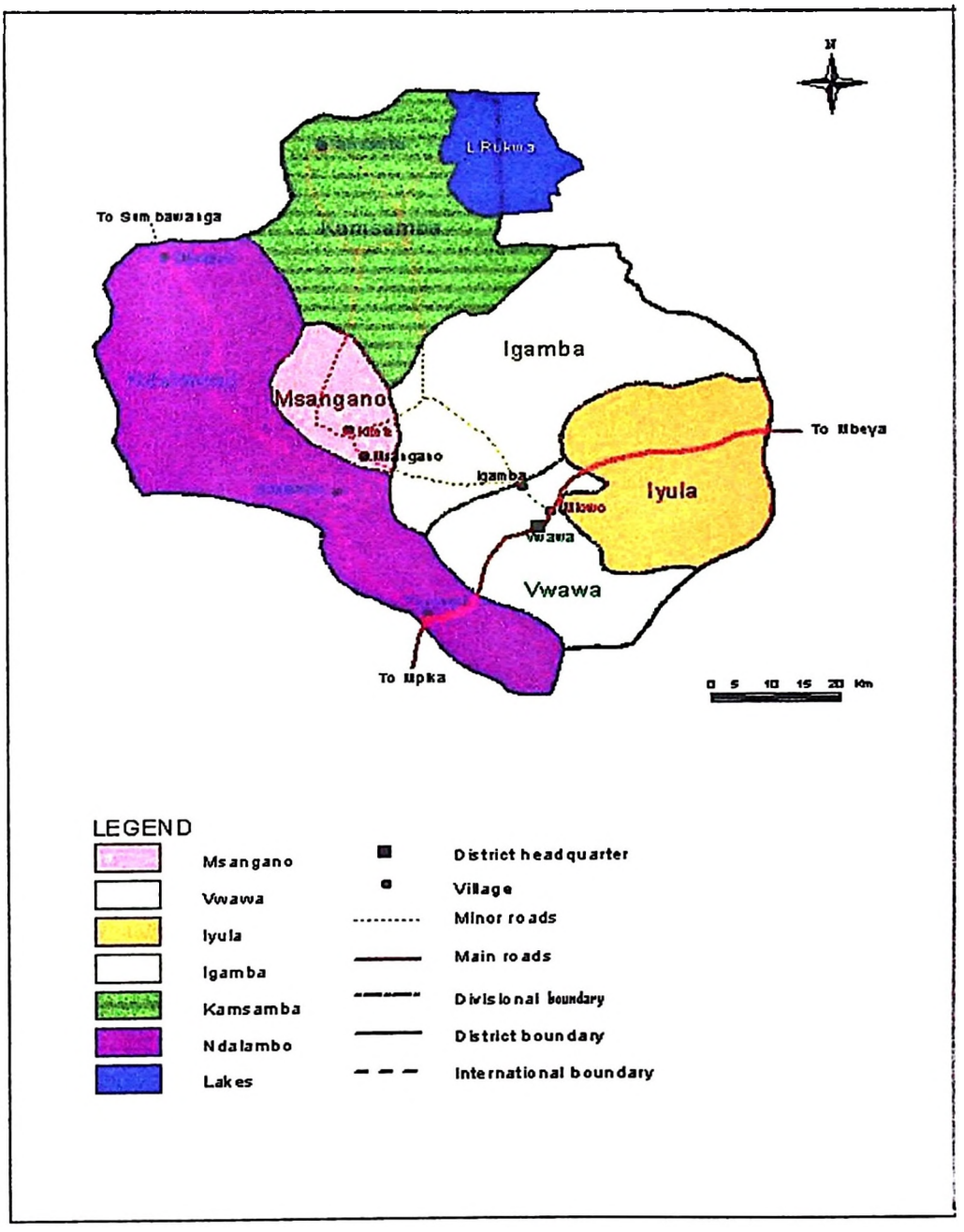

Figure 2 : Map showing divisions of Mbozi district.

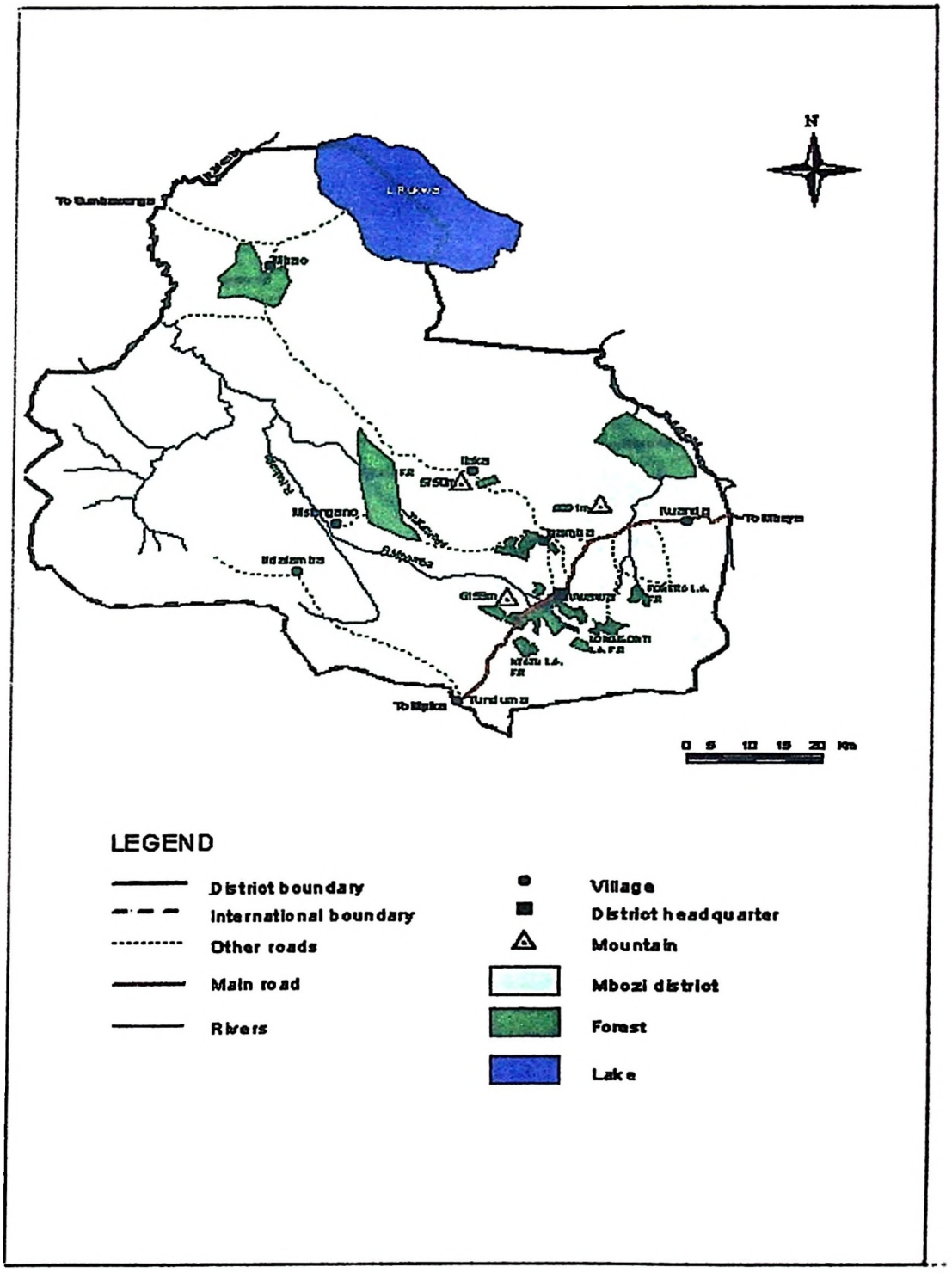

Figure 3: Map showing forest reserves in Mbozi district

3.1.3 Climate

Mbozi district has a tropical type of climate with clearly distinguished rainy and dry seasons. It receives adequate and reliable rains ranging between 1350 mm and 1550 mm per annum. The rainy season usually starts in October and ends in May. The district is moderately hot ($26^{O}C$-$28^{O}C$) in the months of August - December. It experiences cold weather ($18^{O}C$-$21^{O}C$) in June and July, while January - May are the months of average warmth ($24^{O}C$-$26^{O}C$).

3.1.4 Demography

According to 1988 census, the district was comprised of 59674 households and had 330,282 people of which 157,325 were males and 172,957 were females. The 2000 population projections were 493,576 people based on 3.4% growth rate. The district is highly populated with population density of 45 people per sq km. The major ethnic groups in terms of numbers are the Wanyiha and the Wanyamwanga. The Wanyamwanga occupy the lowland areas of Kamsamba, Msangano and Ndalambo divisions. They account for 30% of the total population of the district. The Wanyiha is the dominant ethnic group of the highland areas of Igamba, Iyula and Vwawa divisions. The Wanyiha group, account for 50% of the total population. Other ethnic groups include the Wawanda, Wanyakyusa, Wandali, Wakinga, Walambya, Wamalila, Wasafwa, Wamaasai, and Wasukuma these together accounts for 20% of the total population of the district (Planning commission 1996). Unless stated otherwise, the local language used in this document is Nyiha.

3.1.5 Farming systems and agro-ecological zones

The agricultural sector employs more than 90% of all residents in the district. Out of the total area of 967,000 hectares, 79.2% or 766,640 hectares are suitable for agricultural production. The district has three agro-ecological zones based on soil and climatic conditions, namely lowland, highland and southwestern zones.

(i) Lowland zone

This zone covers two divisions of Kamsamba that borders Lake Rukwa, and Msangano. This area is characterized by unreliable rainfall frequent food shortages and high prevalence of malaria and bilharzias. Population density is very low (15 people per sq Km) especially in Kamsamba division such that there is plenty of unoccupied land and shifting cultivation is commonly practised. In Msangano the population density is 20 people per sq Km. Soils vary from grayish brown sand on the higher areas to deep dark gray silt loams and clays in the flatter parts. The average annual rainfall is between 600 and 900 mm. The natural vegetation is mainly *Acacia combretum* woodland in higher areas and *hyparrhenia & sporobulus* grassland.

The main crops in the lowland zone are finger millet, maize (*Zea mays)*, sorghum, sesame (*Sesamum indicum*) and some paddy *(Oryza sativa)*. They are grown primarily for subsistence but surpluses are sold for cash. Livestock keeping is of considerable importance in this zone particularly in Kamsamba division while fishing is a major activity near Lake Rukwa.

(ii) Highland zone

This is also called the coffee zone. It covers the eastern part of the district, including Igamba and Iyula divisions and Vwawa division except the southwestern part of it. This is the highest, wettest and most densely populated part of the district. The population density is low to medium Igamba (55 people per sq Km), Iyula (54 people per sq Km) and Vwawa (111people per sq Km). Greater part of the zone is hilly and steeply dissected. There are areas of undulating to rolling land, particularly the plateau around Vwawa. Altitude varies from about 1000 m. a.s.l in the north to over 2000 m. a.s.l in the extreme southeast. Soils vary from reddish yellow to reddish brown clay loams and clays in the south to very dark brown gray loams and clay loams in the north. They are shallow in hilly areas but deeper on more gentle slopes. The average annual rainfall varies from 800 mm in the north to about 1500 mm in the southeast. The dominant natural vegetation is *Brachystegia and Julbernadia* woodland. The main cash crop is coffee; others include pyrethrum, and wheat for cash and food respectively. The major food crop is maize (*Zea mays)*. Other crops are finger millet, cassava (*Manihot esculentum)*, beans (*Phaseolus vulgaris*), sweet potatoes (*Ipomea batata)* and groundnuts. Cattle, sheep, and goats are the animals kept.

(iii) South western plateau zone

This includes Ndalambo division and the southwestern part of Vwawa division. This is the southeastern part of the Ufipa plateau. Population density is very low (20 per sq Km), especially in the north where there is plenty of unoccupied land and shifting cultivation *(chitemene*) is a common practice. Greater part of this zone consists of a rolling to hilly plateau, with seasonally waterlogged depressions and valleys. Elevation is between 1400

and 1800 m.a.s.l. Soils are mainly reddish brown in colour and vary from sands to sandy clay loams, except in the depressions, where there are very dark grey to black sands and loams. The average annual rainfall is about 900 to 1000 mm. The dominant vegetation is *Brachystegia* woodland. The main crop in this zone is finger millet for subsistence use and for sale. Other crops include maize, simsim, sorghum, beans, groundnuts and castor seeds (Planning commission, 1996).

3.1.5.1 Livestock keeping

In 1996, Mbozi district had an estimated 204,184 heads of indigenous cattle. According to the National Livestock Census undertaken in 1984 and 1996, there has been a significant increase in the number of livestock in the district; this is due to immigration of nomadic pastoralists into the area. The district is also estimated to have 42,096 goats and 18,900 sheep. Livestock keeping is mainly concentrated in Kamsamba, Msangano and Ndalambo divisions (Planning commission, 1996).

3.1.5.2 Beekeeping

Beekeeping is one of the economic activities being carried out by a number of households using traditional equipment and techniques. Beekeeping is practised in all the divisions. In 1995 honey production was 20885 kg with a value of 12,531,000 TSH. Beeswax production was 1392 kg with a value of 139,200 Tsh (Planning Commission, 1996).

3.2 Data Collection Methods

3.2.1 Research design

A cross-sectional survey design was used that allowed data to be collected at a single point in time (Bailey, 1994). The survey involved interviewing sampled respondents. Focus group discussions were also used. According to Bailey (1994), the design uses minimum time and resources. The study was carried out in two phases. Phase one constituted a preliminary survey, in which Participatory Rural Appraisal techniques were employed in Kilimampimbi, Hasamba and Ilyika Villages. The purpose of this phase was to help the researcher to get accustomed to the study area and select study villages. The second phase was based mainly on questionnaire survey.

3.2.1.1 Participatory Rural Appraisal

Participatory Rural Appraisal (PRA) approach is essentially a process of learning about rural conditions in an intensive, interactive and expeditious manner (Mearns, 1994). A total of 13 households constituted a PRA group in Kilimampimbi, Hasamba and Ilyika villages. The group included 16 women and 13 men. Methods applied were designed in such a way that they quickly generated information and hypotheses about local conditions and livelihoods.

The methods used include direct observation, participatory resource mapping and modelling, seasonal calendars, semi-structured interviews, local histories, and pair wise ranking and scoring. These methods ensured that participants in the discussions were relaxed and thus provided maximum cooperation. These methods were preferred because they assist respondents to evaluate their own situations (Mearns, 1994). Pre-testing of

questionnaire went alongside with the PRA techniques to check the reliability and validity of the questions. As a result of the pre-testing, re-arrangement of some questions was done in order to get a good flow of information.

