ASSESSMENT OF THE CONTRIBUTION OF EDIBLE WILD PLANTS FROM MIOMBO WOODLANDS TO THE RURAL LIVELIHOODS IN KILOSA DISTRICT, MOROGORO, TANZANIA

BY

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ABSTRACT

This study was conucted in Kilosa district, Tanzania. The aim of the study was to assess the contribution of Edible Wild Plants (EWPs) to the rural livelihoods in Kilosa district. Specifically the study aimed at identifying EWPs available in the miombo woodlands of the study area; assessing methods used in processing and preservation of EWPs and assessing socio-economic factors that influence the collection of EWPs. Data were collected from October to December 2005 using structured and semi-structured questionnaire survey, Participatory Rural Appraisal (PRA), Ethnobotanical survey, participants' observation and focused group discussions. Statistical Package for Social Sciences (SPSS) version 11.5 for Windows was used for analyzing quantitative data. Content and structural-functional analyses were employed to analyze qualitative data. Plant species were identified using checklists, taxonomic books and taxonomists. The study identified a total of 380 useful plant species which play an important role in the improvement of rural livelihoods. Logistic regression analysis indicated that, an increase in distance from homestead to the miombo woodlands tends to reduce the chances of people to collect EWPs, while age was observed to have a direct relationship with collection of EWPs. The study concludes that, EWPs contributes to the improvement of rural livelihoods through household food security, health care, and generation of income. The study therefore, recommends that further studies be undertaken in the area to acquire more knowledge on how to improve harvesting, processing and preservation methods as a strategy for improving

quality and adding value to EWPs. More studies should also be undertaken with regard to improving and strengthening marketing channels so as to increase income generation for the rural people, also local communities should be encouraged to plant and retain useful EWPs in their home-gardens and farms so as to safeguard them from extinction.

DECLARATION

I Ellasy Lugano Johnson Mujillah 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.

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DEDICATION

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ABBREVIATIONS AND SYMBOLS

DANIDA	=	Danish International Development Agency
DRC	=	Democratic Republic of Congo
EWPs	=	Edible wild plants
FAO	=	Food and Agriculture Organization of the United Nations.
FBD	=	Forestry and Beekeeping Division
H/H	=	Household
i.e	=	That is
KDC	=	Kilosa Distric Council
MNRT	=	Ministry of Natural Resources and Tourism
NTFPs	=	Non-Timber Forest Products
NWFPs	=	Non-Wood Forest Products
OLS	=	Old Least Square
PRA	=	Participatory Rural Appraisal
Sp./spp.	=	Species
SPSS	=	Statistical Package for Social Sciences
TAS	=	Tanzanian shillings
U.S.	=	United States
URT	=	United Republic of Tanzania
US$	=	United States Dollars
Var.	=	Variety

CHAPTER ONE

INTRODUCTION

1.1 Background

In many parts of the world, edible wild plant (EWP) products play important biological and social roles in local food systems (FAO, 1995). They can contribute substantially to nutrition, either as part of family diet or as a means to achieve household food security (Nyingili, 2003). EWP products come from locally available woodlands, which are part of and/or compatible with the local ecosystem (FAO, 1995). They can also improve health through prevention and treatment of diseases. Rural and poor people in particular depend on these products as sources of food and medicines. Historically, traditional societies used a variety of wild plants as food both during bumper harvest and during hunger periods (Zinyama *et al.*, 1990). Hunters collected edible wild plants before the technology to cut timber was developed (Chambelian *et al.*, 1998).

Tradable EWPs contribute to the fulfillment of daily needs and provide employment as well as income, particularly for rural people and especially women (FAO, 2001). The food resources of miombo woodlands are central to the livelihood systems of millions of rural and urban dwellers (Lawton, 1982). According to Rodgers (in Press) cited in Campbell (1996), Tanzania has more than 50% of the land area, which is covered with miombo, which is estimated 8 500 species of higher plants, over 54% of which are endemic. Miombo woodlands supply many edible plants, which play a great role to the well-being of rural communities,

including provision of food and medicines. But information on stocks and yields are not easily available.

The term edible wild-plant products is used to describe all plant resources outside of agricultural areas that are harvested or collected for the purpose of human consumption in forests and miombo woodlands (Guinand and Lamessa, 2001). According to Okigbo (1977) edible wild plant products include edible nuts and seeds used as staple foods or main dishes; those used as minor food supplements; condiments, thickening agents and flavours; leafy vegetables; edible flowers; fresh fruits; fresh seeds; edible oil; spices; fruit drinks and nonalcoholic beverages; alcoholic drinks (plus flavouring barks); and mushrooms.

According to Ruffo *et al.* (2002) edible wild food plants are those plants with edible parts which are found growing naturally on farms, fallow or uncultivated land, in forests and woodlands. Several types of food can be obtained from wild plants: Leaves, either fresh or dried, normally eaten together with staple grain dishes. Seeds and nuts are also used in various side dishes and sauces. Fruits normally are seasonal food and often eaten as snacks or made into juices. Roots and tubers provide carbohydrates and minerals and are especially valuable during dry seasons and famine periods. Gum and sap from certain trees (e.g. *Acacia Senegal*) are edible and used in various ways. The bark of some trees can be eaten or used as spices. Mushrooms and wild grains from certain bamboo species are also used as food. Edible wild plants products normally provide essential elements in the human diet. Edible wild-plant-foods are incorporated into normal livelihood

strategies of many rural people, be they pastoralists, shifting cultivators, continuous croppers or hunter-gatherers (Bell, 1995). By the term livelihoods, we mean the whole complex of factors that allow families to sustain themselves materially, emotionally, spiritually, and socially. Central to this is income, whether in the form of cash, or in the form of directly consumable products for subsistence, such as food, fuel, or building materials (Chambers and Conway 1992).

Tanzania has the greatest diversity of plant species of all African countries with the exception of the Democratic Republic of Congo (DRC) and South Africa. There are over 9 000 species of higher plants in Tanzania, most of them are endemic (Ruffo *et al.* 2002). It is in these forests where several EWPs products and other products occur (DANIDA, 1989). Makonda (1997) found that, about 156 useful plant species are used as food in Geita, Mwanza, Tanzania. Harkonen *et al.* (1995) conducted a comprehensive study on edible mushrooms of Tanzania and found that there are about 31 types of most common wild mushrooms.

1.2 Problem Statement and Justification

For many years the importance of edible wild plants in subsistence economies in the developing world as a food supplement and as a means of survival during times of drought and famine has been overlooked. Generally, the consumption of the so-called 'wild-food' has been and still is being under-estimated (Bell, 1995), some of which are consumed at times of drought, war and other hardships (Abebe and Ayehu, 1993). This may very well be the case for Kilosa district. Rural people in Kilosa district are endowed with a deep knowledge concerning the use of wild

plants. Elders and other knowledgeable community members are the key sources or 'reservoirs' of traditional knowledge on plants.

Household surveys have been used for decades to measure income and consumption patterns, but they have not traditionally assessed what portion of this income was from natural resources (Cavendish, 2000). As a result, the kind of comprehensive data needed to quantify the dependence of the poor on woodlands income has been scarce, increasing the tendency of policymakers to overlook the woodlands in poverty alleviation policies. This research is an attempt to fill this gap by undertaking qualitative and quantitative studies on miombo woodland contribution at the rural household level. World Bank (2004) found that, much of the economic value of forests and woodlands to the poor is missed in official state accounting of forest economy (Mogaka *et al.*, 2001). The rural poor derive a significant fraction of their total income from woodland goods and services. Income accrued from woodlands deserves special attention, since it is often the element that is not accurately accounted for in most considerations of rural livelihoods.

Information on the resource base and on sustainable use of EWPs is very limited, mainly because of the technical difficulty and high cost of measuring and reporting on them (FAO, 2001). A similar problem exists for the economic value associated with the products because value can be calculated at different stages of production and processing. The data obtained from traditional forestry institutions often differ from the trade data reported by customs agencies. This study will assess the

availability of EWPs products and examine socio-economic factors which determine the collection and utilization of EWPs products.

Despite the fact that EWPs products can contribute substantially to rural household food security, in Kilosa districts, little has been done to assess their contribution to household livelihood in the rural communities. Kilosa district communities are believed to be potentially rich sources of valuable traditional information on plant use owing to their long traditional practices on the flora surrounding them. Mziray (1990) suggested that, such practices and the extensive knowledge that exists among the traditional cultures about the great potential virtues of plants could be profitably tapped. It is important to find out the effect of ethnobotanical activities on the vegetation. This study will undertake an ethnobotanical assessment of the people-biota-environment interactions; and other important information and documents them so that they can reach a wider range of Tanzanian population. It is expected that information obtained from this study will inform policy and decision maker on EWPs, their role in food security and conservation approaches.