3.2.1.2 Sampling method

A multi-stage sampling technique was employed. Three divisions out of six were selected (Vwawa, Msangano and Iyula), basing on availability of NWFPs and accessibility in terms of transport. Then four wards were chosen on the basis of close proximity to forest reserves and accessibility. The wards involved were Isandula &Vwawa in Vwawa division; Msangano in Msangano division and Iyula in Iyula division. Then one village very close to the forest reserve in each ward was selected. The villages involved were Ikomela, Kilimampimbi, Msangano and Idiwili in Isandula, Vwawa, Msangano and Iyula wards respectively. The sampling unit in this study was a household. Random sampling of households from village registers was done. The household here is taken as the unit of analysis because it is where all decisions about production, collection, investment and consumption are primarily taken (Thomson and Metz, 1997). The household is defined as the members of the family who dwell under the same roof and share the same bowl, and they usually share dwelling houses and may cultivate the same land (Makundi, 1996). They recognize the authority of one person, the household head, who is the ultimate decision maker for the household (Kajembe, 1994).

The sample size was 5% of the total number of households in each village (as shown in Table 1). A random sample should at least constitute 5% of the total population to be a representative of that population (Boyd *et al.*, 1981 cited by Kajembe and Luoga, 1996).

In each village, the households interviewed consisted of female and male-headed households. Heads of the households were the key respondents but other members of the households were encouraged to attend so as to supplement information.

Table 1: Number and proportion of households sampled in each study village

Village name	Number of households	Sample size	Percentage sampled
Idiwili	320	16	5
Ikomela	306	15	5
Kilimampimbi	499	25	5
Msangano	308	15	5
Total	1433	71	5

3.2.1.3 Questionnaire survey

In the second phase of the study a structured and semi- structured questionnaire was used as a tool for interviewing heads of households although other members of the household were allowed to participate so as to supplement information. The questionnaire was designed to permit acquisition of both quantitative and qualitative information. Both open and close-ended questions were included. In the open-ended questions respondents had to give their own views while in close-ended questions they had to choose among the given alternatives (Appendix 1). Data collection did focus on collectors and end users of NWFPs. The data included socio-economic variables such as occupation, education, household composition, amount of NWFPs collected and used per week, availability of NWFPs, demand for NWFPs. Others included market prices, and roles of men and women in collecting, processing and preserving of NWFPs, household sources of income, agricultural crops (cash and food) and other various sources of food. A checklist was used to interview key informants such as village leaders and elders, extension workers and traditional healers (Appendix 2). Key informants are individuals who are accessible,

willing to talk and have wide knowledge about the issues in question. Key informants are not only members of the clientele, but are most often informed outsiders (Mettrick, 1993).

3.2.1.4 Transect walk

According to Martin (1995), tribal and non- tribal people who have strong ties to the forest can identify hundreds of productive species and how they are used as source of food, medicine, and fibre and construction materials. With this knowledge in mind, a purposeful selection of at least 5 people as key informants with the researcher conducted a transect walk through the forest. Transect walk involved physical observation and identification of plant species useful to villagers. Plant specimens were taken pressed and labelled for scientific identification.

3.2.1.5 Group interviews

This involved participating in casual talks with local people on various issues focusing on food security and collection of NWFPs, their availability and uses. Such conversations were held in places where the researcher and villagers found appropriate. Information collected was documented immediately after the conversation.

3.2.2 Secondary data

These involved collecting information from different sources including books, journals and official reports, in libraries, NGOs, relevant government offices and other institutions. The electronic databases such as the CD-ROMs and websites were also explored.

3.2.3 Data analysis

3.2.3.1 Qualitative data analysis

Consultation with plant identification experts at the National Tree Seed Herbarium in Morogoro helped to identify some of the collected plant sample species. Other samples of plant species were identified by the help of officers from Natural Resources Department at Vwawa, Officers of Agricultural Development Project (ADP) Mbozi branch and botanists at SUA. Data collected through PRA techniques in phase one, were analysed with the help villagers and results were communicated back to them for verification. Content and structural-functional analyses were used to analyse qualitative data and information. The components of verbal discussion were analysed in detail with the help of content analysis method. In this way the recorded dialogue was broken down into smallest meaningful units of information. This helped the researcher in ascertaining values and attitudes of the respondents.

Structural-Functional analysis helped to explain social facts as they were related to each other within the social system and to the physical surroundings. This analysis helped the researcher to distinguish between latent and manifest functions. Latent functions are 'those consequences which are neither intended nor recognized by actors in the system'. Manifest functions are 'those consequences which are intended and recognized' (Kajembe and Luoga, 1996).

3.2.3.2 Quantitative data analysis

The data collected through questionnaire were compiled, summarized and analysed by using the Statistical Package for Social Sciences (SPSS) to obtain descriptive statistics

such as percentages, means, standard deviations and coefficient of variation. Moreover, inferential analyses were done to find relationships between some variables and to provide an idea about whether the patterns described in the samples were likely to apply in the population from which the samples were drawn (Kajembe, 1994). In this regard, cross tabulations and multiple regressions were applied. Cross tabulation is both the commonest and powerful method of data presentation, Casey and Kumar, (1988) cited by Mwagile, (2001).

Multiple regressions were used to show the relationship between per capita key NWFPs collected and utilized per year as dependent variables and socio-economic factors as independent variables. Per capita collections were used as dependent variables instead of gross household collections, because they reflect individual level of consumption for each member in the household. For a household with very few members even a small amount of NWFPs collected was found to be more meaningful than for a household with a considerable number of members. By using this criterion households with higher per capita values were considered more dependent on NWFPs than others. The general model used in multiple regressions was:

$$Y_i = a + b_1X_1 + b_2X_2 + \ldots\ldots B_kX_k + e_i$$

Where:

Y_i = the i^{th} observed value of the dependent variable which was per capita key NWFPs collected.

X_1 to X_k= independent variables which were age, number of years in formal education, income (purchasing power), farm size, number of wives, household size & composition and residence duration.

a = intercept

b_1 to b_k= regression coefficients

e = error term

i = 1, 2 ....n

Multiple regressions were used due to the fact that, first, they almost inevitably offer fuller explanations of the dependent variables, since very few phenomena are products of a single cause. Second, the effect of a particular independent variable is removed. Partial regression coefficients (beta weights) were used to explain different phenomena. Coefficient of determination (adjusted R^2) was used to tell how much variation in the dependent variable was explained by the independent variables. The higher the value of R^2 the stronger the model. The regression equation developed in this study emphasized explanation rather than prediction.

Hypotheses tested were:

H_0: $b \neq 0$ (Meaning that there was no correlation between key NWFPs (dependent variable) and socio-economic factors (independent variables).

H_1: $b=0$ Meaning that there was positive or negative correlation between key NWFPs and socio-economic factors.

A two tailed t-test at 0.1, 0.01 and 0.05 levels of significance were used, that is, H_0: was rejected where $P < 0.1$, $P < 0.01$ and $P < 0.05$.

- **Multicollinearity**

Multicollinearity refers to presence of high correlation among explanatory variables in a model. The problem of multicollinearity becomes serious when at least one of the independent variables highly correlates with other variables with Pearson correlation

coefficient of at least 0.8 (Menard, 1995). High multicollinearity can affect the reliability of the estimates of the separate effects. A correlation showed that there was no pair of independent variables that correlated with a Pearson correlation coefficient approaching 0.8. The matrix confirmed absence of serious multicollinearity.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Non-Wood Forest Products in the study area

4.1.1 Species commonly used in the study villages

Respondents were asked to mention species of NWFPs commonly used in their area. As shown in Table 2, Kilimampimbi village had high number of fruit species (22) followed by Msangano (11) Ikomela (10) and Idiwili (7). Msangano had high number of vegetable species mentioned (9) followed by Ikomela (4), Idiwili (3) and Kilimampimbi (2). Msangano village had the highest number of wild roots and tubers (6), which are mostly used during food shortages.

Table 2: Distribution of species mentioned per study village

	Number of Species Mentioned			
NWFP	Kilimampimbi	Ikomela	Msangano	Idiwili
Fruits	22	10	11	7
Vegetables	2	4	9	3
Roots and tubers	2	-	6	1
Mushrooms	87	5	2	1
Insects	4	4	7	4
Birds	2	2	2	2
Small animals	5	5	-	10
Fiber	7	8	4	3
Medicine	12	10	14	10
Fodder	2	4	3	12
Resins/gums/glue	6	4	2	4
Oil seeds	1	1	3	5
Fencing	4	3	2	8
Thatching	5	3	3	5
Drink	1	2	5	4

The high number of wild roots consumed in Msangano show that respondents in that area are more knowledgeable about edible wild roots probably due to the fact that the area has unreliable rains and faces frequent food shortages as explained in section 3.1.5.

Kilimampimbi had the highest number of mushroom species (7) mentioned followed by Ikomela village (5). Both villages are in Vwawa division.

4.1.2 Collection of NWFPs

Table 3 shows that Mushrooms, fruits, vegetables and insects had higher frequency of collection and this indicates that most respondents are familiar with the wild food items in their surroundings. Other wild foods collected include birds, small animals, roots & tubers and honey. Honey collection and hunting of small animals is mostly done by men. Boys do catching of birds; gum is used in trapping birds. Women mostly collect roots and tubers in times of critical food shortages with a few exceptions of *Eriosema burkei* and *Satyrium spp* that are collected for cash earning.

Table 3 Frequency of collection of NWFPs in the study area

Item	Frequency (n=71)	Percentage (n=71)
Fruits	67	94.4
Vegetables	66	93.0
Roots and tubers	18	25.4
Mushrooms	68	95.8
Insects	65	91.6
Birds	28	39.4
Small animals	21	29.6
Honey	15	21.1

Figure 4 shows that 7% of respondents reported to collect NWFPs daily. The majority reported to collect weekly (45%) while 16% reported to do it monthly. However, 32% reported to collect quarterly.

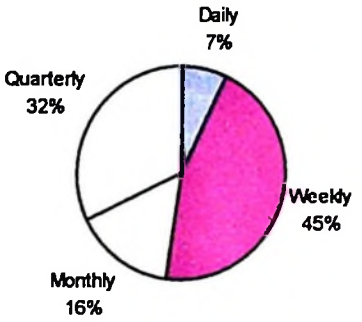

Figure 4: Frequency of collection of NWFPs

4.1.3 Availability of NWFPs

Current availability of NWFPs was compared to the past and the majority of respondents (98.4%) reported a decrease in availability while 1.6% reported that NWFPs are adequately available (Table 4). Respondents also reported that they walk longer distances and use more time in searching for NWFPs as compared to the past. It seems that the decrease in NWFPs is due to clearance of forests and woodlands for settlement and expansion of agricultural activities. It was also observed that the common methods used to harvest NWFPs include debarking of tree trunks and roots, peeling of tree stems, cutting shoots, picking fresh leaves, and uprooting of some species such as *Satyrium spp.* and *Eriosema burkei*. Some of these methods such as peeling, debarking and uprooting are detrimental. It is worthy noting that overharvesting of *Satyrium spp.* and *Eriosema burkei* was observed.

Table 4: Availability of NWFPs in the study villages

Response	Percentage
Decreased	98.4
Same/constant	1.6
Total	100.0

4.1.3.1 Suggested methods to improve availability of NWFPs

The suggested best methods to improve availability of NWFPs include controlling livestock grazing (9.2%) protecting forests from fire (50.7%), planting trees near homesteads to minimize pressure in the forests (12%), controlling tree cutting (12%) and environmental protection as a whole (10.6%). Other suggestions include controlling human population growth (2.1%) and educating the public about the importance of protecting forests (3.5%), (Table 5).

Table 5: Improving availability of NWFPs

Response	Percentage
Controlling livestock grazing	9.2
Forest protection from fire	50.7
Tree planting near homesteads	12.0
Population growth control	2.1
Controlling tree cutting down	12.0
Environmental protection	10.6
Public education on the importance of protecting forests	3.5

4.1.4 Wild vegetables commonly used in the study area

The respondents mentioned 11 species of wild vegetables commonly used in the study area (Table 6). The identified species include *Xanthoxylum chalybeum*, *Maerus edulis*, *Sesamum spp*, *Solanum gilo*, *Pistia Stratiotea*, *Arundinaria alpina*, *Solanum nigrum*, *Solanum incunum*, *Gynandropsis gynandra*, *Astripomoea hyoscyamoides* and *Ipomea spp*. The identified vegetables include herbs, flowers, climbers, tree leaves and bamboo

shoots. 54.5% of the vegetables mentioned were identified in the lowland semi-arid agro ecological zone of Msangano. This shows that the use of wild vegetables is more popular among residents of the lowland area. And these people are more knowledgeable about edible wild vegetables. A study of valuation of non-timber and other forest products by Maximillian (1998) found that six species of vegetables were commonly used around North Ruvu Forest. Ogle & Grivetti, (1985) identified 48 species of wild vegetables in Swaziland and Uiso & Johns (1996) found 19 species of wild vegetables commonly consumed in Tarime. Kumar and Sastry (1999) also reported consumption of bamboo shoots and noted that shoots of some bamboo species are not only edible and succulent but also nutritious.

Table 6: Wild vegetables used in the study area

Local name	Scientific name	Season
Isambwe/usambwe	*Astripomoea hyoscyamoides*	Dec – May
Pupwe	*Zanthoxylum chalybeum*	Dec – April
Usakasaka	*Maerus edulis*	Year round
Emang'a	*Sesamum spp.*	July – Oct
Mpulula	*Solanum gilo*	Year round
Chifutila	*Pistia stratiotea*	Dec – May
Ekalazi (shoot)	*Arundinaria alpina*	Dec – Jan
Sungwi	*Solanum nigrum*	Year round
Indunu	*Solanum incunum*	Year round
Mzimwa	*Gynandropsis gynandra*	Year round
Esungulwa	*Ipomea spp.*	Year round

4.1.5 Wild fruit species commonly used in the study villages

The study identified 33 species of fruits commonly used in the study area (Table 7). The most preferred fruit tree species include *Uapaca kirkiana, Parinari curatellifolia, Vitex mombasae, Passiflora edulis, Annona senegalensis, Vitex doniana* and *Azanza garkeana.*

Table 7: Wild fruits used in the study area

Local name	Scientific name	Maturing season
Makusu	*Uapaca kirkiana*	Sept – Dec
Makuyu	*Ficus sycomorus*	Year round
Imbula/Mawula	*Parinari curatellifolia*	Sept – Nov
Mafungo	*Saba florida*	Sept – Nov
Masugwa	*Syzygium cordatum*	April – May
Insongwa	*Garcinia spp*	Sept – Nov
Mafyomi	*Syzygium cuminii*	Sept – Dec
Busambya	*Markhamia lutea*	April – Sept
Chabugali	*Annona squamosa*	May – Aug
Masasati	*Vitex mombasae*	April – July
Malonji/Mambolesi	*Passiflora edulis*	Jan – July
Manjama	*Physalis peruviana*	Oct – Nov
Manona	*Annona senegalensis*	Aug – Oct
Mapunungu	*Vitex doniana*	April – July
Mantonongwa	*Vangueria madagascariensis*	Oct – Jan
Buluba	*Rubus spp*	Year round
Itwinza	*Kigelia Africana*	Sept – Nov
Amahoya	*Ensete Ventricosum*	Year round
Mkwa	*Strychnos innocua*	Feb – May
Ming'ongo	*Sclerocarya birrea*	Oct-Feb
Liwisha/Mswisa	*Myrianthus holstii (moraceae)*	July-Sept
Magwigwi	*Lannea schweinfurthii*	Aug – Oct
Mafisya	*Syzygium guineense*	Sept – Oct
Matowo	*Azanza garkeana*	June – July
Mikole (mipele)	*Grewia bicolour*	Dec – Feb
Kafupa	*Ximenia caffra*	Feb – April
Mlewe	*Rauvolfia caffra*	November
Zanza	*Cordia monioica*	June – July
Nkaipame	*Canthium crassum*	Nov – Dec
Tumilwa	*Strychnas cocculoides*	Nov – Dec
Mapensya	*Manilkaras mochisia*	Nov – Dec
Enakabinibini	*Syzygium owariense*	Nov – Dec
Msisi	*Tamarindus indica*	July – Dec

The peak season for most wild fruits is between October and March with a few exceptions that mature between April and September. In most of the households, women collect fruits while collecting vegetables, mushrooms and firewood. Children were

reported to collect and eat wild fruits while herding. Wild fruits are eaten between meals as snacks. No household reported to eat fruits as a main meal. Ogle and Grivetti (1985) observed that in Swaziland, children do collect and consume more species of fruits than adults. In Southern Zimbabwe, Campbell (1986) reported that no household had been eating wild fruits in the main meal but wild fruits are important supplementary food source. It was observed during this study that apart from few avocado (*Persea americana*) trees, banana *(Mussa spp)* stems and mango *(Mangifera indica)* trees, there were no other exotic fruits in the area. It was also observed that some wild fruit trees were retained in the farms to provide shade and fruits during farm work. Some fruits were found rotting on the ground indicating that there are plenty of fruits especially during peak seasons. It was argued by Ramadhani *et al.*, (1998) that despite the abundance of wild fruits in miombo woodlands of Tanzania, they are given less attention. The reported fruits preferred for making beverage in this study include *Tamarindus indica, Parinari curatellifolia, Cordia monioica* and *Ximenia caffra.* It was also reported that the mesocarp of *Parinari curatellifolia* could be added to cereal porridge as a substitute for sugar.

4.1.6 Commonly consumed wild mushroom species in the study area

This study identified nine species of mushrooms commonly consumed in Mbozi district. These include *Termitomyces aurantiacus, Lactarius spp .aff. pseudovolemus., Lactarius kabansus, Amanita zambiana,, Termitomyces letestui* and *Russula cellulata.* Others were *Lactarius edulis, Cantharellus symoensii and Termitomyces microcarpus (*Table 8). Mushrooms in the study villages were highly valued and considered as delicacy.

Table 8: Mushrooms consumed in the study area

Vernacular	Scientific name	Season
Ngunda	*Termitomyces aurantiacus*	Jan – April
Kambakas	*Lactarius kabansus*	Nov – April
Umpofu	*Lactariusspp.aff. pseudovolemus.*	March
Ndelema	*Amanita zambiana*	Nov – April
Mvumbu	*Termitomyces letestui*	Sept – Dec
Mongwe	*Russula cellulata*	Dec – Feb
Sokwa	*Lactarius edulis*	Nov – Jan
Namasiti	*Cantharellus symoensii*	Oct – Jan
Unyasua/Uwusonge	*Termitomyces microcarpus*	Dec – Feb

Harvesting of mushrooms involved uprooting the whole stem. Boys collect mushrooms while herding or go purposely for mushroom picking while girls and their mothers collect mushrooms during vegetable and firewood collection. Adult men pick mushrooms when they go for hunting and collection of fibre, honey and craft materials. Women must identify the mushrooms before cooking them. Mushrooms brought home after sunset, are not cooked till the next day after proper identification. Children are not allowed to cook mushrooms in the absence of the mother or adult woman. This is to avoid consumption of poisonous species of mushrooms. Respondents reported to prepare mushrooms by stewing, frying and grilling then eaten with stiff porridge, cooked rice and other staple foods. Respondents reported to collect and consume mushrooms every day during the peak season, which falls between November and March. These results conform to those of Harkonen *et al.*, (1995), who reported that mushrooms are consumed every day among the Bena, Hehe, Makua, Nyamwezi, Nyiha and Sambaa during rainy season.

4.1.7 Edible insects

Three species of edible insects were identified. These include: *Hoplocerambyx spinicormis*, *Hoplocerambyx severus*, and *Scarabaeidae* (Table 9). The first two are caterpillars while the third is termite. The caterpillars are collected from some miombo trees such as *Brachystegia spiciformis, Brachystegia microphylla* and *Julbernardia paniculata.* The caterpillars are collected by women and children and roasted before being used as food; they are rarely sold. Termites are also collected by women and children and grilled, fried or roasted before being consumed or sold. Most households interviewed reported to sell some termites. The processed insects are eaten as snack and/or eaten with the staple food *ugali.* These insects are good sources of animal protein and good substitutes for meat or fish, which are too expensive for the smallholder farmers.

Table 9: Edible insects in the study area

Local name	Scientific name	Season
Amabungu/Amongo	*Hopoloceramb*yx *spinicormis*	Oct – April
Masenda	*Hoplocerambyx severus*	Year round
Nswa/Samlasi/Imbebe	*Scarabaeidae*	Dec – Jan

4.1.8 Bush meat

Traditional hunting of wild animals offers food and protein supplements. The study identified three species of rodents namely *Mastomyms natalensis*, *Tachyoryctes spp.* and *Cricetomys gambianus*, which are consumed in the study area. Species of birds identified include *Francolin francolinus*, *Numida micrata* and some small birds like *Oriolus larvatus*, *Glareola pratincola*, *Paridae* and *Nectarinidae* family. Six species of small animals commonly hunted were identified. These include, *Lepus capensis, Hippotragus spp., Canis spp., Papio spp., Hippotragus spp.* and *Heliosciurus spp* (Table 10).

Table 10: Rodents, other small wild animals and birds

Local name	Scientific name	Season
I. Rodents		
Imbeba (shamba rat)	*Mast omyms natalensis*	Year round
Utunko (mole rat)	*Tachyoryctes spp*	Year round
Impenga (giant rat)	*Cricetomys gambianus*	Year round
Usindi	*Heliosciurus spp.*	Year round
II.Birds		
Inkwale	*Francolin francolinus*	Year round
Kanga	*Numida mitrata*	Year round
Njuni (Collective name for all small birds)	*Oriolus larvatus* *Paridae family* *Nectarinidae family* *Glareola pratincola*	Year round
III.Small animals		
Halulu	*Lepus capensis*	Year round
Ndondoli	*Hippotragus spp*	Year round
Habila	*Canis spp.*	Year round
Mbwaji	*Papio spp.*	Year round
Inkanya	*Hippotragus spp.*	Year round

Most small animals were mentioned in Idiwili village, which is close to Fonera Forest Reserve. This indicates that some small animals still exist in Fonera Forest Reserve while there is no trace of small animals in other forests. Bush meat is the meat of animals that live in forests, from gorillas to rodents (FAO, 2002). However, respondents reported a decrease in bush meat. Many animal species are being hunted at a rate that outpaces their ability to reproduce and replenish their populations (FAO, 2002).

4.1.9 Honey collection

It was reported that honey was collected from forest trees, traditional log beehives, underground caves and caves under big stones. Tree species preferred for log beehives include, mitukutu (*Vernonia* spp), miyombo (*Brachystegia* boechmii), miyepu (*Cordia monoica),* Iwombe/malembelembe (*Albizia gummifera*) Sengamino (*Bridelia micrantha*),

Mzingati (*Cordia africana*), Litanji (*Dombeya rotundifolia*), Mpunungu (*Vitex doniana)* and Mbula (*Parinari curatellifolia)* trees are used for hanging or projecting the beehives. These particular trees are not cut down because they are also used for rituals. Honey was reported to substitute sugar in tea and porridge. Respondents also reported to use honey in treatment of coughs (mixed with lemon juice). Burns and scalds are also smeared with honey to prevent blisters and enhance quick recovery. Pure honey taken orally was reported to treat gastro-intestinal ailments such as stomachache.

4.1.10 Wild roots and tubers consumed in the study area

The study identified four species of roots and tubers consumed in the study area. The species include, *Cyperus rotundus*, *Eriosema burkei, Dioscorea spp.* and *Satyrium spp* (Table 11).

Table 11: Edible roots and tubers used in the study area

Local name	Scientific name	Season
Ndao[2]	*Cyperus rotundus*	Dec – April
Utambalala[1]/ Mkoyo[2]	*Eriosema burkei*	Year round
Ming'oko[2]	*Dioscorea spp.*	Year round
Vinaka[1]/chikanda[2]	*Satyrium spp.*	Jan – May

Cyperus rotundus provide chewing tubers that can also be made into flour, which is then used to make porridge. Children like chewing tubers especially during herding. The roots of *Eriosema burkei* are used in making soft drink. The plant is used extensively and it is threatened by extinction. The drink is common in Msangano division. The tubers of *Satyrium spp* are prepared and used as snack or can be prepared and used as relish and

[1] Nyiha language
[2] Nyamwanga language

eaten with the staple food stiff porridge. Plate 1 shows the *Satyrium spp* tubers and plate 2 shows the *Eriosema burkei* plant.

Ming'oko roots are prepared cooked and eaten as main dish in times of food shortages. These results conform to what other studies reported. Missano *et al.*, (1994) found in two villages of Mtwara region that Ming'oko roots are consumed throughout the year. In Kenya, Kabuye, (1986) found that wild roots and tubers were consumed only as snack while herding. Mhoro and Mtotomwema (1981) found mbao-mng'oko (a wild edible yam) being sold at Mbuyuni village, Coast region, Tanzania.

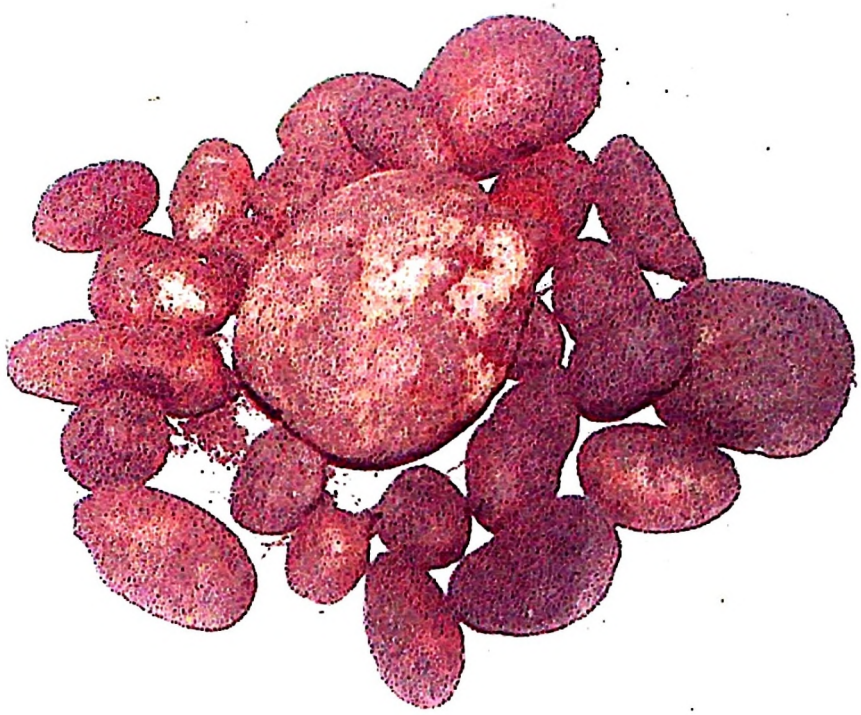

Plate 1: ***Satyrium spp***

Plate 2: Eriosema burkei

4.1.11 Wild oil seeds commonly used in the study villages

Three species of wild oil were identified (Table 12). The oil seeds especially the *Parinari curatelliforia* and *Telfaria pedata* seeds were reported to have wide application in cooking vegetables and other relishes. Respondents reported that the seeds of *Ricinus comunis* have no application in food preparation but are used in treatment of skin diseases and if swallowed, help in sight improvement. The edible wild oil seeds substitute the industrial oils, which are expensive.

Table 12: Wild oil seeds

Local name	Scientific name	Season
Imbula	*Prinari curatelliforia*	September-November
Itandu	*Telfairia pedata*	June-September
Imbono	*Ricinus comunis*	July-November

4.1.12 Plant species used for rope making in the study area

About eight species were reported to provide fibres in the study area (Table 13). The fibres are used for tying together head loads of fire wood, thatch grass and construction materials. The fibres are also woven into strong ropes and used to tie cattle and goat.

Table 13: Plant species used for fibre production

Local name	Scientific name	Use
Ivumu	*Borassus aethipum*	Rope making
Ilonji	*Passiflora edulis*	Ropes
Indola	*Ficus thoningii*	Rope making
Indulwe	*Desmodium spp*	Ropes
Ing'anzo	*Brachystegia boemnii*	Rope making
Itukutu	*Julbenardia globiflora*	Rope making
Shingati/zingati	*Cordia africana*	Rope making
Amabale	*Palm spp.*	Mat making

4.1.13 Provision of gum, fodder, fencing and thatching materials in the study area

Three species were reported to provide gum namely *Ficus sycomorus*, *Borassus aethiopum* and *Ficus thoningii*. The gum is used for catching birds for home consumption. About ten species of plants were identified as commonly used fodder for livestock (Table 14). Fodder from forests was reported to be especially important during dry season when crop residues in fields and fodder in general lands have been exhausted.