1.3 Study Objectives

1.3.1 Overall objective

The overall objective of the study is to assess the contribution of the edible wild plant products from miombo woodlands to the rural livelihood in Kilosa district.

1.3.2 Specific objectives

(i) To identify and assess products of EWPs from miombo woodlands of the study area;

(ii) To assess methods used in collection, Frequency, processing and preservation of EWPs;

(iii) To assess socio-economic factors underlying collection of EWPs products.

1.4 Research Questions

1. What types of EWP products from miombo woodlands found in the study area?
2. What is the amount of EWPs such as vegetable, fruits and mushrooms harvested, processed and preserved per household annually?
3. Which methods are used in harvesting, processing and preservation of EWPs?
4. What are the socio-economic factors underlying collection of EWPs?

1.5 Research Hypotheses

HO: Edible wild plants have no significant contribution to the rural livelihood in Kilosa, District.

HI: Edible wild plants have significant contribution to the rural livelihood in Kilosa district.

1.6 Conceptual Framework

A conceptual framework model helps to show the interconnectedness of information. Hence it provides guidance for collection of realistic data and information. Figure 1 indicates that, socio-economic factors in the study area

influence communities to collect products from edible wild plants for different purposes, for example, food, income and medicinal purposes. EWPs products ultimately have effects on the improvement of rural livelihoods. Under certain circumstances exploitation of EWPs may have negative impct on the environment resulting from overexploitation or inappropriate use of miombo woodland resources; hence a reverse pattern can as well be observed.

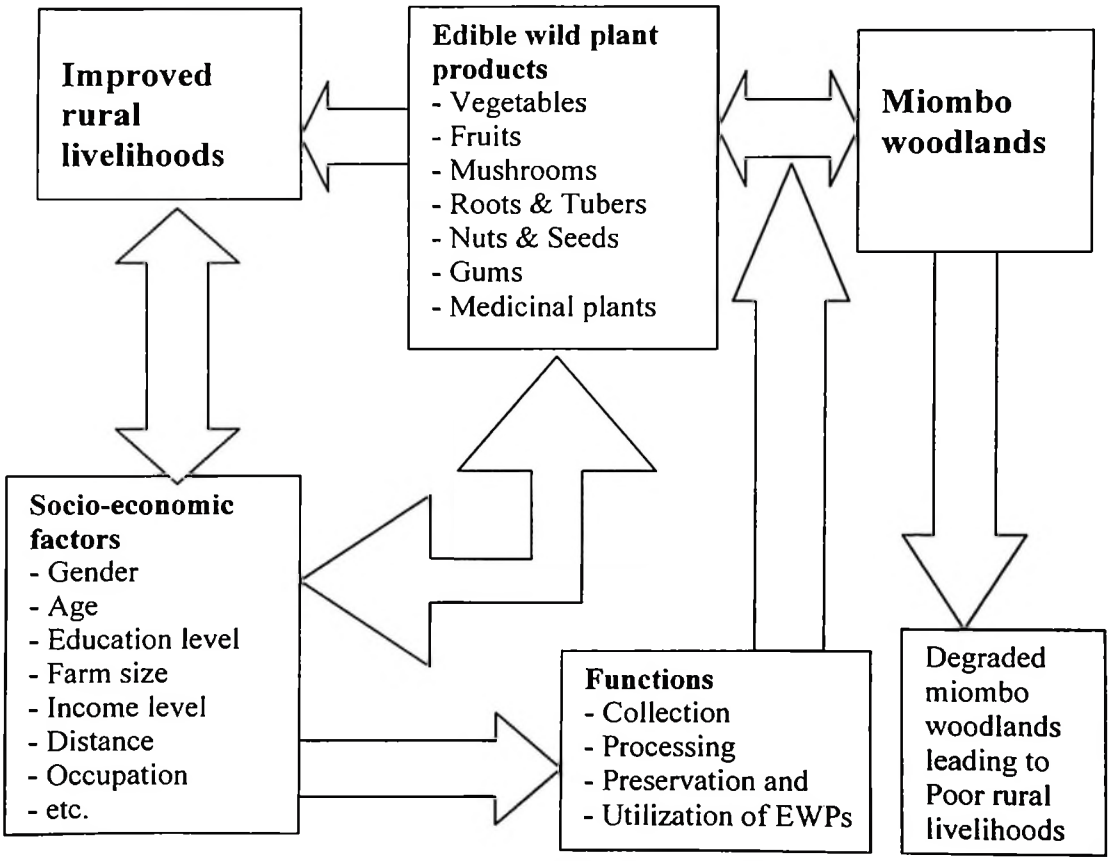

Figure 1: Conceptual framework on contribution of Edible wild plants to rural livelihoods in Kilosa district, Tanzania.

1.7 Study Limitations

(i) The study was conducted during the dry period, when most of the vegetations had shed down most of their leaves and forest fires passed

through most of the forests and caused a lot of destruction. This caused some difficulties in carrying out the research especially for collection of plant specimens for identification. Samples were collected from few trees which started to sprout out and some had young fruits. Species which were not available during that period such as mushrooms, vegetables, nuts and roots and tubers, their local names were listed down then used the check lists and local peoples' explanations to identify them.

(ii) Resources were limited with regard to time, transport facilities and funds required for carrying out this research. The costs of hiring a vehicle for field surveys doubled compared with the estimates. Moreover the study was conducted in very remote areas with very rough roads, which necessitated using four-wheel drive vehicles. In order to overcome such situation, the researcher used own effort to make sure that all necessary data were obtained by using locally available transport such as (bicycles, motorcycles and by hiring private vehicles or by walking). For the case of time constraint, the researcher worked from morning tol evening, and from Monday to Sunday in order to effectively accomplish the research work in time.

(iii) Most of the respondents were not willing to disclose some of the information such as on household income, use of traditional medicines and use of famine foods or wild food plants in general. Many people were very reluctant to provide information on income because the

majority claimed that they were unable to keep records on the earnings and expenditures. Very few tried their best to estimate the annual incomes. In order to overcome this problem the researcher used indirect way of gathering such information such as amount of agricultural crops sold last season, number of livestocks sold last year and if there were some hunger incidences and types of food used to overcome hunger in a household and/or strategies used to cope with the situation.

(iv) Some women were shy to talk, especially when men were present. This caused some difficulties in acquiring proper information such as amount of vegetables and mushrooms which are adequate for a meal. It was assumed that, women are more responsible with domestic activities such as collection and preparation of meals for their families. Thus, the study, expected to acquire more knowledge on EWPs from women. To overcome this problem, more men were contacted than women. In certain cases, their husbands assisted them to answer some of questions. The researcher also used a technique of probing more in order to get right information.

CHAPTER TWO

LITERATURE REVIEW

2.1 Miombo Woodlands

Miombo is a term used to describe those central, southern and eastern African woodlands dominated by the genera *Brachystegia, Julbernaedia* and *Isoberlinia,* three closely related genera from the legume family *Fabaceae* and Subfamily *Caesalpiniaceae* (Celander, 1983). Such woodlands extend across about 2.8 million km^2 of the southern subhumid tropical zone from Tanzania and Democratic Republic of Congo in the north (DRC), through Zambia, Malawi and eastern Angola, to Zimbabwe and Mozambique in the south (Desanker *et al.*, 1997). They constitute the largest more-or-less contiguous block of deciduous tropical woodlands and dry forests in the world. Interspersed within the woodlands are broad, grassy depressions (called dambos or mbuga). These seasonally waterlogged bottomlands can cover up to 40% of the landscape in some areas. "Dambos" are set into the landscape through differential weathering and subsurface removal of material by the lateral flow of groundwater (McFarlane and Whitlow, R. 1990). They are important sites for cultivation and livestock grazing. Miombo ecosystems directly support the livelihoods of over 40 million people and are the sources of products that serve the basic needs of an additional 15 million urban people who also depend on food, fibre, fuelwood, charcoal and building materials (Campbell, 1996).

Most of the mimbo trees are deciduous but produce new leaves before the onset of rains. They are broad-leaved, thornless trees, while the grasses comprise mainly species in the family *Andropogoneae*. The diversity of canopy tree species is low, although the overall species richness of the flora is high (Frost, 1996). Among other distinctive features are the number of tree species with meso- and microphyllous compound leaves, the flush of new leaves before the rains, the dominance of tree species with ectomycorrhizae, and the low numbers and biomass of large herbivores. Woody plants make up more than 95% of plant biomass in mature woodlands but grasses dominate in the "dambos". Another notable characteristic feature of miombo woodlands are their apparent uniformity over large areas. This uniformity is due partly to the remarkably similar physiognomy of the dominant canopy trees, a reflection of their origins in the *Caesalpiniaceae*, and partly due to similar environmental conditions across the region (Frost, 1996). Over most of its range, mature undisturbed miombo is closed deciduous non-spinescent woodlands. They generally occur in geologically old, nutrient-poor soils in the uni-modal rainfall zone. The shrub layer is variable in density and composition. The ground cover varies from a dense coarse grass growth to a sparse cover of herbs and small grasses. Fires are a characteristic feature of miombo woodlands (Celander, 1983). Miombo comprises the woodland-dominated end of the spectrum of savanna formation.