Table 14: Plant species used as fodder for livestock

Local name	Scientific name	Season
Ipepete	*Heteropogon contotus*	June - November
Iyegeye	*Nicandra physalodes*	May - September
Chigugu	*Clandestenum purpuneum*	Year round
Sankwa	*Digitaria scalarum*	Jan- May
Masale	*Panicum cloratum*	May-Dec
Imbwela	*Hyperrhenia silipendula*	April-Nov
Matete	*Phragimites mauritanus*	May-October
Igwina tree leaves	*Breonardia salicina*	Year round
Iteti tree leaves	*Ocotea usambarensis*	Year round
Ihangaga	*Cyperus spp.*	June -November

Five species of plants were reported to provide fencing materials (Table 15). Fencing was reported to be important in protecting huts and houses from strong winds and to protect field crops from livestock.

Table 15: Plant species used for provision of fencing material

Local name	Scientific name	Season
Amalanzi	*Arundinaria alpina*	Year round
Indete	*Phragmites mauritianus*	Year round
Isale	*Panicum cloratum*	May - November
Ipepete	*Heteropogon contotus*	July - November
Kigugu	*Pennisetum purpuneum*	Year round

Six species of plants commonly used for thatching were reported (Table 16). Most houses in the study villages were grass thatched indicating the importance of thatching grass in this area

Table 16: Plant species used as thatching material

Local name	Scientific name	Season
Insano	*Cymbogon spp.*	June-November
Impwela	*Hyparrhenia silipendula*	April-November
Intyetye/hatyetye	*Hyparihenia ruffa*	July-Dec
Igawo	*Ensete ventiracosum*	Year round
Ipepete	*Heteropogon contotus*	July-November
Ingonangila	*Pennisetum clandestinum*	Year round

4.1.14 Traditional medicine

Respondents reported about forty plant species used to treat various human diseases in the study area. The medicines are also sold in the market to earn cash income. Traditional medicines help to keep labour force healthy during the agricultural season, thus ensuring higher productivity. Most respondents reported to use traditional medicines rather than conventional medicines, which are expensive and villagers have to walk long distances to reach health centres. Traditional healers were able to give some description on the species they use and the diseases they cure. Traditional healers interviewed reported to mix several species of plants for treatment of certain diseases. They reported to earn an average of 3000/= Tshs per day. None of them reported to buy food using this income. The species used and diseases treated are summarized in Appendix 3.

Traditional medicines were also reported to treat some animal diseases. Examples include *Datura stramonium* mixed with water to treat New Castle Disease (NCD) in poultry; the bark of *Garcinia spp* is pound, mixed with water and honey or the roots are pound and mixed with honey to treat black quarter in cattle; the leaves of *Ocotea usambarensis*, and *Rauvolfia caffra* pound together with caustic soda, are used in the treatment of fever in cattle, goat and sheep. Also the mixture is used to treat black quarter in cattle. A solution of crushed leaves of *Vernonia myriantha* is sprayed to livestock to control ticks. Some NWFPs were reported to control field and storage pests. For instance tobacco powder mixed with powder of *Tephrosia vogelii* or the latter alone controls maize weevils. A solution made from leaves of *Physallis peruviana* is sprayed in field to control maize stalk borer, bean weevils and bean bruchid. The powder made from leaves of *Vernonia myriantha* is applied to grains to control storage pests.

4.1.15 Craft materials

All plant species used for mats, baskets, household decorations and rope making are included in this group. The species include Indete[1] (*Phragmites mauritianus)* ekalazi[2] *(Arundinaria alpina),* misoko (*Cyperus rutunus*), mitukutu[2](Vernonia spp.), mitowo[2] (*Azanza garkeana*), ivumu[1] (*Borassius aethiopium*) ihangaga[1] (Cyperus spp) and mabale (Palm spp). Red dye-Nawazi[2] (*Pterocarpus angolensis)* and deep orange dye-ngenenge[1] *(Euclea divinorum)* provide dyes for decorating the household articles.

4.1.16 Seasonality of NWFPs

In the study villages, farmers rely on seasonal crop production. For many smallholder farmers, and especially for the poor, these cycles entail periods of food shortage. It is at these critical periods that the importance of forest foods is greatest. The peak season for most wild fruits in Mbozi district is between October and March with a few exceptions that mature between April and September. The traditional hungry season for this area was reported to be between November and February. This is also the period for land preparation; seed sowing and then weeding and other farm operations, such that there is little time for food preparation. Thus the peak season for wild fruits coincides with the food shortage period and peak farm operations such that wild fruits make an important part of diet. Even adults are forced to eat much of the fruits at that particular time.

For the case of vegetables it was observed that about 55% of them are available throughout the year forming an important part of relish. Mushrooms are collected from September to April with peak period being between November and March. Collection of insects was reported to start in October through to April with exception of *Hoplocerambyx severus,* which is collected throughout the year. Collection of honey was

reported to take place after every three months; honey is a good complement of calories especially during food shortage. Wild roots & tubers were reported to be collected during critical food shortage with exception of *Satyrium spp.*and *Eriosema burkei,* which were collected on commercial basis. *Cyperus rotundus* and *Satyrium spp* were collected between December and May while *Eriosema spp* and *Dioscorea spp* were available throughout the year. Because of their seasonal nature, NWFPs complement agricultural crops in improving household food security.

4.2 Contribution of NWFPs to household food security

4.2.1 Direct contribution

The direct contribution of NWFPs to household food consumption was determined by computing the contribution of NWFPs to total household consumption in terms of weight. The denominator was taken to be the total household food consumption comprising of agricultural crops & NWFPs consumed and food purchased. Contribution of NWFP to total food consumed was found to be 12.7% (Figure 5). This proportion is lower to that Wachiira (1987), in Falconer (1999), reported for forest foods in Machakos district in Kenya, which he said NWFPs contributed 35% by weight to the diet. The individual annual averages of NWFP consumed per household in kg were 90 (fruits), 59 (vegetables), 44.8 (mushrooms), 25.4 (insects) 7 (honey), 4 (small animals), 2.3 (birds), 2.1 (root & tuber). Forest foods in the study area are highly valued as they often help to even fluctuations in food supply. Furthermore, during land preparation, planting, weeding and harvesting seasons, forest fruits provide snacks, which supplement the diet due to little time available for meal preparation.

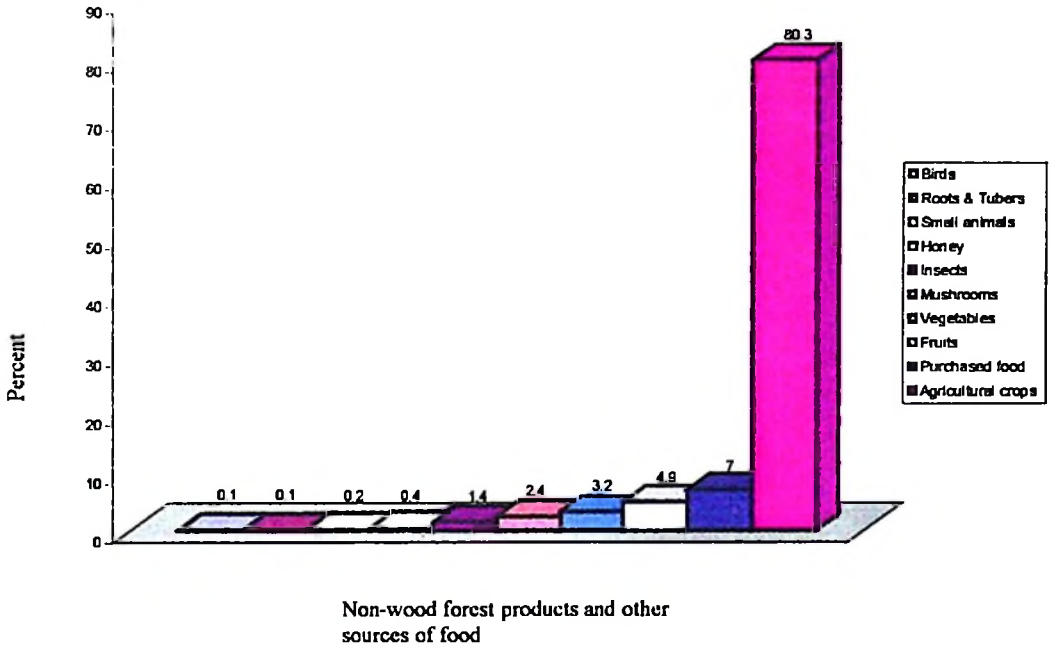

Figure 5: Contribution of NWFPs to household food consumption in terms of total weight.

4.2.2 Indirect contribution

4.2.2.1 Selling Non-wood Forest Products

About 59% of respondents reported that they do sell NWFPs weekly, 6.9% monthly while 34.5% reported to do it quarterly (Table 17). NWFPs sold include honey, roots and tubers, medicine, ropes, baskets, mats household decorations, mushrooms, and insects.

Table 17: Distribution of respondents by frequency of selling NWFPs

Response	Frequency	Percentage
Weekly	17	58.6
Monthly	2	6.9
Quarterly	10	34.5
Total	29	100

The contribution of NWFPs to total household income was found to be 7.5% (Figure 6).

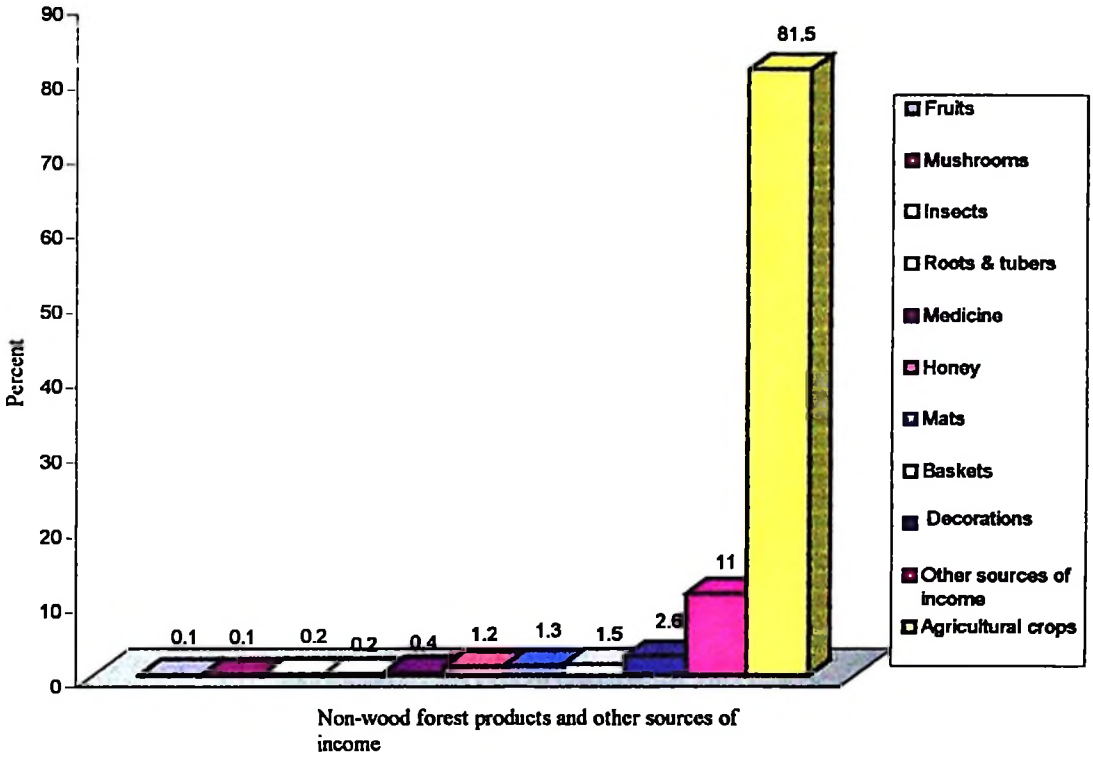

Figure 6: Contribution of NWFPs to total household cash income

The results showed that household accessories/decorations had the highest (2.6%) annual contributions to household income followed by baskets (1.5%), mats (1.3%) and honey (1.2%). Others were medicine (0.4); insects (0.2%), fruits (0.1%) and mushrooms (0.1%). These results are in contrast to the results of other studies. Barham *et al.*, (1999) reported that 3% of income was obtained from extraction of NWFPs in one of the villages in the Pacaya-Samiria National Reserve in Peru. Malhotra *et a.l.*, (1991), cited by Prasad, (1999) reported that in parts of West Bengal, communities derive as much as 17% of their annual household income from NWFPs collection and sale. It was also reported by Prasad, (1999) that small-scale forest-based enterprises, many of which rely on NWFPs, provide

up to 50% of the income for about 25% of India's rural labour force. The plausible explanation can be that economic returns to exractive activities can vary widely, even in neighbouring locations, because of differences in resource access and/or the richness of natural resource stocks. Also seasonal and unpredictable changes in the environment and in market conditions can dramatically alter incomes from extractive activities over time. The results imply that most NWFPs are collected for subsistence use rather than for sale. Although the proportion is smaller as compared to agriculture, it is important to the sellers of NWFPs since it provides income for regular household expenditures. It was reported that when farmers run out of agricultural crops, NWFPs become important sources of income. The respondents also reported that there is always something in the forest for direct consumption or for sale throughout the year.About 59% of the income from selling NWFPs was reported to be used for food purchasing.

4.3 Roles played by men and women in collecting, processing and preserving NWFPs

4.3.1 Collection of NWFPs by different members of the household

About 59% of respondents reported that women do the collection of NWFPs, 31.6% reported that men do the collection, while 9.5% of the respondents reported that children do the collection (Figure7). Women collect vegetables, mushrooms, insects, craft materials (especially the *Cyperus spp*) and fruits bearing oil seeds. Men collect honey, bush meat, fibres, craft materials such as *Arundinaria alpina* and *Phragmites mauritianus*. On the other hand children collect fruits, mushrooms, fodder, gums, and do catching of birds.