White (1983) divided miombo woodlands into dry and wet. The dry miombo woodlands occur in areas receiving less than 1000mm rainfall annually. They occur in Zimbabwe, central Tanzania, and the southern areas of Mozambique, Malawi

and Zambia. Canopy height is less than 15m and the vegetations are floristically impoverished. The wet miombo woodlands occur in areas receiving more than 1000mm rainfall per year and these are found in eastern Angola, northern Zambia, south western Tanzania and central Malawi. Canopy height is usually greater than 15m reflecting the generally deeper and moister soils, which create favorable conditions for growth. The vegetation is floristically rich (Frost, 1996). The present day distribution of miombo reflects its history, particularly past climatic changes and past and present human activities (Scott, 1984). The miombo woodland environment has a characteristic of fluctuating rainfall patterns and the frequency of droughts which make it possible for most people to rely on mimbo woodlands products. In times of droughts (as in other times of hardship and hunger) rural households turn to woodland products as a source of sustenance and cash income. Also, miombo woodlands have been an emergency resource and a buffer, providing a livelihood of the last resort when other options retreat (Campbell, 1996).

Miombo woodlands provide a wide range of products and services to rural households, and these are likely to make an appreciable contribution to rural household income and welfare (Campbell, 1996). Miombo woodland products contribute to rural household welfare in a range of direct ways, providing food and non-food consumption goods. In addition, miombo woodlands provide a range of indirect values, whether environmental (watershed protection, soil preservation), aesthetic and spiritual. The woodland resource use is characterized by strong differentiation across uses and across households. The key driving variables are

institutional (tenure: local and state authority), degree of commercialization, features of the household (such as wealth status or labour availability) and features of the resource (such as scarcity levels, distance to resources and spatial variability, and the existence of substitutions and backstops) (Campbell, 1996). It has been documented that much of the miombo woodlands have been subjected to intensive use, such that there is very little unmodified miombo woodlands remaining. Miombo woodlands are increasingly being cleared. These changes in miombo woodlands, leads to the changing patterns of utilization and cover over time and also to changes in social, political and economic processes (Dewees, 1994).

Most indigenous EWP products, which are marketed, are harvested from communal lands. In circumstances where there is open access, there can be considerable competition to harvest EWP products if the supply is limited (Gumbo *et al.*, 1990). Over-harvesting for the market has been blamed for a reduction in the population of the resource in some cases (McGregor, 1995). The method of harvesting can also lead to resource decline, such as by pulling rather than cutting mushrooms (Campbell *et al.*, 1993) cited in Campbell (1996) or by cutting excessive amounts of branches or entire trees. The sudden increase in demand brought about by the establishment of an organized, large-scale market for *Uapaca kirkiana* fruit in Zambia has led to concerns that the area in question is being stripped of its fruits (Packham, 1993), which may have long term repercussions for the sustainability of the fruit-tree resource. Gathering of some medicinal plants is associated with rules and rights. For example collection is allowed only early in the morning and late afternoon and some plants are supposed to be collected late in the evening with

minimal disturbance or placing some money at the base of the mother trees with reciting some verses to the ancestors (Odera, 1997). In some cases sacrifice must be made before medicines are gathered from particular plants. Medicine efficacy is thought to be highest from plants collected in the wild and plants from deep forests are considered to be stronger than from the fringe (Abdallah, 2001).

2.1.1 Livelihood

2.1.1.1 The concept of livelihood

According to Ellis (2000), the concept of livelihood is widely used in contemporary writings on poverty and rural development, but its meaning can often appear elusive, either due to vagueness or to different definitions being encountered in different sources. Its dictionary definition is a 'means to a living', which straight away makes it more than merely synonymous with income because it directs attention to the way in which a living is obtained, not just a net results in terms of income received or consumption attained. A popular definition is that provided by Chambers and Conway (1992). They developed a definition of livelihoods and the factors that make them sustainable which underpins all of the livelihoods frameworks currently being used: "a livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain and enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels in the long and short term."

A slightly modified version of the definition originally developed by Chambers and Conway was accepted by Department for International Development (Carney, 1998). "A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base." An important feature of this livelihood definition is the direct links between assets and the options people possess in practice to pursue alternative activities that can generate income level required for survival. Livelihoods are the means of everyday support and subsistence. As commonly conceived, a livelihood generates financial resources that come from employment or subsistence activities. But livelihoods also draw on other resources: human and social resources that give structure and context to our daily lives, as well as the natural and physical resources that underpin our work. The UN Development Programmes Human Development Reports in particular drew attention to human well-being, defined by health, education, opportunity, a healthy environment, and a decent standard of living, as the core of development practice (Solesbury 2003).

The term 'capabilities' refers to the ability of individuals to realize their potential as human beings, in the sense both of being (that is, to be adequately nourished, free from illness and so on) and doing (that is, to exercise choices, develop skills and experience, participate socially and so on). Strictly speaking, capabilities refer to the set of alternative that a person can achieve with his or her economic, social, and

personal characteristics (Dreze and Sen, 1989). Satge *et al.* (2000), defined capabilities as the combined knowledge, skills, state of health and ability to labour or command labour of a household.

The term 'assets' refer to the resources used for gaining a livelihood (Satge *et al.*, 2000). 'Shocks' are sudden events which undermine household livelihoods. These include retrenchment, death of an economically active household member, as well as impact of hazards such as drought, floods or other extreme weather events. 'Stresses' are ongoing pressures which face households and individuals. These include long-term food insecurity and limited access to essential services such as health or water supplies. Another stress is degrading the natural resource base, something which may force people to travel further and further for natural resource products. 'Vulnerability' refers to the characteristics that limit an individual, a household, a community, a city, a country or even an ecosystem's capacity to anticipate, manage, resist or recover from the impact of natural or other threats (often called 'hazard' or natural 'trigger'). 'Resilience' is a measure of the household's ability to absorb shocks and stresses (Satge *et al.*, 2000). A household with well-diversified assets and livelihood activities can cope better with shocks and stresses than the one with a more limited asset base and few livelihood resources.

2.1.1.2 Rural livelihoods diversification

Rural livelihood diversification is defined as the process by which rural households construct an increasingly diverse portfolio of activities and assets in order to

survive and to improve their standard of living (Ellis, 2000). According to Satge *et al.* (2000), livelihood diversification refers to a household's attempt to reduce its vulnerability by having more than one livehood activity. In a diversified household, if one productive activity does not provide enough, or fails completely, there are other sources of livelihood that the household can fall back on. Livelihood diversification widens people's options, reduces reliance on particular natural resources, encourages spatially diverse transactions, increases cash in circulation in rural areas, and enhances human capital by providing those who diversify with new skills and experiences (Ellis and Allison, 2004). Currently farming on its own rarely provides a sufficient means of survival in rural areas of low income countries (Ellis, 1998). For this reason most rural households are found to depend on a diverse portfolio of activities and income sources. Livelihood diversification is found in all locations, as well as across farm sizes and across ranges of income and wealth. Most rural families have truly multiple income sources. This may indeed include off-farm wage work in agriculture, but it is also likely to involve wage work in non-farm activities, rural non-farm employment (e.g. trading), and remittances from urban areas and from abroad (Ellis, 1998).

Diversification occurs for various reasons of which underlying trends and processes include: rural population growth, farm fragmentation and declining returns to farming compared to other activities (which in itself may occur due to rising real production costs or declining real prices or a combination of both). Household survival strategy reasons include risk reduction, overcoming income

instability caused by seasonality, improving food security, taking advantage of opportunities provided by nearby or distant labour markets, generating cash in order to meet family objectives such as the education for the children and, sometimes, the sheer necessity of survival following personal misfortune (e.g. accident, ill health or eviction) or natural and human disasters (e.g. drought, flood, civil war) (Ellis, 1998).