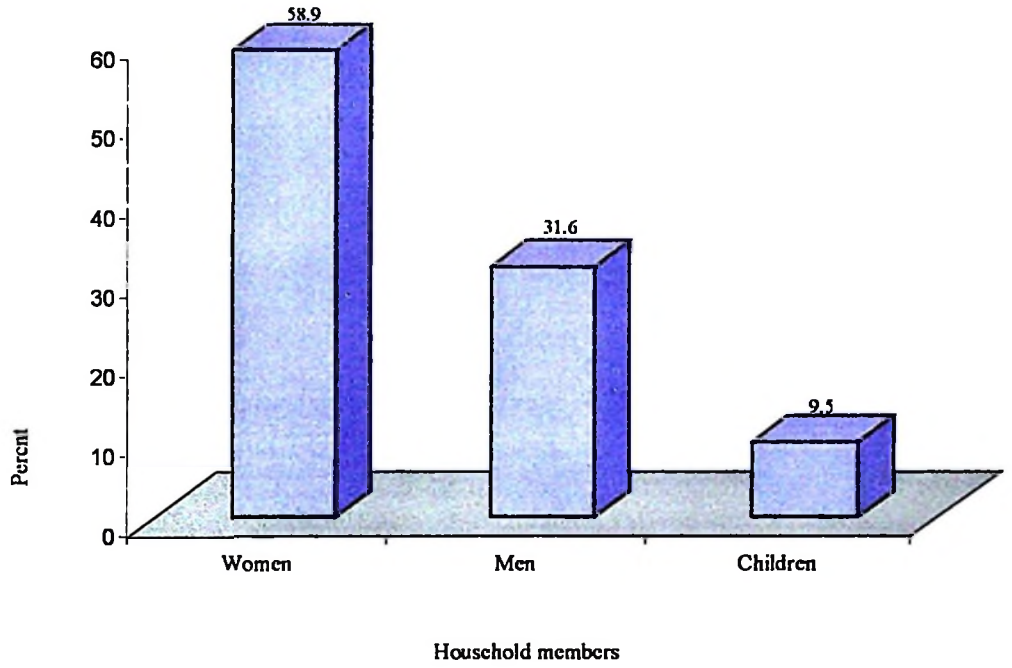

Figure 7: Collection of NWFPs by different members of the household

4.3.2 Processing

The results show that most of the processing of NWFPs, is done by women, as reported by 74.7% of the respondents. 22.9% of the respondents reported that men do the processing and 1.2% reported that children do processing while 1.2% reported that all household members do the processing (Table 18). Women and girls process vegetables, mushrooms, insects, oil seeds and make mats for household use and for sale. Men and boys process honey, bush meat, and make ropes, baskets and winnowing trays.

Table 18 Processing of NWFPs

Response	Percentage n=71
Women	74.7
Men	22.9
Children	1.2
All household members	1.2
Total	100.0

4.3.3 Preservation

Most respondents reported to preserve NWFPs (Table 19). Common methods used in preservation are sun drying and grilling. The common items preserved are vegetables, mushrooms, insects and some fruits of *Adansonia digitata*. Other items preserved are honey and bush meat. Sun drying is done during rainy season when most vegetables, insects and mushrooms are plenty and kept in big clay pots or any waterproof containers. Women preserve processed vegetables, mushrooms, and insects for future use. Men preserve processed honey and bushmeat.

Table 19: Distribution of respondents by Preservation of NWFPs

Response	Percentage n=71
Do preserve	95.6
Do not preserve	4.4
Total	100.0

The dried NWFPs are normally utilized during dry season when most NWFPs are rare. Gumbo *et al.*, (1990) reported that drying and other methods of preservation were employed on indigenous fruits in Zimbabwe for consumption in dry season.

About 93% of the respondents reported that women do the preservation of NWFPs. About 7% of the respondents reported that men do the preservation (Table 20). Women are responsible for preservation of vegetables, mushrooms, insects and fruits. Preservation of honey and bush meat is done by men.

Table 20: Involvement in preservation of NWFPs by gender

Response	Percentage n=71
Women	93.3
Men	6.7
Total	100.0

These results about collection, processing and preservation of NWFPs are similar to what other researchers reported. In Nepal women are involved three times more than men in collecting NWFPs while consumption was the same between men and women and processing was the task of women, Ford Foundation (1998) cited by Rijsoort (2000). Kessy, (1998) reported that women do the collection of vegetables in the East Usambaras on the days earmarked for collection of firewood in the forest reserves. Kainer and Duryea (1992) reported that in Acre, Brazil women have responsibilities for processing all plants intended for human and animal consumption.

4.4 Socio- economic factors influencing collection of key NWFPs.

Collection of NWFPs for household food security is to some extent influenced by a number of socio-economic factors. To ascertain the relationship between socio-economic factors and amount of NWFPs collected, a multiple regression model was developed for each of the key NWFPs collected. The key NWFPs were chosen on the basis of high proportion in terms of weight contributed to total household food consumption i.e. fruits (4.9%), vegetables (3.2%), mushrooms (2.4%) and insects (1.4%). Tables 21, 22, 23 and 24 summarise the results.

4.4.1 Multiple regressions

4.4.1.1 Per capita fruits collected

Table 21 shows significant correlations between per capita fruit collected with education level (0.05), age of household head (0.01), household size (0.05), number of male and female members of the household under 18 years old (0.1); number of male members of the household of the age18-55 years (0.05).

The results also showed positive influence with income per capita and negative influence with land under crop production. The overall coefficient of determination (adjusted R^2) was 0.683 implying that independent variables were able to explain about 68% variations in the dependent variable. This is a relatively strong model, as only 32% of the variations were not explained.

Table 21: Results of regression of per capita fruits collected

	Y R^2= 0.683		
X	Beta (b*)	T	Significance
Land under crop production	-0.175	-1.110	0.286 ns
Males under 18 years of age	-1.061	-2.075	0.057*
Females under 18 years of age	-0.567	-1.799	0.094*
Age of respondents	-0.477	-3.101	0.008***
Males of 18-55 years	-0.641	-2.527	0.024**
Household size	1.934	2.301	0.037**
Number of wives	0.289	-1.186	0.255 ns
Females of 18-55 years	0.199	-0.675	0.511 ns
Income per capita	0.231	1.342	0.201 ns
Years spent in formal education	-0.397	-2.719	0.017**

Key
X = All independent variables
Y = Dependent variable
R^2 = Coefficient of determination
b* = Beta weight
* = Significant at 0.10 level
** = Significant at 0.05 level
*** = Significant at 0.01
ns = not significant

The model results reflected F-statistics of 6.181 significant at 0.001 or 6.181***. The F-ratio measures the overall significance of a regression model. It is the test statistic for the coefficient of determination on whether it is significant or not. At 0.001 levels of significance the proposed equation is acceptable to explain the relationship between the dependent and independent variables.

4.4.1.2. Per capita vegetables collected

Table 22 shows significant correlations between per capita vegetable collection and all the independent variables included in the model. The results also showed positive correlations between per capita vegetable collection and age of respondents, number of wives, number of females between 18-55 years old, and household size. However, the model showed negative correlations with land under crop production, number of male and female household members under 18 years old, number of male household members between 18 and 55 years of age and number of years spent in formal education.

Table 22: Results of regression of per capita vegetables collected

	Y R^2= 0.694		
X	Beta (b*)	t	Significance
Land area under crop production	-0.292	-2.130	0.049**
Males less than 18 years of age	-1.181	-2.669	0.017**
Females less than 18 years of age	-0.500	-1.936	0.071*
Age of respondents	0.542	3.946	0.001***
Males of 18-55 years	-0.461	-2.448	0.026**
Household size	1.771	2.809	0.013**
Number of wives	0.492	2.588	0.020**
Females of 18-55 years	0.461	2.448	0.026**
Years spent in formal education	-0.262	-1.925	0.072*

Key: (As shown in Table 21).

The overall coefficient of determination (adjusted R^2) was 0.694 implying that independent variables were able to explain about 69% of the variations in the dependent variable. This is a relatively strong model, as only 31% of the variations were not explained. The model results reflected F-statistics of 7.814 significant at 0.000 or 7.814***.

4.4.1.3 Per capita mushrooms collected

Table 23 shows positive and significant correlations between per capita mushroom collected and number of male members of the household under 18 years old (0.1) and age of respondents (0.01). The results also indicated positive but not significant correlations between per capita mushrooms collected and residence duration, number of female household members under 18 years of age and number of males between 18 and 55 years old.

Table 23: Results of regression of per capita mushrooms collected

	Y R^2= 0.620		
X	Beta (b*)	t	Significance
Land under crop production	-0.108	0.955	0.349 ns
Males under 18 years old	0.229	1.786	0.087*
Females under 18 years old	0.149	1.006	0.324 ns
Age of respondents	0.721	5.340	0.000***
Males of 18-55 years old	0.023	0.188	0.852 ns
Residence duration	0.156	1.094	0.285 ns
Females of 18-55 years old	0.172	1.246	0.225 ns

Key: (As shown in Table 21).

The overall coefficient of determination (adjusted R^2) was 0.620, implying that independent variables were able to explain about 62% variations in the dependent variables. This is a relatively strong model as only 38% of the variations were not explained. The model reflected F-statistics of 8.218 significant at 0.000 or 8.218***.

4.4.1.4 Per capita insects collected

Table 24 shows significant correlations between per capita insects collected and number of female household members under 18 years of age, (0.01), age of respondents (0.01)

and income per capita (0.01). The model revealed positive but not significant correlations between the dependent variable and household size, land under crop production and number of years in formal education. The results also showed negative not significant correlations between per capita insects collected and number of male household members under 18 years of age, number of female & male household members between 18 and 55 years of age.

Table 24: Results of regression of per capita insects collection

	Y R^2= 0.547		
X	Beta (b*)	t	Significance
Land under crop production	0.180	1.428	0.167 ns
Males under 18 years old	-0.535	-1.229	0.232 ns
Females under 18 years old	-0.950	-2.942	0.008***
Age of respondents	-0.429	-2.998	0.007***
Males 18-55 years old	-0.200	-1.016	0.321 ns
Household size	0.984	1.310	0.204 ns
Females 18-55 years old	-0.055	-0.210	0.836 ns
Income per capita	0.484	3.362	0.003***
Years spent in formal education	0.144	0.994	0.331ns

Key: (As shown in Table 21).

The overall coefficient of determination (adjusted R^2) was 0.547 meaning that independent variables were able to explain about 55% of variations in the dependent variable. The results suggest that the model did not explain about 45% of the variations and this is a relatively weak model. Results reflected F-statistics of 5.161 significant at 0.001 or 5.161***.

4.4.2 Explanatory variables

4.4.2.1 Land under crop production

The beta weight associated with land area under crop production was positive but not significant for collection of insects (Table 24) and negative but significant at 5% for collection of vegetables (Table 22). It was also negative and not significant for collection of fruits (Table 21) and mushrooms (Table 23). The model showed that increase in land under crop production increases collection of insects but not significantly. The results also revealed a significant decrease in collection of vegetables and a decrease in collection of fruits, which is not significant. These results imply that insects are superior commodities such that even those respondents with enough land for cultivation do collect them. As shown in figure 8, most respondents had farm size of more than one hectare. It was observed during this study that households with enough farm size concentrated more on agricultural crop production rather than collecting NWFPs thus had enough food in stores.

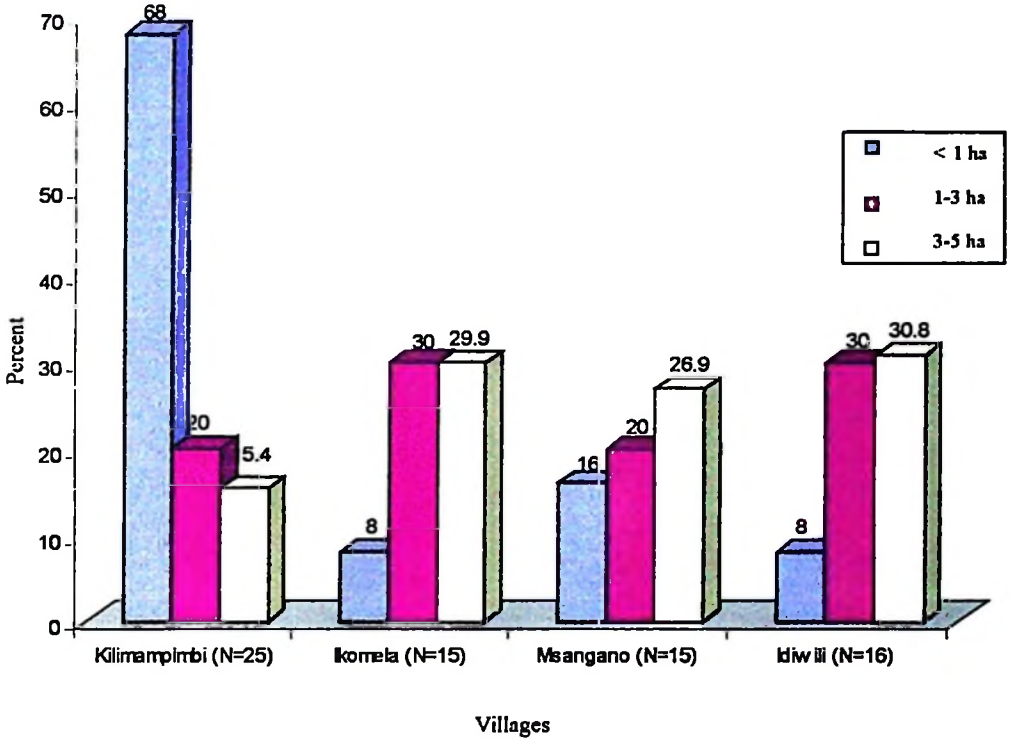

Figure 8: Distribution of farm size in hectares by village

These results are similar to that of Mwagile (2001), who reported that the odds of deciding to collect wild foods were lower for farmers who had stored more than four bags of grains than those who had stored less.

4.4.2.2 Relationship between per capita income and NWFPs

The models showed positive correlation between incomes per capita and per capita fruit collection (Table 21). The results also showed positive and significant (at 1% level) correlation between income per capita and per capita insect collection (Table 24). The variable was dropped for per capita mushroom collection and per capita vegetable collection because land under crop production increased coefficient of determination more than income per capita. The results implied that increase in per capita income

influences positively per capita fruit collection and increases per capita insect collection significantly. Plausible explanation could be that wild fruits and insects were not inferior commodities such that increase in income increased demand. Table 25 shows that most respondents had moderate to higher income.