In general, diversification can be said to have a positive impact on livelihoods if it makes them more secure, reduces the adverse impacts of seasonality, and helps to raise poor rural households out of the poverty trap. In other words, diversification is positive if it reduces the vulnerability of individuals and households to deprivation and disaster (where vulnerability is taken to mean proneness to stress and shocks). Conversely, diversification has a negative effect on livelihoods if it increases the vulnerability of households (Ellis, 1998). Livelihood seem to offer a more complete picture of the complexities of survival in low-income countries than term formerly considered adequate like 'subsistence', 'incomes' and 'employment'. Diversification recognizes that people survive by doing many different things, rather than just one thing or a few things. Natural resources are fundamental assets in rural livelihoods, but access to them needs to be viewed through the same lens of widening options and opportunity as livelihood diversification itself (Ellis and Allison, 2004). These beneficial effects of diversification depend upon social attributes of mobility, flexibility, and adaptability, as well as on the ease of engaging in spatially diverse transactions. According to Shackleton and Shackleton (2000), rural people throughout the world make use of plant resources around

them. Such use includes direct use or consumption within the household and harvesting for income generation (Stiles, 1994, Taylor, 1997 and Qureshi and Kumar, 1998 cited in Shackleton and Shackleton, 2000). A wide variety of woodland resources were harvested and processed by the rural communities of South and Southern Africa (Shackleton and Shackleton, 2000). The higher returns to labour engaged in natural resource harvesting as opposed to wage labour perhaps raised the question of why are not more people engaged in harvesting as primary livelihood? Firstly, most households do have one or more members engaged in harvesting one or more woodland resources. This is especially so for home consumption and supplementary income. Example was given that, 92% of households in Bushbuckridge Lowveld, South Africa consume edible herbs and 81% utilize edible fruits. The importance of livelihood strategies is based on the use of land in areas that were perceived to be under-productive. Resource harvesting is probably the safety net that allows many households to survie in areas of poor agricultural potential, high human populations and low employment opportunities. These activities should receive the same level of extension support from government agencies that arable and livestock agriculture do. This would also be one approach towards promoting sustainable harvesting within the rural areas. Thus, harvesting is an integral component of local livelihood strategies (Shackleton and Shackleton, 2000).

2.1.1.3 Sustainable livelihoods

The concept of sustainable rural livelihoods is a normative one. The aim is to improve the lives of poor people and strengthen the sustainability of their

livelihoods (Carney, 1998). The approach is inherently responsive to people's own interpretations of and priorities for their livelihoods. One of the potential strengths of the livelihoods approach is that it mainstreams the environment within an holistic framework. The framework is holistic and dynamic and recognizes the many complex interactions in rural livelihoods. The framework is intended as a means for understanding livelihoods, rather than as a programme of action (Carney, 1998). Despite differences in emphasis by different practitioners, the livelihood framework helps us to: identify and value what people are already doing to cope with risk and uncertainty; make the connections between factors that constrain or enhance their livelihoods on the one hand, and policies and institutions in the wider environment; and identify measures that can strengthen assets, enhance capabilities and reduce vulnerability (Satge *et al.*, 2000). The framework currently in use deals with an analysis of the five different types of assets upon which individuals draw to build their livelihoods. These include:

- **Natural capital** - The natural resource stocks from which resource flows useful for livelihoods are derived (e.g. land, water, wildlife, biodiversity, environmental resources);
- **Social capital** - The social resources (networks, membership of groups, relationships of trust, access to wider institutions of society) upon which people draw in pursuit of livelihoods;
- **Human capital** - The skills, knowledge, ability to labour and good health important to the ability to pursue different livelihood strategies;

- **Physical capital** - The basic infrastructure (transport, shelter, water, energy and communications) and the production equipment and means which enable people to pursue their livelihoods; and
- **Financial capital** - The financial resources which are available to people (whether savings, supplies of credit or regular remittances or pensions) which provide them with different livelihood options (Carney, 1998) as adapted from Scoones (1998).

For many of the poor, livelihoods seem to fit better than employment as a concept to capture how poor people live, what their realistic priorities are, and what can help them. Sustainable then refers to the long-term and livelihood refers to the many activities which make up a good living (Chambers, 1995). On sustainability, it is common prejudices among those who are not poor that poor people inherently live hand-to-mouth and take the short term view. However, in practice, again and again, poor people show tenacity and self-sacrifice in trying to take the long-term view and safeguarding the basis for their livelihoods. A significant element of the 'safety net' for many rural people in times of stress consists of 'famine foods' which can be gathered from woodlands and fallow lands (Norton *et al.*, 1994 cited in Campbell, 1996). The ingenuity and opportunism of poor people, and the diversity and complexity of their strategies, for different social groups of the landless, even within the same village can have completely different strategies (Beck, 1989; Heyer, 1989).

Strategies and sources of food, income, support and survival include the follwing:

- **Home-gardening** – Both rural and urban (exploitation of micro-environments) (Hoogerbrugge and Fresco, 1993).
- **Common property resources (CPRs)** – Gathering in forests, woodlands, swamps, savannas, wastelands, roadsides for a vast range of wild foods and medicines. The value of CPRs to the poor is heightened because they often provide varied safety nets in the form of remunerative activity or food at times when other opportunities are lacking (Beck, 1994).
- **Scavenging** – (mainly urban) and **gleaning** (mainly rural), including traditional rights and access to private residues (buttermilk, crop residues as fuel etc.).
- **Processing, hawking, vending and marketing** – Including produce from home gardens and common property resources.
- **Share-rearing of livestock** – Where livestock are lent for herding in exchange for rights to some products and/or offspring (Chambers, 1995).

These points illustrate livelihood strategies. Often, an individual or a household engages in many livelihood activities over a year. In identifying actions, then, it makes sense to shift thinking from labour intensive growth towards sustainable livelihood intensive change. As a concept, labour intensity links with employment. Sustainable livelihood intensive strategy goes beyond employment to stress (Chambers, 1995).

The "sustainability" element of the livelihoods approach is achieved by helping people to build resistance to external shocks and stresses, maintain the long-term productivity of natural resources, move away from dependence on unsustainable outside support, and avoid undermining the livelihood options of others (Chambers, 1995).

2.1.1.4 Forestry and sustainable rural livelihoods

The term 'forests' as used here include all resources that can produce forest products. These comprise woodland, scrub land, bush fallows and farm bush and trees on farms, as well as forests (Arnold, 1998). The contribution that forests and tree resources make to livelihood outcomes can be summarized as follows:

- **Increased income** – large numbers of people generate a portion of their income from woodland products, for some such activities can become a major and expanding income source.
- **Increased well-being** – forests are ever more widely the source of subsistence goods and materials, supplementing inputs from farming activities.
- **Reduced vulnerability** – forest and tree stocks provide a biomass reserve upon which people can fall back for subsistence and income in times of crop failure, unemployment, drought and other kinds of hardship, or to meet exceptional needs such as school fees and weddings.
- **More sustainable use of the natural resources base** – trees and woodland in agricultural landscapes can help protect crops and soil, and can contribute to maintaining site productivity.

The contribution of forests and trees to rural livelihoods varies greatly from situation to situation, among households in a particular situation and over time. People living in forest environments and practising hunting, gathering and shifting cultivation are likely to draw heavily on forests and their outputs. Elsewhere, the importance of forest products is usually more in the way they fill gaps and complement other sources of subsistence inputs and income than in their absolute magnitude or share of overall household inputs. Ease of entry and proximity to widely dispersed rural markets enable very large numbers of people to generate some income from forest products. Forest products can therefore be very important to the poor, including poor women, in situation in which they are unable to obtain income or sufficient income from agriculture or wage employment and where few other options exist (Arnold, 1998).

Miombo woodlands are surrounded by continually escalating poverty stricken human populations with high dependence on forests for the direct and indirect benefits such as non-wood forest products (fruits, medicine, vegetables, honey and mushrooms) (Lulandala, 2007). The non-wood forest products from miombo are therefore important as they form alternative source of livelihood, contribute to poverty alleviation through generation of income and provide food and improved nutrition, medicine and a range of products and foreign exchange earnings (Makonda and Gillah 2007). Research done in six communities in Tanzania by CIFOR (1999) cited by Makonda and Gillah (2007) found that farmers were deriving up to 58% of their cash income from the sale of honey, charcoal, fuelwood, wild fruits and vegetables. Majority of rural people in tropical countries depend on

forests and woodland ecosystems for their livelihoods (Campbell, 1987, Packham, 1993, Desanker et al., 1997). In most of the sub-Saharani countries including Tanzania, Mozambique, Malawi, Zimbabwe and Zambia, maore than 80% of rura people are poor and traditionally rely on non-wood goods and services FAO (1999).

2.1.2 Edible wild plant products from miombo woodlands

Food and medical products are EWP products traditionally obtained from the miombo woodlands. Mushrooms, fruits, berries, flowers, seeds, tubers and young shoots of different species are extracted for food (Celander, 1983). EWPs from miombo woodlands can broaden the food base and diversify the diet thus preventing nutrient deficiencies and ensuring dietary balance (FAO, 1995). Miombo woodlands provide varieties of products from EWPs such as: flowers and seeds of *Stenostylis*, tubers of *Dioscorea*, bulbs of *Cyanastrum johnstonii*, young shoots of *Adenia gummifera* and wild yam (Malaisse, 1978). Many botanical and anthropological studies have documented edible forest plant products gathered by forest and non-forest dwellers (Campbell, 1986). Wild leaves such as those of *Grewia* sp. are consumed primarily in spring and summer, while fruits are eaten during winter and spring when they are the main source of vitamin C supply. In Swaziland the top four species of socio-economic significance are: *Sclerocarya birrea* subsp. *caffra*, *Bequaertiodendron megalismontum*, *Syzgium cordatum* and *Ximenia caffra* (FAO, 2000).

Many authors have documented the role of wild foods in improving nutrition and increasing food security particularly in poor rural ares and during famine periods (FAO, 2001, MNRT, 1998, FBD, 1999). In pronounced severe food shortage in Tanzania for example, wild vegetables either supplement or substitute staple foods, common in parts of Iringa, Dodoma, Singida and Morogoro (FBD, 1999; Mvungi, 2001). Ruffo et al. (2002) found that in humid areas of Tanzania, wild food plants, especially vegetables such as *Amarantus spinosa* and *Bidens pilosa*, are available throughout the year. But others are only available seasonally. In dry areas of Tanzania vegetables are most abundant between December and June, while fruits are abundant from April to June. They also observed that some of the wild food plants such as *Ceratotheca sesamoides, Adansonia digitata* and *Azanza garckeana*, are collected during the peak season and preserved for use during the off-season.

2.1.2.1 Vegetables and edible leaves

Wild leaves are another important source of food derived from miombo woodlands. Rural households in Lushoto, Tanzania were found to consume 15 species of wild leaves including *Chenopodium opulifolium, Celosia trigyna, Launaea cornuta, Mansonia angustifolia, Momordica foetida, Justicia sp., Opilia amentacea, Ormocarpum kirkii, Oxygonum sinuatum, Physalis peruviana, Pouzolzia mixta, Pupalia lappacea, Rourea orientalis, Sonchus oleraceus* and *Solanum anguivii* (Fleuret, 1979). Luoga *et al.* (2000) in their study in miombo woodlands of eastern Tanzania found that, three arborescent species produce edible leaves namely: *Zanthoxylum chalybeum, Ormocarpum kirkii* and *Zanha africana*. A study carried out in Uluguru North Mountains and West Usamabara Mountains, Tanzania by Msuya *et al.*, (2004)

found that indigenous vegetables are consumed and preferred more as compared to indigenous fruits, nuts/seeds because they are easily obtainable, available all the year round and can be prepared without cooking oil, which is expensive. Ruffo *et al.*, (2002) argue that some indigenous forest food products have higher nutritive value as compared to exotic ones. For example, indigenous vegetables such as *Amaranthus spinosus, Bidens pilosa, Corchorus olitorius* and *Solanum nigrum* have high protein, fat, minerals (calcium and iron) and carotene than some exotic vegetables such as *Brassica chinensis* and many other of the cabbage family. In central Zambia, ten species of edible wild leaves were recorded (Campbell, 1996) which are *Grewia ectasicarpa, Corchorus olitorius, Basella alba, Ormocarpum* sp. *Adeinia gummifera, Amaranthus* sp., *Corchorus tridense* and others. McGregor (1995) points out that only a few of the many wild vegetables eaten actually come from the woodlands, the rest are found in disturbed areas growing as weeds. In Malawi, edible leaves of *Ormocarpum* sp. has been recorded (Lowore *et al.*, 1995 cited in Campbell, 1996). The most common leaves consumed in Mozambique are *Adeinia gummifera, Amaranthus* sp., *Corchorus tridense, Ipomea lapatifolia* and *Momordica balsamica* (FAO, 2000).

2.1.2.2 Fruits

Miombo woodlands are rich in varieties and quantities of fruit trees (Campbell, 1987). Wild fruits of many species are appreciated as a food supplements. Fruits are collected from many tree species including *Uapaca kirkiana, Anisophyllea boehmii* and *Parinari curatellifolia.* In Tanzania a total of 83 species of indigenous fruit trees have been recorded, most of which occur in miombo woodlands including: *Strychnos*

and *Chrysophyllum bangweolense*, drupes of *Vitex*, *Parinari* and *Uapaca* (Temu and Msanga, 1994). Monela *et al.* (2000) argued that, *Tamarindus indica, Sclerocarya birrea* sub sp. *cafra, Kigelia africana, Adansonia digitata, Syzygium* spp. and *Brachystegia microphylla* are some of the potential edible wild fruits from miombo woodlands. *Tamarindus indica* and *Adansonia digitata* produce fruits used for making juices and flavouring ice creams. At the village level fruits play a very important part in complementing diet with vitamin C content. Wild fruits are also widely used for making beverages like beer, juice, jam and wine (Plate 1). Fruits of *Sclerocarya birrea, Vitex doniana,* and *Uapaca kirkiana* have been used for this purpose in Western Tanzania woodlands around Tabora (Personal observation).

Luoga *et al.* (2000) identified nine tree species which bear edible fruits including *Flueggea virosa, Allophylus rubifolius, Heinsia crinita, Diospyros zombensis, Grewia bicolar, Vangueria infausta, Annona senegalensis, Tamarindus indica* and *Ximenia cafra. Grewia flavescens* fruits are grounded and made into porridge, comprise nearly 25% of the food items during the dry season in a remote communal area in Northern Zimbabwe after the 1981 - 82 drougth (Clarke, 1983). *Parinari* fruits are processed to make porridge, and *Syzygium mucronata* fruits are processed into a distilled spirit. *Sclerocarya birrea* can be made into a beer (Campbell, 1996).

Plate 1: Jams from *Flacourtia indica* and *Vitex doniana* (left photo) and Fruits of *Uapaca kirkiana* (right photo) (Photo: E. Mujillah 2005).

The survey carried out in southern Mozambique by Albano *et al.* (1998 cited in FAO 2000), recorded 41 edible fruit species, the most common fruits were *Strychnos madagascariensis, Strychnos spinosa, Sclerocarya birrea, Hyphaene coriacea, Phoenix reclinata, Aloe* sp., *Ficus sycomorus, Ximenia caffra, Boscia albitrunca, Diallium schlecteri, Trichilia emetica, Antidesma venosum, Ziziphus mucronata, Grewia* sp., *Garcinia livingstonei, Dovyalis longispina, Syzygium cordatum, Mimusops* spp., *Manilkara discolor, Landolphia kirki, Tabernaemontana elegans, Vangueria infausta,* and *Coffea racemosa.* Indigenous fruit-trees of the miombo are also used to generate income (both cash and barter) through sales of fruits and fruit products. Wild fruits have long been valued as buffer food resources in periods of famine and food shortage. Wild berries (e.g. gooseberries, raspberries) are not only consumed at subsistence level, but are also commonly offered for sale and provide some employment for young people (FAO, 2000).

2.1.2.3 Mushrooms

Moist miombo woodlands have abundant and diverse mushroom populations. According to FAO (2000) mushrooms are one of the most sought-after wild foods in the natural ecosystems, particularly in the miombo ecosystem. Most people in Tanzania collect mushrooms and include them in their diet. In the rainy season most families eat mushrooms two or three times a week, but some people in the Bena, Hehe, Makua, Nyamwezi, Nyiha and Sambaa communities usually have mushroom meal every day (Harkonen *et al.*, 2003). The largest diversity of edible mushrooms exisit in the southern and western parts of the country, most of which are covered with miombo woodlands. Mushrooms make a remarkable addition to the daily diet of the Tanzanians, since they appear at the beginning of the rainy season when the crops from the previous growing season have, for the most part, been used. Because of their seasonal appearance, most Tanzanians consider mushrooms as a delicacy. Over 31 species of edible mushrooms are known to occur in Tanzania (Harkonen *et al.*, 2003) and 53 in the Democratic Republic of Congo (Lawton, 1995), miombo woodland being the major habitat for many of them.

In the Boni area, Kasungu District, in Malawi, 26 species of edible mushrooms were identified and 16% of journeys to the woodlands were for mushroom collection (Lowore *et al.*, 1995 cited in Campbell, 1996). FAO (2000) reported that, in Malawi, 60 species of edible mushrooms has been documented and that are widely sold along roadsides during the rainy season, particularly by women and children. In Zimbabwe, researchers found that, in Shirungwi area, 21 species of mushrooms were collected and both richer and poorer households eat fresh mushrooms, but

only poorer households ate dried mushrooms (Campbell, 1996). Celander (1983) documents that, there are between 15 and 25 species of mushrooms which are utilized for food in the Zambian miombo woodlands.

2.1.2.4 Medicinal plants

In Tanzania, medicinal plants play a vital role in primary health care of both rural and urban communities (Augustino, 2002). It was estimated that about 80% of the rural population in Tanzania depended on herbalists who handled their medical problems (FAO, 1986). Roots, leaves and barks of many different species are used in health care and as medicine (Celander, 1983). Plant material combinations are used in self-treatment of common ailments, such as cough, headaches, sores and diarrhoea. Among the medicinal plants are the roots of *Brachystegia boehmii* which are used to treat diarrhoea, the bark of *Julbernardia globiflora* of which tannin is useful as laxative, and extracts from the bark of *Julbernardia paniculata* which are used to cure sores and common colds (Celander, 1983). The disappearance of miombo woodlands makes it harder to find the traditional medicines, and is identified by rural people as a factor in reducing their well-being (Campbell, 1996). A total of 35 tree species from eastern Tanzania miombo woodlands in Morogoro have medicinal properties. Eighty three percent of these species were harvested from roots. *Mimosoidea* species were mostly used for remedies, representing nearly 23% of all medicinal trees (Luoga *et al.*, 2000).