Table 25: Distribution of household income in the study villages

Income Tsh/year	Kilimampimbi N=25		Ikomela N=15		Msangano N=15		Idiwili N=16		Total N=71	
	No.	%	No.	%	No.	%	No.	%	No.	%
<5000	12	60	2	10.0	2	10	4	20	20	100
5000-10000	6	28.6	6	28.6	4	19	5	23.8	41	100
>10000	2	10.5	2	10.5	9	47.4	6	31.6	60	100

4.4.2.3 Number of wives

Beta weight associated with number of wives was positive and significant at 5% for collection of vegetables (Table 22), negative and not significant for collection of fruits (Table 21). The variable was dropped for collection of mushrooms and insects because number of females of age under 18 years increased the coefficient of determination (adjusted R^2) than number of wives. These results imply that increase in number of wives increases collection of vegetables significantly, but influences collection of fruits negatively. Plausible explanation could be that, wives are knowledgeable about edible species of wild vegetables, their availability and preparations. Children do fruit collection, while adults regard fruits as food for children. Thus wives do not enter into the forest reserves for collection of fruit but can pick them when collecting firewood and/or vegetables. The study showed that 49.1% of the male household heads had several wives (Table 26).

Table 26: Number of wives

Number of wives	Response n=57	Percentage
1	29	50.9
2	22	38.6
3	5	8.8
5	1	1.7
Total	57	100

4.4.2.4 Residence duration

Multiple regression analysis revealed that residence duration influences positively per capita mushroom collection (Table 23). The implication could be that increase in residence duration increases collection of mushrooms and that local people are always knowledgeable about tree species associated with availability of mushrooms and differentiation between poisonous and non-poisonous species of mushrooms. As shown in Table 27, the majority (about 86%) of respondents had stayed in the area for more than 20 years. The variable was dropped for collection of fruits, vegetables and insects because age of respondent increased the coefficient of determination more than residence duration.

Table 27: Residence duration

Residence duration (Years)	Response N= 71	Percentage
1–20	10	14.0
21-40	34	47.9
41–60	12	17.0
61–80	15	21.1

4.4.2.5 Household size

The coefficient associated with household size was positive and significant at 5% for collection of fruits (Table 21) and vegetables (Table 22). The variable was dropped for collection mushrooms because number of males under 18 years old increased the

coefficient of determination (adjusted R2) more than household size. The result showed that increase in household size significantly increases collection of fruits and vegetables, also influences positively collection of insects.

4.4.2.6 Age of the household head

The coefficient associated with age of respondents was positive for vegetable (Table 22) and mushroom collection (Table 23) but negative for insect (Table24) and fruit collection (Table 21). It was significant at 1% in all models. The results showed that increase in age increases collection of vegetables and mushrooms significantly but decreases collection of insects and fruits significantly. This implies that adults who can distinguish between poisonous and non-poisonous species collect vegetables and mushrooms while children collect insects and fruits. As shown in (Table 28), about 28% of respondents had ages below 35 years; about 44% had ages between 36 and 60 years, while about 28% had ages above 60 years. This implies that households with young members had higher probability of being food secure by collecting and consuming fruits. Ogle and Grivetti, (1985) argues that children collect and consume more species of fruits than adults and that adults regard most fruit species as children's food. Most fruits mature and ripe during critical period of food deficit that is, from October to February, the period before harvest. Thus fruits ensure food security in the households. Campbell, (1986) mentioned that fruits are mostly gathered during food shortage. FAO, (1996b) also documented that during times of seasonal food shortages forest foods offer vital insurance against malnutrition or famine.

Table 28: Age distribution of respondents

Age	Frequency	Percentage
Below 35 years	20	28.2
36–60 years	31	43.6
More than 60 years	20	28.2

4.4.2.7 Respondents' educational level

The beta weight for number of years spent in formal education was positive but not significant for collection of insects (Table 24). It was negative but significant at 5% for collection of fruits (Table 21) and vegetable at 10% (Table 22). The results indicated that increase in number of years in formal education has positive influence in collection of insects. Explanation for that could be that insects are important part of diet in this area such that even literates value them. The results also showed that increase in number of years in formal education decreases significantly collection of fruits and vegetables. This implies that literates had greater chance of having substitutes for wild fruits and vegetables. The variable was dropped for per capita mushroom collection because number of males under 18 years old increased the coefficient of determination more than years spent in formal education. The results showed that 62% of the respondents had some formal education (Table 29). These findings are similar to those reported by Mhinte, (2000) who argued that in both theoretical and practical terms, education level of the household head plays a significant role in enabling household's access to food. The author further narrated that education increases skills; working efficiency and productivity such that households with more educated heads are more entitled to income and food.

Table 29: Respondents' educational level

Number of years in education	Response	Percentage
Seven	42	59.2
Twelve	02	2.8
None	27	38.0
Total	71	100

4.4.2.8 Number of male household members under 18 years old

The beta weight of male members of household under 18 years old was positive and significant at 10% for collection of mushrooms (Table 23); it was negative but significant for collection of fruits (at 10%) (Table 21) and vegetables (at 5%) (Table 22). The results revealed that increase in male household members under 18 years old increases collection of mushrooms significantly. It was also showed by this study that increase in male household members under 18 years old reduces collection of fruit and vegetables significantly. These results imply that households with large numbers of male household members under 18 years old, had large amount of mushrooms collected as compared to households with few male members under 18 years of age. The results also imply that households with large number of male members under 18 years old had less fruit and vegetables collected. The explanation is that, boys collect and consume fruits while herding livestock; or when at school and on the way to and from school; they rarely bring fruits home. It was observed during this study that boys do not collect vegetables.

4.4.2.9 Number of female household members under 18 years old

Beta weight for female members under 18 years of age in the household showed a positive but not significant correlation with per capita collection of mushrooms (Table 23) and negative but significant correlations with per capita collection of fruits (Table 21) and vegetables at 10% (Table 22) and per capita collection of insects at 1% (Table 24). These results indicate that increase in number of females under 18 years decreases collection of fruits, vegetables, and insects significantly. The plausible explanation could be that children under 18 years old comprise of primary and secondary school pupils who have limited time to collect NWFPs for household consumption. These school pupils pick

fruits and eat them as snack, which is rather difficult to quantify. Other children under 18 years old are pre-scholars and/or toddlers who cannot assist in the collection of NWFPs.

4.4.2.10 Number of female household members of 18-55 years of age

The results revealed negative correlation between number of female household members between 18 and 55 years old and per capita collection of fruit (Table 21). The results also showed positive and significant at 5% correlation with collection of vegetables (Table 22); positive correlation with collection of mushrooms (Table 23); and positive correlation with collection of insects (Table 24). These results imply that a decrease in fruit collection was observed in households with large numbers of female members of 18-55 years old this is because fruits are regarded as food for children such that adults do not engage themselves in collecting. Mushroom collection is influenced positively with increase in number of female members of 18 to 55 years old (Table 23). Females of 18-55 years old play a crucial role of identifying and collecting non-poisonous mushroom species. The results also imply that increase in number of female members increases collection of vegetables. It was observed during this study that women identify and collect wild vegetables for household consumption. The results also revealed that increase in number of female members in the household has positive influence in collection of insects. Women do identify and collect edible insects when they collect firewood especially the caterpillars, which are found in logs.

4.4.2.11 Number of male household members of 18-55 years old

The results showed a positive but not significant correlation between per capita mushroom collection and number of males of 18-55 years old in the household (Table 23). The results also showed negative but significant at 1% correlations between per

capita fruit (Table 21) and vegetable (Table 22) collection and number of males of 18-55 years old. The variable also indicated a negative correlation with per capita collection of insects (Table 24). These results imply that as number of males of the age 18-55 increases in the household, mushroom collection is influenced positively. Males of 18-55 years old collect mushrooms when they see them during collection of honey, fibre, and medicine and during hunting. The results also imply that increase in male members of the age 18-55 years decreases fruit and vegetable collection. Plausible explanation is that fruits are regarded as food for children thus adults do not engage themselves much in collecting them. Male members of the household do not collect vegetables. The results also indicated that increase in males of the age 18-55 years in the household reduces collection of insects because males of this group do not involve themselves in collecting insects.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Rural people in Mbozi district are heavily dependent on NWFPs for a wide range of needs. The contribution of NWFPs to household food security in this area ranges from direct supply of food to generation of cash income. This study found that NWFPs contribute 12.7% to total household food consumption in terms of total weight. It was also found by the study that the contribution of NWFPs to total household income is 7.5%. The study also found that 59.2% of the income obtained from sale of NWFPs is used for food purchasing. Because of their seasonal nature, NWFPs complement agricultural commodities in improving the household food security.

Over harvesting of some species such as *Eriosema burkei* was observed and uprooting of *Satyrium spp.* was learnt. It was also learnt during this study that a lot of wild fruits are being wasted through deterioration during rainy season, which is the peak season for fruit production.

It was found in this study, that except for the gender-neutral NWFPs like medicine, there is a clear gender division of labour as regards to the collection, processing and preserving NWFPs. Women were the main actors found to deal mostly with mushrooms, roots & tubes, insects, vegetables and fruits, while men dealt with honey, bush meat, ropes and basketry.

Although traditionally forest dependent people are economically poor, within and among forest dependent communities significant differences are seen in holdings of land and other assets, and such differences are of considerable importance to the use of NWFPs. In

this study multiple regression analysis revealed that differences in land holdings, and income had significant influence on the collection and use of NWFPs to cope with food deficits. Households with land less than one hectare were found to be food insecure and were more likely to become food secure by collecting NWFPs as compared to their counterparts who had more than one hectare of land. Likewise, the study revealed that households with low income were more likely to become food secure by collecting NWFPs.

Multiple regression analysis also revealed that collection and use of NWFPs have been influenced by some socio-economic factors. These include: age, farm size, educational level and household size and composition.

The respondents in the lowland zone reported more vegetable and root species as compared to those in the highland zone. This is due to the fact that the lowland zone has unreliable rainfall and frequent crop failures and thus frequent food shortage incidences. Hence lowland zone of this district is more dependent on NWFPs than highland zone.

5.2 Recommendations

- The study recommends to the government that efforts be made to add value to NWFPs by developing and disseminating simple appropriate technologies for harvesting and processing wild fruits into different products such as jams, marmalades, juice, preserves and pickles in order to minimize wastage, during peak seasons this will fetch distant market and improve cash income earnings. This will give households more food purchasing power. Such interventions should focus mainly on women as they are the main actors in activities concerning

NWFPs. Income controlled by women is more likely to be used for the household's well being including ensuring household food security.

- It is recommended that the economic and ecological importance of NWFPs should be well understood and promoted in the study area so that sustainable harvesting can be made to avoid extinction of some of the plant and animal species.

- The contribution of NWFPs to household food security in the study area, suggest that the forests and woodlands, from which the NWFPs are obtained, need to be conserved to ensure sustainable supply.

- Awareness should be raised on the importance of NWFPs for rural development and the environment (biodiversity conservation). It is recommended that communities should be encouraged to plant desired tree species near homes and around fields so as to minimize pressure on the forests and woodlands.

- Knowledge of plant/animal species, various products and their use represents an important resource in itself. It is recommended that further studies be conducted in Mbozi district to capture more local knowledge and use it for contemporary development in the study area and the country at large.

REFERENCES

Appleton, H.E; and C.L.M. Hill, (1994). Gender and indigenous knowledge in various organizations: In indigenous knowledge and development monitor. Volume 2/No.3/1994 special issue. 2(3):14-19.

Armon, P.J. (1980). The Use of honey in the treatment of infected wounds. *Tropical Doctor*. 10:91-93.

Arnold, J.E.M. (1995). Socio-economic benefits and issues. In: Non-wood forest Products 3. Report of the International Consultation on non-wood forest products. FAO. Rome. 465 pp.

Bagachwa, M., Shechambo F., Hussein, S. Kulindwa, K., Naho, A. and Cromwel, E. (1996). Tanzania Case Study. In: Reed D. (ed). *Structural Adjustment, the Environment and Sustainable Development.* Earth Scan, London, U.K. pp.107-127.

Bailey, K.D. (1994). Methods of Social Research. Fourth edition. Free Press. Toronto. 588 pp.

Barham, B.L., Coomes O. T. and Takasaki, Y. (1999). Rainforest livelihoods: income generation, household wealth and forest use. *Unasylva* 50(3): 34 – 42.

Busch, L., and Lacy, W.B. (1984). What does Food Security Mean? In L. Busch & W.B. Lacy (Eds): Food Security in the United States. West View Press, Inc. 2 pp.

Campbell, B. M. (1986). The importance of Wild Fruits for peasant's household in Zimbabwe. *Food and Nutrition*: 12(1): 38 – 44.

Campbell, C. (1990). Food insecurity: Definitions and measurement: New York: Cornell University. 45 pp.

Campbell, B.M., Luckert, M. and Scoones, I. (1991). Local-level valuation of Savanna resources: A case study from Zimbabwe. International Institute for Environment and Development (IIED). London. 26 pp.

Campbell, B.M., Clarke, J., Luckert, M., Matose, F., Musvoto, C. and Scoones, I. (1995). *Local level economic valuation of Savanna woodland resources: Village cases from Zimbabwe. Hidden harvest.* Project Series 3. International Institute for Environment and Development (IIED). London. 125 pp.

Campbell, B.M., Luckert, M. and Scoones, I. (1997). Local level valuation of Savannah resources: A case of Study from Zimbabwe. *Econometrics in Botany* 51: 59-77.

Campbell, B.M., Costanza, R. and Van den Belt, M. (2000). Introduction, overview and synthesis: Land use options in dry tropical woodland ecosystems in Zimbabwe. *Ecology and Econometrics*. 33: 341-351.

Chambelian, J., Bush, R. and Hammet, A.L. (1998). Non-Timber Forest Products. *Forest Products Journal* 48 (10): 38-44.

Chandrasekharran, (1993). Issues involved in the sustainable development of NWFPs. In: Non-Wood Forest Products: a regional consultation on NWFPs for English speaking African Countries, held on 17-22 October, 1993, Arusha, Tanzania. FAO and Commonwealth Science Council, Rome, London. 471 pp.

Chihongo, A.W. (1994). Non-Wood Forest Products of Tanzania. In: Workshop Proceedings of "*Information acquisition for Sustainable natural forest resources of Eastern, Central and Southern Africa*". (Edited by Malimbwi, R.E. and Luoga E.J.). 31 October – 4 November 1994. pp. 225 – 267.

Chipompha, N.W.S. (1985). Some mushrooms of Malawi. Forest Research Record No. 63. Malawi Government, Zomba. pp. 5 - 14.

Clarke, J., Cavendish, W. and Coote, C. (1996). *Rural household and miombo woodlands: Uses, Values and Management.* In: Campbell, B. (ed). The Miombo in Transition: Woodlands and welfare in Africa. CIFOR, Bogor Indonesia. pp 101-135.

Cohen, B.E., and Burt, M.R. (1989). Eliminating hunger: Food security policy for the 1990's. Washington, D.C: The urban Institute. pp 3 - 5.