2.1.2.5 Roots and tubers

Roots and tubers provide carbohydrates and some minerals. They are drought and famine foods, they can persist under reduced precipitation and they can be important source of water. Roots and tubers are also important ingredients in traditional medicines (FAO, 1991). Malaisse *et al.* (1985) identified more than 40 root species used for food in Upper Shaba province in the Democratic Republic of Congo. Many roots and tubers require processing (soaking and cooking) in order to be edible, perhaps accounting for their use primarily in times of food shortages. Luoga *et al.* (2000) found that *Maerua tryphylla* produces edible roots and tubers that provide food security, especially during drought years. In Malawi, one species of edible leaves of *Ormocarpum species* and one tuber, *Habenaria walleri*, have been recorded (Lowore *et al.*, 1995 cited in Campbell, 1996).

In Mozambique, roots and tubers are consumed only on an occasional basis. The most important ones are *Commiphora negleta, Nymphaea capensis, Oxalis semilobata* and *Scilia hyacinthine* (FAO, 2000). Nyingili (2003) in her study carried out in Mbozi district, Tanzania identified four species of wild roots and tubers including *Cyperus rotundus, Eriosema burkei, Dioscorea* spp. and *Satyrium* spp. Fleuret (1979) reports that in rural households in Lushoto, Tanzania roots are important sources of food derived from miombo woodlands. The study by Missano *et al.* (1994) in Mtwara region, Tanzania reported that 'Ming'oko' roots are consumed throughout the year.

2.1.2.6 Nuts and seeds

Seeds and nuts are used in various side dishes and sauces (Ruffo *et al.*, 2002). Nuts which maintain their products or whose products survive in the ground or in storage for long periods of time provide the greatest food products in some communitiesduring hunger periods (FAO, 1991). Seeds and nuts generally provide calories, oil, and protein to the diet (Ruffo *et al.*, 2002). In addition, fats and oils they provide are also important for absorption of vitamins A, D, and E. Examples of nutritionally important nuts and seeds are the palm nuts, oil palm and babassu palm. Coconuts are of central importance in many cultures. The seeds of *Allanblackia* spp. provide edible oils; the seeds of *Bombax rhodognaphalon* var. *tomentosum* (Wild kapok) provide oils and are used as snacks, also as famine food among pastoral people in the semi-arid areas of Tanzania (Ruffo *et al.*, 2002). On a world scale, they represent 7% of the world's fat ration. An estimated 8 billion nuts were consumed raw in 1965 (Cornelius, 1973) as cited by FAO (1991).

2.1.2.7 Gums

Gum and sap from certain trees (e.g. *Acacia senegal*) are edible and used in various ways (Ruffo *et al.*, 2002). In Tanzania, the annual production capacity of gum arabic is 1 000 tonnes, out of which 50% is exported (Chihongo, 2000). According to Kagya (2002), gum Arabic from *Acacia senegal* and *Acacia seyal* trees are of great importance in Tanzania. In other parts of the world, outside miombo woodlands eco-regions, the use of gum has also been reported. The gum of *Sterculia* sp. is used as a dietary supplement by the Wolofs of northern Senegal (Becker, 1983). It is

added to soups and stews and it is also a good source of vitamin C. Similarly, gum Arabic (*Acacia senegal*) is also traditionally an important food for pastoralists, agricultulists and hunter-gathers (Becker, 1983). Nomads from Mauritania use it to make N'dadzalla, a mixture of fried gum, butter and sugar (FAO, 1991). It is also used as a milk substitute when mixed with sugared water (Giffard, 1975). Grieve (1967) cited in Campbell (1996) noted that, six ounces is sufficient to support a man for a day. It is often the staple food for the gum collectors in the field. The Senegalese Forest service estimates that 500 tons are consumed annually by gatherers (Giffard, 1975). It could be used as a dietary supplement, as it increases the intensity of vitamin synthesis (FAO, 1991). Makonda (1997) identified seven species which produce gums and latex including *Ficus spp, Commiphora Africana* and *Euphorbia tirucalli*. Gum Arabic is now used mainly in confectionery industries (FAO, 1989).

2.1.2.8 Spices and aromatic barks

The bark of some trees can be eaten or used as spices. According to Ruffo *et al.* (2002), the inner bark (phloem strands) and the thick fruit pulp are boiled in water, sugar added and then drunk as tea (by Maasai tribe); the bark is cooked with meat soup and eaten in order to strengthen the body and as a stimulant (by Maasai tribe). Seeds of *Aframomum angustifolium* (Wild cardamom) and *Peper guineense* (Ashanti pepper) are used as spices which improve palatability and taste of food (Ruffo *et al.*, 2002). Spices, condiments and culinary herbs are other important groups of products that consititute a significant component of world trade. For

example, World trade in cinnamon is between 7 500 and 10 000 tonnes annually. The world trade in *Cassia* sp. is on the order of 20 000 to 25 000 tonnes annually (FAO, 2001). Spices and Aromatic barks normally provide essential elements in the human diet (Ruffo *et al.*, 2002).

2.1.2.9 Grains

Grains provide carbohydrates and some minerals and are used as famine foods. Thus they are used during critical periods of food shortages. Mapolu (2002) on her study in Tabora district, Tanzania found that, 50% of the respondents utilized grains (*Dactylactenium aegytium*) as main meal. Other studies in different areas have reported the utilization of certain species of grains during critical food shortages (Zinyama *et al.*, 1990). A study conducted by Missano *et al.*, (1994) in Mtwara region, Tanzania found that, some household were consuming wild grains from bamboo locally known as "mbuga" (in makonde and makua language). Consumption of these grains was associated with poor crop harvests leading to critical famine. Consumption of wild grains in many parts of Tanzania has not been sufficiently researched, though it is said that many tribes consume wild grains available during food shortages (Kajembe *et al.*, 2000).

2.2 Methods of Processing and Preservation of EWP Products

Edible wild plants and mushrooms are processed in a variety of ways including simple drying, more complex preservation techniques and the production of beverages (Gumbo *et al.*, 1990). Common methods used in preservation are sun

drying and grilling. The common items preserved include vegetables, mushrooms, medicines and some fruits of *Adansonia digitata*. Sun drying is done during rainy season when most EWP products and mushrooms are available. They are kept in water proof containers such as guords, big clay pots, sisal bags/sacs, plastic containers, bottles for liquid medicines. EWP products and mushrooms are processed and preserved for future use (Nyingili, 2003). Drying and other methods of preservation for indigenous fruits for consumption outside their normal season appear to be quite common in some parts of Zimbabwe. The nuts of *Sclerocarya birrea* have considerable requirements for processing prior to sale. Nuts are extracted manually; twenty-four hours are required to fill a tin that holds 800 grams of the nuts.

A few products may be purchased and then processed further: the roots of *Rhynchosia insignis* are sold fresh or dried for processing into "munkoyo" beer in Zambia (Njovu, 1993, cited in Campbell, 1996); The Zambia National Breweries buy *Uapaca kirkiana* fruits from rural people for processing into "musuku wine" (Packham, 1993); *Sclerocarya birrea* fruit can be used to make an alcoholic drink (Gumbo *et al.*, 1990) and *Zizyphus mucronata* fruit is also made into an alcoholic drink, which is locally sold in Zimbabwe. Fruits from wild plants are usually consumed raw as they are picked. Leaves and other tender parts of wild plants are prepared like cabbage and other vegetables, i.e. chopped into small pieces and boiled in water. Roots are either eaten raw or cooked. Some wild tubers are first dried and then crushed. Root parts are usually more complicated and need a longer preparation time and process, especially those which are toxic and need special

treatment. Kernels, seeds and nuts are also mostly cooked for a fairly long time before consumption (Guinand and Lemessa, 2001). Plant medicine needs to be processed before being utilized by customers and storage for future use. The important processing methods include: boiling, pounding, chewing, warming or heating, chopping and soaking (Hamza *et al.*, 2004). Boiling of plant medicine before use is due to the beliefs that it is the best method for extracting active ingredients from plant medicines and the process ensures sterility. Maximillian (1998) reported that, some medicinal plants were used when fresh and others when dried. Drying of medicinal plants was done to the plants which are not available throughout the year. This helps to make the medicine available especially during the dry season. Food processing techniques are known but unused due to time or other constraints. Processing technowlogies should be incorporated into extension and training programmes of the introduced food products. Often this knowledge is not known by local women (FAO, 1991).