Dumronglet, E. (1983). A follow up study of chronic wound healing dressing with pure natural honey. *Journal of National Research Council* 15 (2): 39 - 66.

Falconer, J. (1990). Hungry season food from the forests. *Unasylva* 41 (1): 14 -19

FAO, (1983). Food and fruit bearing species: examples from East Africa. FAO Forest Paper No 44:1 FAO. Rome.179 pp.

FAO (1984). *Traditional (indigenous) Systems of Veterinary Medicine for Small farmers in Nepal*. RAPA Program Paper No. 81. Bangkok, Thailand.

FAO, (1989). Forest and food security. FAO Forestry Paper No. 90. FAO, Rome. 128 pp.

FAO, (1990). Household food security and forestry, A field guide for project design and implementation. FAO. Rome, Italy. 45 pp.

FAO, (1991*). Household Food Security and Forestry, an analysis of Socio – Economic issues*. Community Forestry Note No.1. Food and Agriculture Organization, Rome, Italy pp 17-27.

FAO, (1992). *Improving household food security. Major issues for Nutrition Strategies. International Conference on Nutrition.* Theme Paper No. 1. FAO/WHO. FAO, Rome.

FAO, (1995a). Non-wood Forest Product 3. Report of the International Expert Consultations on Non-wood Forest Products. Yogyakarta, Indonesia, 17-27 January 1995. FAO. Rome. 465 pp.

FAO, (1995b). Non-wood Forest Products for rural income and sustainable forestry. Non-wood Forest Products No. 7. FAO. Rome. 127 pp.

FAO (1996a). *Food Supply Situation and crop Prospects in Sub-Saharan Africa.* Global Information and Early Warning System on Food and Agriculture 1. FAO, Rome, Italy. 56 pp.

FAO, (1996b). The role of forests in food security. World Food Summit. Rome, Italy, pp. 2-4.

FAO, (1997). *Wildlife and food security in Africa.* FAO Conservation Guide No. 32. Rome.

FAO (1999). Non-wood Forest Products and Income generation. *Unasylva. An International Journal of Forestry and Forest Industries.* 50 (3): pp. 2.

FAO (2001). Global Forest Resources Assessment 2000. Main report. FAO Forestry Paper 140. Rome. 479 pp.

FAO, (2002). Non-Wood News An information bulletin on Non-Wood Forest Products. FAO 9, Rome, Italy. 99 pp.

Fernandez, M.E. (1994). Gender and Indigenous knowledge. *Indigenous knowledge and Development Monitor.* Volume 2(3): 11-25.

Frankenberger,T.R. (1985). Adding a Food Consumption Perspective to Farming Systems Research. Report prepared for USDA, Office of International Cooperation and Development, Nutrition Economics Group. Washington D.C: U.S Department of Agriculture. pp. 16-33.

Gittinger, J.P., Chermick, S., Horenstein, N.R., and Saito, K. (1996). Household Food Security and the Role of Women. World Bank Discussion Papers. The World Bank, Washington, D.C. 33 pp.

Gumbo, D.J. (1993). Is there traditional management of indigenous forest resources in communal lands of Zimbabwe? *The ecology and Management of indigenous forests in Southern Africa.* Proceedings of an International Symposium . (Edited by Pieace, G.D and Gunbo, D.J.) 27 – 29 July 1992, Victoria Falls, Zimbabwe. Zimbabwe Forestry Commission and SAREC, Harare. pp. 83-214 .

Gumbo, D.J., Mukamuri, B.B., Muzondo, M.I. and Scoones, I.C. (1990). Indigenous and exotic fruit trees. Why do people want to grow them? In: *Agroforestry and Sustainable Production: Economic Implications.* (Edited by Prinsley, R.T.) Commonwealth Council. London. pp.185-244.

Hamza, F.K.S. (1997). Introduction to Non-wood Forest Products (NWFPs). Compendium. Faculty of Forestry and Nature Conservation. Sokoine University of Agriculture, Morogoro, Tanzania. 82 pp.

Harkonen, M., T. Saarimaki and L. Mwasumbi (1995). Edible mushrooms of Tanzania. Karsteria. 35:15-22 pp.

Hines, D and K. Eckman, (1993). *Indigenous multipurpose trees of Tanzania. Uses and economic benefits for people.* FAO, MISC/93/9. Rome. 221 pp.

Hubbard, M. (1995). Improving food Security. A Guide for rural Development Managers, Intermediate Technology Publications, London. 151 pp.

ICN, (1992). International Conference on Nutrition, Plan of Action. Rome. Italy. pp. 191 – 212.

Ishengoma, C.G. (1992). Prevalence of Child Malnutrition and Factors Associated with it. A case study of Morogoro Urban. Unpublished Dissertation for Award of Msc. Degree at Sokoine University of Agriculture, Morogoro, Tanzania. 245 pp.

Ishengoma, C.G. 1998. The Role of Women in Household Food Security in Morogoro Rural and Kilosa District. Unpublished PhD Thesis. Sokoine University of Agriculture, Morogoro, Tanzania. 371 pp.

Kabuye, C.H.S., (1986). Edible roots and wild plants in arid and semi-arid Kenya. *Journal of Arid environments.* 11 (1): 65-73.

Kahatano, D.E. (1997). Trade in wild medicinal plants in Tanzania. Report prepared for TRAFFIC East/Southern Africa. pp. 27.

Kaimowitz, D., Byron, N. & Sunderlin, W. (1998). *Public policies to reduce inappropriate deforestation.* In: Agriculture and the environment: Perspectives on Sustainable Rural Development. (Edited by Lutz, E.). Washington, DC, USA, World Bank, pp. 303 – 322.

Kainer, K.A. and Duryea, M.L. (1992). Tapping Women's knowledge: Plant resource use in extractive reserves. *Economic Botany.* 46(4): 408-425.

Kajembe, G.C. (1994). Indigenous Management Systems as a basis for community forestry in Tanzania: A case study of Dodoma urban and Lushoto Districts. Tropical Resource Management Paper No. 6. Wageningen Agricultural University. The Netherlands. 194 pp.

Kajembe, G.C. and Luoga, E.L. (1996). Socio-economic aspects of tree farming in Njombe District. Consultancy report to the Natural resource Conservation and Land-Use Management Project. FORCONSULT, Faculty of Forestry, Sokoine University of Agriculture, Morogoro. 126 pp.

Kajembe, G.C., M.I. Mwenduwa, J.S. Mgoo and H. Ramadhani (2000). Potentials of Non-wood Forest Products in Household Food Security in Tanzania: The role of gender based local knowledge. Report submitted to Gender, Biodiversity and Local Knowledge Systems (Links) to strengthen Agriculture and Rural Development (CGCP/RAF/338/NOR), July 2000. 47 pp.

Katani, J.Z. (1999). The role of Gender – based indigenous Knowledge in developing coping strategies against deforestation: A Case of Mwanza District. MSc. Thesis, Sokoine University of Agriculture. 110 pp.

Katigula (1999). Dependence of local communities on protected forests as source of non-timber forest products and its role in forest management: A case of East Usambara Protected Natural forest, Tanzania. MSc. Thesis in socio-economic Information for Natural Resources Management. International Institute for Acrospace Survey and Earth Sciences Enschede. The Netherlands. 130 pp.

Kavishe, F.R. and Mushi, S.S. (1993). Nutrition Related Actions in Tanzania. TFNC Monograph Series No. 1; UN ACC/SCN Country case study supported by UNICEF. A case study for XV Congress International Union of Nutritional Sciences. September 29 to October 1,1993. Adelaide. 209 pp.

Kessy, J.F. (1998). Conservation and Utilization of Natural Resources in the East Usambara Forest Reserves. Conventional Views and Local Perceptive. Tropical Resources Management Papers No. 8, Wageningen Agricultural University. The Netherlands. 168 pp.

Kihwele, D.V.N., Lwoga, P.D. and Sarakikya E. (1999). Feasibility Study of beekeeping and honey hunting in the MBOMIPA project area, Iringa District. 60 pp.

Kiondo, M.R. (1998). A survey of local use and economic value of bee products in some Tanzanian tribes. A case study of Hai District, Kilimanjaro Region. In: *Sustainable beekeeping for Africa*. NWRC/DFID. Project A 9316.10 pp.

Krell, R. (1996). *Value-added products from Beekeeping*. FAO. Rome. 409 pp.

Kulkarni, R.S., Gangaprasad, S. and Swamy, G.S.K. (1993). Tamarind: Economically an important minor forest produce. *Minor Forest Products News* 3:3-6.

Kumar A. and Sastry C.B. (1999). The International Network for Bamboo and Rattan. *Unasylva*: 50(3). 48-53.

Kundlande, G., Adamowicz, W.L. and Mapaure, I. (2000). Valuing ecological services in a Savanna ecosystem: A case study from Zimbabwe. *Ecology and Econometrics* 33: 395-400.

Laessoe, T. and Del Conte, A. (1998). *The Mushroom Book. Practical know-how on identifying, gathering and cooking wild mushrooms and other fungi.* Kindersley. London. 2560 pp.

Lema, U.C. (1997). *Forest Resource Management for Sustainable Development: A case Study of Mount Meru Forest Reserve in Northern Tanzania.* Mphil. Thesis. Department of Environmental and Geographical Science, University of Cape Town. 89 pp.

Lipper, L. (2000). Forest degradation and Food Security. *Unasylva*. FAO, Rome, 51(3). 13-18.

Liseki, S. and Mmbaga, A. (1998). A Survey of local use and economic value of bee products in some Tanzanian tribes. A case of Babati and Handeni Districts. In: *Sustainable Beekeeping for Africa.* NWRC/DFID. Project A 9317. 6 pp.

Maganga, E.T. (1996). Notes on Edible Mushrooms (*Pleurotus* spp) cultivation. The case of Southern Highlands. Ministry of Agriculture, Research and Training Institute, Uyole, Mbeya, Tanzania. Unpublished. 61 pp.

Makonda, F.B.S. (1997). The role of non-wood forest products to the livelihood of rural communities of Geita district. Unpublished Dissertation for Award of MSc Degree at Sokoine University of agriculture, Morogoro, Tanzania. 121 pp.

Makundi, F.L.K. (1996). Household Food Security in rural Tanzania. A case study of Moshi Rural District. Unpublished Dissertation for Award of MSc Degree at Agricultural University of Norway. 138 pp.

Margen, S. (1989). Food Security and methods of assessing hunger in the Untied States. Washington DC: U.S. Government Printing Office. 7 pp.

Martin, G.J. (1995). *Ethnobotany:* A people and Plants' Conservation Manual. Chapman Hall. London. 268 pp.

Mattila, K.V., L. Mwasumbi and A. Klahti (1997). Traditional use of wild vegetable in the East Usambara mountains. East Usambara Catchment Forest Project. Technical Report, No. 37. 27 pp.

Maximillian, J.R. (1998) Evaluation of Tropical Non-Timber and other forest products of Kibaha District. Unpublished Dissertation for Award of Msc Degree at Sokoine University of Agriculture, Morogoro, Tanzania. 123 pp.

McGregor, J. (1995). Gathered produce in Zimbabwe's communal areas: Changing Resource availability and use. *Ecology of food and Nutrition. 33:* 163-193.

Mearns, R. (1994). Natural Resources Mapping and Seasonal Variations and Stresses in Mongolia PRA notes 20: 95 -105.

Menard, S. (1995). Applied Logistic Regression Analysis. Sage University Paper series on quantitative applications on social sciences. Thoughs Oaks, CA, Sage. 237 pp.

Mettrick, H. (1993). *Development Oriented Research in Agriculture.* An ICRA Text Book. Wageningen. The Netherlands. 287 pp.

Mgaya, G.J.M. (1994). Animal factors affecting work performance of draught cattle: in Mbozi District. Unpublished Dissertation for Award of Msc Degree at Sokoine University of Agriculture, Morogoro, Tanzania.115 pp.

Mhinte, A.R. (2000). Analysis of Rural Households Coping Strategies Against Seasonal Food Insecurity in Kilosa District. Unpublished Dissertation for Award of Msc Degree at Sokoine University of Agriculture, Morogoro, Tanzania. 121 pp.

Mhoro, E.B. and Mtotomwema, K. (1981). Tanzania Notes and Records no. 88 and 89: 109-111.

Missano, H., Njebele, C.W., Kayombo, L. and B. Ogle. (1994). Dependency on Forests and trees for food security. A pilot study in Nanguruwe and Mbambakofi villages, Mtwara region, Tanzania. TFNC report No. 1614. pp. 5-18.

MNRT, (1998). Ministry of Natural Resources and Tourism. National Forest Policy. Government Printers. Dar es Salaam, Tanzania. 59 pp.

Monela, G.C., Kajembe, G.C., Kaoneka, A.R.S. and Kowero, G. (2000). Household Livelihood strategies in the Miombo woodlands of Tanzania: Emerging Trends. *Tanzania Journal of Forestry and Nature Conservation.*73:17-33.

Munyanziza, E. (1994). Miombo trees and Mycorrhizae: Ecological Strategies and basis for Afforestation. PhD Thesis. Wageningen. 193 pp.

Mwagile, M.Y. (2001). Gender-Based Coping Strategies Against Food Insecurity in Dodoma rural district. Unpublished. Dissertation for Award of Msc Degree at Sokoine University of Agriculture, Morogoro, Tanzania. 97 pp.

Mwakatobe, A.R. (2001). The Importance of Home gardens on Beekeeping activities in Arumeru District. Unpublished Dissertation for award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania. 131 pp.

Nkana Z.G. and Iddi, S. (1991). Utilization of Baobab (*Adansonia digitata*) in Kondoa district, Tanzania. Faculty of Forestry and Nature Conservation. Forest record No. 50. Sokoine University of Agriculture. 81pp.

NRC, (1992). National Research Council. *Neem: A tree for solving global problems.* National Academy Pres. Washington, D.C. 141 pp.

Nsolomo, V.R., Shayo, N.B. and Ridhiwani, R. (2000). Nutritional value of Termitomyces microcarpus and two other wild edible mushrooms from Miombo woodlands. *Tanzania Journal of Forestry and Nature Conservation.* 73: 88 – 93.

Nyange, D. (2001). Concepts, Dimensions, and Assessment of Food Security. In: *Proceedings of a workshop on Natural Resources Management and Food Security.* 22–26 January, 2001, Morogoro, Tanzania, pp. 18 – 36.

Nyborg, I. and Haug, R. (1994). Food Security Indicators for development activities by Norwegian NGOs in Mali, Ethiopia and Eritrea. NORAGRIC. 37 pp.