2.3 Socio-Economic Factors Underlying Collection of EWP Products

Socio-economic factors may also influence resource use in different situations. EWPs differ in a number of characteristics including yield, perishability, value, and seasonality of availability. In addition, the local communities harvesting these resources differ in age structure, gender, education level, income level, farm size, culture, and distance from the forest/woodland resource. Thus socio-economic status of the communities may be the underlying factors for collection and utilization of EWP products. Also factors which influence resource demands and lead to differential use patterns can be clustered into four broad groups (Campbell

and Byron, 1996). These factors include nature and value of the resources, household characteristics and livelihood strategies, market for forest products and land and resource management institutional. All these variables are inter-related, forming a complex of biophysical, social and economic variables, which underpin patterns of use and value across forest and woodland types (Campbell and Byron, 1996).

Nature of the resource: The types and quantities of goods and services available are directly related to the existing vegetation types and conditions. Miombo woodlands can be defined along rainfall continuum, ranging from dry to wet (White, 1983). The actual species found in each type and therefore the specific categories of products derived from them will differ from place to place. Furthermore, the availability of particular resources derived from natural environments constantly fluctuates, both seasonally and over larger period of time (Leach *et al.*, 1997).

Households' characteristics and livelihood strategies: Communities are not homogeneous, but are made up of diverse set of households and individuals each with their own entitlements and priorities which influence their access to and use of woodland resources (Leach *et al.*, 1997).

2.3.1 Gender

According to Fernandez (1994) 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 them (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 their 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 men and women 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).

A study conducted in Meatu district in Shinyanga Region, Tanzania by Kagya (2002) found that, there was a clear gender division of roles in collection, processing and marketing of EWPs in the district. Women were mainly involved in collecting and marketing of lowly paying wild vegetables and fruits, while men collected and marketed highly paying forest products such as fodder and honey. Also the author further argue that, 97% of the respondents indicated that, collection, processing and marketing of wild vegetables is a sole domain of women and proceeds earned are controlled by women for their own needs. Kagya (2002) in her study observed that, women seem to be involved in collecting EWP products

which are found in fallow, gardens and forest margins near areas of residences, whereby men harvest from distant forests and woodlands.

Yadama *et al.* (2001) revealed that, the primary players in the collection, processing, and marketing of EWP products are women who gather the bulk of forest produce, including food and medicinal-related forest products. Women also gather EWP products that are primarily sold in the market. Men are mainly responsible for construction timber, poles and some collection of medicinal plants which are also gathered by women. The differential roles and responsibilities of men and women vis-à-vis forests and the concomitant social and economic consequences for tribal households at large, and women in particular, are considerable (Yadama *et al.*, 2001). Interestingly, the considerable role played by women in ensuring food security, and in the provision of cash income from the sale of NWFPs gives women a higher status in tribal societies.

According to Guinand and Lamessa (2001), mostly children collect and consume the fruits of wild plants. Women frequently collect wild food when they are on their way to fetch water, to collect firewood, on their way to the market and when walking back home from the fields. Able-bodied male members of the community usually migrate for daily labour opportunities elsewhere during periods of food shortages. Women and children are left behind to manage the local situation/resources. Therefore, women and children are the main actors concerning the collection, preparation and consumption of wild-food plants. Children forage and climb trees for collection while women do the preparation and the cooking

(Guinand and Lamessa, 2001). Young boys consume more wild-foods than older ones in normal times. At times of food shortage, however, all ages and both sexes consume equally. But young boys do not eat wild-food simply to satisfy their need for additional sustenance but also because there exists a traditional obligation and social group pressure at a certain age (from the end of childhood to the beginning of teen age) to collect and eat for example wild fruits together with children of the same age (Guinand and Lamessa, 2001).

2.3.2 Age

According to Hamza and Msalilwa (2004) age of an individual plays an important role in one's physical ability and level of indigenous knowledge on utilization of EWPs. They further noted that each age group specialize in utilization of specific EWPs. People with less than 20 years old were considered as children and were mainly involved in collection of wild fruits. Those aged between 21 to 50 years were considered as adults and were mainly involved in collection of building poles, vegetables and fruits. Older people above 51 years may not be so energetic to participate much in collecting EWPs but have a lot of indigenous knowledge thus contribute effectively to supply of information on EWPs utilization and availability (Hamza and Msalilwa 2004). Kagya (2002) argue that age between 31 and 51 are the middle age and are considered as the working class. Composition of household members in terms of age distribution has some implications for the household's ability to meet household requirements (Nyingili, 2003).

2.3.3 Education level

In both theoretical and practical terms, education level of the head of the household plays a significant role in enabling household's access to livelihood activities including sustainable harvesting of EWPs from miombo woodlands. Maro (1995) argued that, Primary education foster human creativity and has a relationship with sustainable utilization of woodlands resources. Mayeta (2004) asserts that, increase in education level tends to increase people's awareness on the importance of natural resources conservation for sustainable development, also increase in education, increases the willingness of the local communities to participate in natural resource conservation activities. On the other hand, Shackleton and Shackleto (2000) argue that some people perceive reliance on woodland resource harvesting as a sign of poverty because it lacks security and it does not have equal social status as formal employment. This was evident among the educated youth. Individuas in that cohort frequently aspire after formal employment. Unfortunately, with high unemployement rates, most fail to find formal employment, even though they have a school-leaving certificate. After a prolonged period of unemployment, they reconsider options within resource harhesting both for home consumption and income generation (Shackleton and Shackleto, 2000).

According to Kilahama (2006) cited in Monela and Abdallah (2007), Socio-economic activities in miombo woodlands vary depending on local conditions, culture and market. Well educated and wealthier societies and their socio-economic activities are differently compared to poor, less educated societies. In poor societies majority of rural population are poverty stricken, and natural resources outskirting them act

as safety net for their wellbeing in most of time. Woodlands are not only the source of a variety of food that supplements what rural household obtain from agriculture, but also as income.

2.3.4 Household income

Low-income in the household contributes to the increased dependency on EWP products. Indigenous forest foods have thus played an important role in poverty alleviation through their big contribution to food security for the poor households (Kajembe *et al.*, 2000, Musuya et al., 2004). Reliance on indigenous forest products for food depends on the degree of poverty in the society (Härkönen and Mattila, 1998). A study conducted by Hamza *et al.* (2004) on the contribution of medicinal plants to the health of communities living around Mgori forest in Singida, Tanzania, found that about 94% of the population using plant medicines had income levels below TAS 200 000 per year, which is below poverty line.

The rural poor derive a significant fraction of their total income from woodland goods and services. Because of their dependence on woodlands income, the poor are especially vulnerable to woodlands degradation (Vedeld *et al.*, 2004). Woodland resources are renewable, widespread, and they are often found in common property areas where the poor can access them without owning the land (Cavendish, 2000). In addition, exploiting natural systems often can be done with little need for investment or expensive equipment, making the cost of entry low, an important consideration for poor families with limited assets. Woodland income deserves special attention, since it is often the element that is not accurately

accounted for in most considerations of rural livelihoods (Cavendish, 2000). Where markets exist, goods harvested from woodlands, such as wild food plants, herbs, fruits and medicinal plants, can be sold for cash or exchanged for services like school tuition. Subsistence use represents the greater part of the value of these natural products to households. Home use of wild products brings a direct reduction in cash expenditures of households, a form of income that is essential to the survival of the very poor. Estimated cash equivalents for subsistence use of wild products in South Africa ranged from US$194 to US$1,114 per year, a significant income fraction (Shackleton et al., 2000). Wild products can as well be a considerable source of cash income. Woodlands are not only the source of a variety of food that supplements what rural household obtain from agriculture, but also as income Monela and Abdallah (2007).

2.3.5 Family size

Family size determines per capita collection and utilization of EWPs. According to Nyingili (2003), the number of members in the household has an important implication in household ability to access enough food. A large number imply more mouth to feed and more people to share the household budget. Households with large number of family members have higher probability of being food secure by collecting enough EWPs.

2.3.6 Distance from homestead to the woodlands

Nearly everywhere users of woodland products are faced with a decline in the size of the resources from which they could obtain their supplies. Collection costs are

also related systematically to distances from homestead to woodlands and spatial variation in woodland resource availability (Campbell, 1996). For the constrained, low-income, rural households, a chief concern is how to allocate its labour time between ranges of possible activities in order to get highest returns (Campbell, 1996). A major factor in deciding these returns will be the cost of undertaking each activity. Thus, further important determinant of the household's demand for miombo woodland resources will be the distance and costs of collection. The higher these are, the less will be demanded, until at some point the household may withdraw from collection of EWPs from miombo woodlands (Campbell, 1996). As resources become scarcer, so collection costs rise and, in response, households may alter their patterns of resources use in a variety of ways (Campbell, 1996).