Ogle, B.M. and Grivetti, L.E. (1985). Legacy of the chameleon: Edible Wild plants in the Kingdom of Swaziland, South Africa: A cultural, ecological, nutritional study. Ecology of food and Nutrition. 17(11): 1- 64.

Otieno, N.J. (2000). Biomass, Inventory and potential of indigenous medicinal plants, at Duru-Haitemba community forest, Babati. Unpublished Dissertation for Award of Msc Degree at Sokoine University of Agriculture, Morogoro, Tanzania. 130 pp.

Pinstrup-Andersen, P., Pandya-Lorch, R. and Babu, S. (1997). A 2020 Vision for Food, Agricculture and the Environment in Southern Africa. In*: Achieving Food Security in Southern Africa: New Challenges, New Opportunities. (Edited by Haddad, L.).* IFPRI. Washington, D.C. pp. 16 – 56.

Planning commission, (1996). Mbozi district social economic profile. 175 pp.

Prasad, R. (1999). Joint forest management in India and the impact of state control over non-wood forest products. *Unasylva.* 50(3): 58 - 62.

Ramadhani, T., Chille, B. and R. Swai. (1998). Indigenous Miombo fruits selected for domestication by farmers in Tanzania. In: Selected Indigenous Trees for Domestication in Southern Africa. Priority setting with farmers in Malawi, Tanzania, Zambia and Zimbabwe. (Edited by Maghembe, J.A. *et al*). ICRAF, Nairobi. Pp. 11-15.

Rijsoort J.V. (2000). Non-Timber Forest Products (NTFPs). Their role in sustainable forest management in the tropics. National Reference Centre for Nature Management (EC-LNV), International Agricultural Centre (IAC). Wageningen, the Netherlands. 57 pp.

Salem, S.N. (1981). Honey regimen in gastrointestinal disorders. *Bulletin of Islamic Medicine.* 1:358-362.

Pinstrup-Andersen, P., Pandya-Lorch, R. and Babu, S. (1997). A 2020 Vision for Food, Agricculture and the Environment in Southern Africa. In*: Achieving Food Security in Southern Africa: New Challenges, New Opportunities. (Edited by Haddad, L.).* IFPRI. Washington, D.C. pp. 16 – 56.

Planning commission, (1996). Mbozi district social economic profile. 175 pp.

Prasad, R. (1999). Joint forest management in India and the impact of state control over non-wood forest products. *Unasylva.* 50(3): 58 - 62.

Ramadhani, T., Chille, B. and R. Swai. (1998). Indigenous Miombo fruits selected for domestication by farmers in Tanzania. In: Selected Indigenous Trees for Domestication in Southern Africa. Priority setting with farmers in Malawi, Tanzania, Zambia and Zimbabwe. (Edited by Maghembe, J.A. *et al*). ICRAF, Nairobi. Pp. 11-15.

Rijsoort J.V. (2000). Non-Timber Forest Products (NTFPs). Their role in sustainable forest management in the tropics. National Reference Centre for Nature Management (EC-LNV), International Agricultural Centre (IAC). Wageningen, the Netherlands. 57 pp.

Salem, S.N. (1981). Honey regimen in gastrointestinal disorders. *Bulletin of Islamic Medicine.* 1:358-362.

Schlosser, W.E. and Blantner, K.A. (1995). The Wild edible mushroom Industry of Washington, Oregon and Idaho. *Journal of Forestry*: 93 (3): 31-36.

Sene, E.H. (2000). Forest and food security in Africa. The place of forest in FAO's Special Programme for Food Security. *Unasylva.* 51: 13 -18

Shepherd, G., Arnold, J.E.M. and Bass, S. (1999). Forests and sustainable livelihoods. Background document, World Bank Forest Policy implementation Review and strategy. Washington D.C. pp. 25-102.

Taylor, D. A. (1996). Income generation from non-wood forest products in upland conservation. FAO Conservation Guide 30. FAO, Rome. 72 pp.

Temu, A.E., Kinabo, J. L., Mattee, A.Z., Ashimogo, G.C., and Wambura, R.M. (1997). A Training Module of Food Security Development Workers. Faculty of Agriculture, Sokoine University of Agriculture and SADC Food Security Training Project. 50 pp.

TFNC, (1997). Tanzania Food and Nutrition Centre: Rapid Assessment of Household Food Security and Nutrition in Drought affected areas in Tanzania Mainland. UNICEF. 67 pp.

Thomson, A. and Metz, M. (1997). Implications of economic policy for food security: A training manual. Training materials for agricultural Planning 40. FAO, Rome. 313 pp.

Thrupp, L.A. with Megateli, N. (1999). Critical Links: Food Security and the environment in the greater Horn of Africa. WRI Project Report. World Resources Institute, Washington, D.C., USA, and ILRI (International Livestock Research Institute), Nairobi, Kenya. 110 pp.

Vladyshevskiy, D.V., Latetin, A.P. and Vladyshevskiy, A.D. (2000). Role of Wildlife and other Non-Wood Forest Products in food security in central Siberia. *Unasylva*. 51(3): 46 -52.

Von Braun, J., Bouis, H., Kumar, S. and Pandya-Lorch, R. (1992). Improving Food Security of the Poor: Concept, Policy, and Programs. IFPRI. Washington, D.C. USA. 43 pp.

Wagao, J.K. (1991). Household Food Security and Nutrition in Tanzania. A Consultancy Report toUNICEF Regional Office, Nairobi, Kenya. 87 pp.

Walters, M. and A. Hamilton (1993). The vital wealth of plants, WWF, Gland Switzerland. World Commission on the Environment and Development (WCED) 1987. Our Common Future. WCED Report. Oxford University press. 400 pp.

Warner, K. (2000). Forestry and sustainable livelihoods. What part can forests and forestry play in reducing poverty? *Unasylva* 202. 51:3-12.

World Bank. (1986). Poverty and Hunger: Issues and options for Food Security in developing countries. *A World Bank Policy Study*. Washington, D.C: International Bank for Reconstruction and Development (IBRD). 184 pp.

Zeitlin, M. F. and Von Braun L. (1992). Integrating Diet Quality and Food Safety into Food Security Programs Nutrition Consultants' Report Series, ESN/CRS 91. Food and Agriculture Organization of the United Nations, Rome. 53 pp.

Zinyama, L.M., Matiza, T. and Campbell, D.J. (1990). The use of wild foods during periods of food shortage in rural Zimbabwe. *Ecology of food and nutrition* 34: 251 – 264.

APPENDICES

APPENDIX 1
HOUSEHOLD QUESTIONNAIRE

Village..... Division.....
Date.....

Household's identification number.

SECTION A: BACKGROUND INFORMATION

1. Name of household head .....
1.1 Gender 1. Male.
2. Female.....
1.2 Age.
1.3 Marital status 1. Single
2. Married
3. Widowed For males number of wives.....
1.4 Religion
1. Moslem.....
2. Traditional.....
3. Christian.....
4. Others (specify).....
1.5 Tribe
1. Nyiha
2. Others (specify)

1.6 a) Education
1. Primary
2. Adult education
3. Secondary
4. Others (specify)

b) Occupation..... .....

Household composition

Age	Male	Female
Under 18 years		
18 – 55 years		
Over 55 years		

SECTION B: NON-WOOD FOREST PRODUCTS, AGRICULTURAL PRODUCTION AND FOOD SECURITY

2. For how long have you been in this Village?.....years

3. Do you collect non-wood forest products?
   1. Yes
   2. No

4. If yes in question 3 above how do you rate your frequency of collecting the nwfps?
   1. Daily
   2. Weekly
   3. Monthly
   4. Occasionally

5. Who collects the non-wood forest products?
   1. Wife
   2. Husband
   3. Children

6. Who does the processing of non-wood forest products?
   1. Wife
   2. Husband
   3. Children

7. a) Are the wild foods preserved?
   1. Yes
   2. No

   b) If yes in (a) above, how is the preservation done?

   c) Who is involved in the preservation activity?
      1. Wife
      2. Husband
      3. Children

8. Who mostly consumes the wild foods within the household?
   1. Men
   2. Women
   3. Children
   4. All household members

9. Who mostly uses the non-wood food products within the household?
   1. Men
   2. Women
   3. Children
   4. All members

10. What is the current availability of non – wood forest products as compared to the past twenty years?
    1. Decreased
    2. Increased
    3. Same/constant
    4. Fluctuates

11. What do you consider to be the best way of improving/sustaining the availability of non-wood forest products?

12. What species do you prefer for:

Item	Species	Season and quantity	Subsistence/sale
a. Food			
b. Medicine			
c.			
d. Fruit			
e. Drink			
f. Resins/gums			
g. Fodder			
h. Oils/dyes			
i. Fencing			
j. Thatching			
k. Honey			
l. Rituals			
m. Fibres			
n. Others			

13. How much money do you get per week from selling non-wood forest products?

14. How frequent do you sell the nwfps? 1. Daily 2. Weekly 3. Monthly

15. Out of this money how much is used to buy food items?

16. What are the items bought?

1. Cereal grains
2. Legume grains
3. Meat/fish
4. Others (specify)

17. Do you own land?
    1. Yes
    2. No

18. If yes in question 17, what was the total area cultivated in the last crop season?

Crop	Area (acres)	Bags production	Income (Tshs)
1.			
2.			
3.			
4.			
5.			
6.			

Total area .....acres

19. a) Does the available land satisfy your annual household food requirements?
    1. Yes
    2. No

    b) If no, what do you do to fill the deficit?
    1. Purchase food
    2. Collect wild foods and other non-wood forest products
    3. Others (specify)

20. a) How do you store the agricultural produces?
    b) Are there any storage problems? List them
    .....
    .....

21. Where do you get materials for making storage facilities?
    .....

22. Do you own livestock?
    1. Yes
    2. No

23. If Yes in 22 above, which kind of livestock?
    .....
24. Which system do you use in keeping the livestock?
    1. Zero grazing
    2. Extensive grazing

25. If the answer in 24 is 1, where is fodder obtained?
    1. Farms
    2. Savannah
    3. Forest/woodland.

APPENDIX 2

CHECKLISTS FOR KEY INFORMANTS

1. Village extension/forestry worker
   a) What are the general conditions of the forests/woodlands?

   b) What can you comment on the availability of non – wood forest products?

   c) What are the environmental strategies to ensure sustainable availability of non-wood forest products? .....

   d) Are there any conservations actions taken towards the forests/woodlands?
   .....

   c) What are the important nwfps you know?
   .....

2. Village leaders:
   a) What is the village population?
   .....

   b) Are there any by-laws concerning the use of non-wood forest products. What are they?
   .....

   c) Do you collect any revenue from harvesting non-wood forest products?
   1. Yes 2. No
   If Yes, how much? .....

   d) What are the village strategies in ensuring sustainable availability of the non-wood forest products?
   .....

3.a) Are there any cultures/traditions/customs governing the availability of nwfps?
   1. Yes
   2. No

   b) If Yes, mention them.
   .....

4a) Are there any cultures/traditions/customs governing accessibility to nwfps
   1. Yes
   2. No

   b) If yes, mention them
   .....

5a) Are there any cultures/traditions/customs contributing to the dependency on non-wood forest products?
   1. Yes
   2. No

   b) If Yes, list them
   .....

6.Village elders (women and men)

a) For how long have you resided in this village?
.....

b) How was the situation with respect to the availability of non wood forest products in the past twenty years?.....

c) Are there any taboos on the use of some of nwfps? Explain .....

d) Is there any traditional use of forest for rituals? .....

e) What are the commonly used nwfps in this villag?e...

f) When are the nwfps mostly used? .....

7 Traditional healers

a) When did you start your activities? .....

b) How much money do you get per day? .....

c) Which species do you use in your activities? .....

Species	Disease	Part used

d) How much money do you use in buying food items per day?

e) Do you have any other economic activities?

1. Yes
2. No

If Yes, list them

.....

.....

.....

APPENDIX 3

Species valued for medicine

Local name	*Scientific name*	Part used	Diseases treated
Chiwanga	*Pericopsis angolensis*	Roots	Headache, flue and pneumonia
Mlewe	*Rauvolfia caffra*	Roots and leaves	Joint ache
Elamba		Roots & leaves	Joints ache
Mbozyo		Leaves	Convulsions
Mpataviwa		Leaves	Stomach ache
Mnyongapembe/ Iwawa		Leaves & roots	Childhood diseases Venereal diseases
Namayoka		Root & bark	Stomach ache
Nansimba		Roots	Stomach ache
Nawazi	*Pterocarpus angolensis*	Barck & extract	Sinking fontanel. Dysentery
Muku (Mkuyu)		Extract	Head fungus Sunken fontanelle
Chawe	*Aloe spp.*	Extract	Stomach ache
		Leaves	Skin fungus Constipation
Isambwe		Roots & leaves	Measles
Mkoyo	*Eriosema burkei*	Roots	Cough
Mzamba			
Nantete		Roots & leaves	Fever & stomach ache
Isogoyo	*Vermonia myriantha*	Leaves & roots	Diarrhoea & worms
Ibanku		Roots	Venereal diseases
Chizolombo		Roots	Venereal diseases
Mlosyo	*Croton macrostachys*	Roots	Venereal diseases
Inyala	*Euphorbia spp.*	White extract	Two drops in porridge treats venereal diseases. Smearing on young boil hastens ripening.
Isale + Isambwet + Coffee		Root + root + root	Measles (oral & bath)
Mkallya	*Zanha africana*	Roots & bark	Fever
Izumbi		Extract	Tooth ache
Nsongwa	*Garcinia spp.*	Leaves, roots & bark	Stomach ache
Kukulembe		Bark	Stomach ache
Mbula	*Parinari curatellifolia*	Bark powder	Stomach ache &cancer
Bulungu		Leaves	Safe delivery
Ifwomi	*Syzygium cuminii*	Root & bark	Diabetes
Munyamunya		Root & leaves	Stomach ache
Shemamu		Roots	Venereal diseases
Injama	*Physallis peruviana*	Leaves & roots	Typhoid & epilepsy
Sisibizi	*Ocetea usambarensis*	Leaves & roots	Chest ache, gonorrhoea & epilepsy
Izuluti			Liver problems
Nzanyanzanya			Stomach-aches, pneumonia
Ibaba (herb)		Root bark	Ulcers
Intwanti (climber)		Leaves	Headache
Ihali (climber)		Roots	Stomach-ache Body pain (not to be taken by pregnant women).
Itula	*Datura stramonium*	Fruit	Toothache, venereal diseases.
Mng'anzo	*Tricalysia cacondensis*	Root & bark	Malaria

Source: Own survey data 2001/02