Location of settlement is another widespread factor that distances people from the woodland food sources they used to be familiar with, thereby constraining people's use of these foods even when they are still available and important for dietary balance (Menlnyk, 1993 as cited in Arnold, 1997). Increasing distance to woodland food resources has lead to the shift in household consumption of wild vegetables from dambo-based species to field-based in Shirungwi, Zimbabwe, as a consequence of a dramatic reduction in the former's availability McGregor (1995). The perceived reduction in species availability was associated with increases in population, expansion of agriculture, increased cattle grazing and road construction. As the use of wild food resources diminishes, knowledge about them also diminishes (FAO, 1991). Consequently, with icreasing resource decline there are less EWPs available. Harvesters in the Bushbuckridge Lowveld, South Africa

must therefore travel longer distances to obtain the EWP products. As a result, some people are deterred by such a challenge, but many are not Shackleton and Shackleto (2000). For example, some people travel over 40 km to obtain woodland resources and sell some of them to those unwilling to travel so far, charge for transportation and retain the rest for their home use.

2.3.7 Hunger foods (famine foods or emergency foods)

Edible wild food plants are capable to fill a variety of food gaps. Traditionally, in Africa edible wild plants have been important in emergency periods, especially in times of drought, famine and wars. They provide food for consumption when crops fail, as well as products can be gathered for cash income (e.g. gum arabic). Famine foods are different from those consumed annually or as supplements to the diet. Characteristically they are more energy-rich, however they often require complicated and time consuming processing, and they have uninteresting taste (FAO, 1991). Malaisse and Parent (1985) identified several plants which are used as famine foods, including *Encephalartos poggei*. The stems of these species are steeped in running water for three days, then sun-dried and crushed into a fine powder. The stem is an extreme good source of energy. Becker (1983) identified several wild plant species used only in times of scarcity and famine; among them are fibers of *Grewia bicolar* and the seeds of *Combretum aculeatum*. Wild yams are commonly used as famine foods. The tubers and other underground parts of plants like *Arisaema concinnum, Dioscorea* spp. easily take the place of potatoes and tuberous crops.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Description of the Study Area

3.1.1 Geographical location

The study was conducted in Kilosa District, Morogoro Region (Fig. 2). In Rudewa, Ulaya, Mamboya, Magubike, Dumila, Mikumi and Kisanga wards and Twatwatwa, Rudewa-Gongoni, Nyameni, Mamboya, Maguha, Kwambe, Ihombwe and Madizini villages. The reason for selecting this site was because; Kilosa district is well endowed with extensive miombo woodlands, which covers 51.3% (km^2) of the total district land area. The district is located in the North - Western part of Morogoro region. It lies within the geographical coordinates of 5°55′ - 7°53′ South and 36°30′ - 37°30′ East. On the North it is bordered by Tanga region, and in the East by Mvomero and Morogoro rural districts. In the South is bordered by Kilombero district and part of the Iringa region and in the west, by Dodoma region. The district has a total area of 14, 567.9 km^2 or about 20% of the land area of Morogoro region (URT, 1997).

Seven wards were selected which included: Rudewa (Kimamba division); Ulaya (Ulaya division); Mamboya, Magubike and Dumila (Mogole division); Mikumi and Kisanga (Mikumi division). They were selected purposively, because they consisted large portions of miombo woodlands. From each ward one to two villages which were very close to miombo woodland were selected. The villages involved were: Twatwatwa and Rudewa-Gongoni (Rudewa ward), Nyameni

(Ulaya ward), Mamboya and Maguha (Magubike ward), Kwambe (Dumila ward), Ihombwe (Mikumi ward) and Madizini (Kisanga ward).

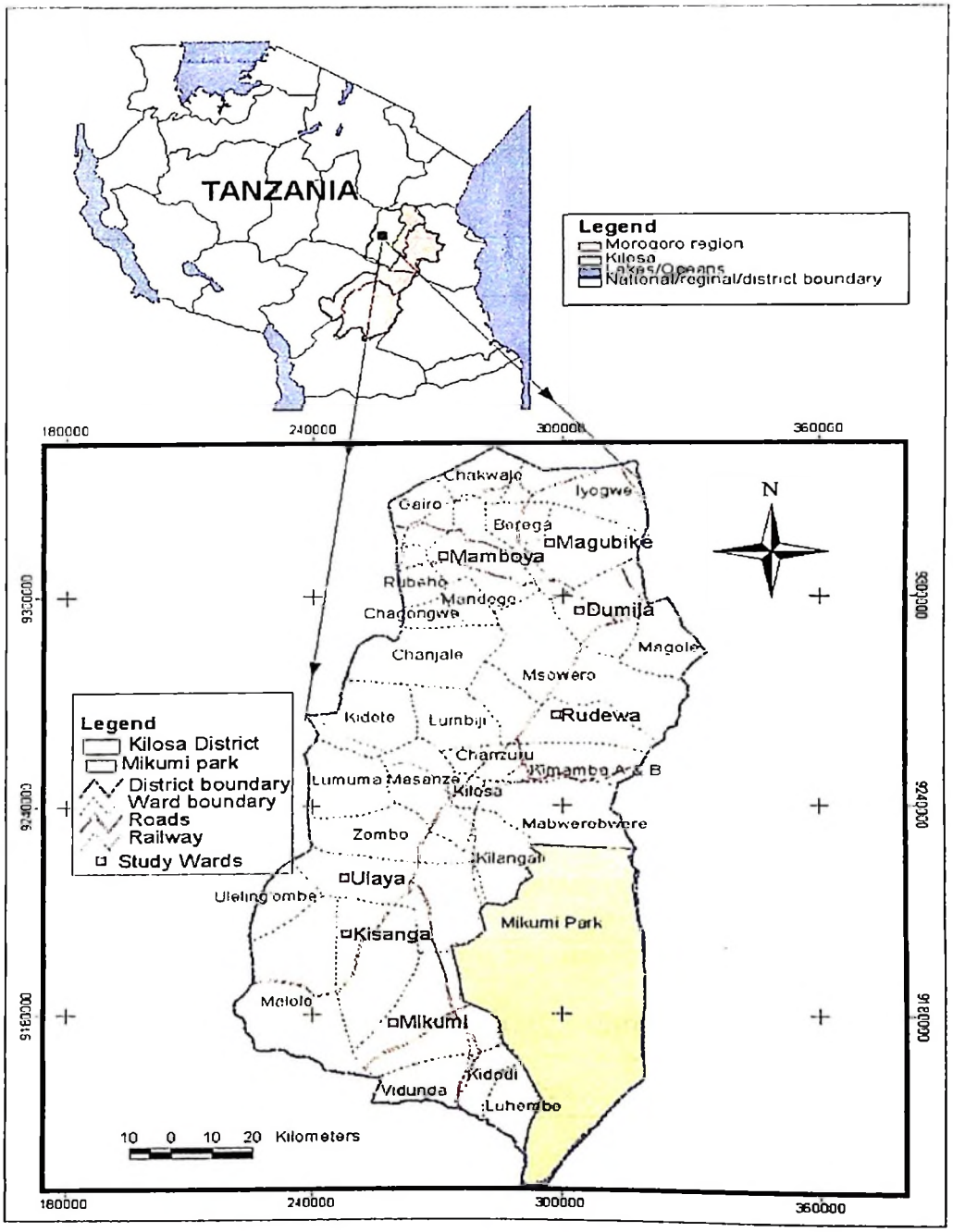

Figure 2: Map showing study wards of Kilosa district, Tanzania.

3.1.2 Population

According to URT (2003), the district had a total population of 489 513 people, in which 244 201 were males and 245 312 female (in 2002). The annual population growth (1988-2002) was 2.6 %. The average household size is 4.6. About 80% of the population lives in rural areas, while the remaining 20% live in the urban and peri-urban areas of Kilosa including Mikumi, Gairo and Kimamba. The major ethnic groups are Kaguru who inhabit the northern part; the central part is inhabited by the Sagara and the southern by Vidunda. Other tribes include: Masai, Hehe, Gogo, Mwela, Pogoro, Ngoni, Chaga, Bena, Sukuma, Rangi and Zigua (URT, 2002). The population growth of Kilosa district is influenced mainly by two factors: natural birth rate and migration (Nduwamungu, 2001).

However, Shishira *et al.* (1997) argues that the migration factor appears to be predominant partly due to the presence of pastoralists such as Masai in Parakuyo village and Barbaig, sisal estates, research and training institutions as well as relatively good transport network connecting Kilosa and other districts. Shishira *et al.* (1997) argue further that, even though currently sisal is no longer an important crop that attracts many labourers as it was the case few decades ago, many former sisal workers or their relatives are still living within or in the proximity to the estates. Shishira *et al.* (1997) warns however that, finding alternative uses for land which was set aside for sisal production might stimulate an influx of people to Kilosa leading further to a tremendous increase of the district population.

3.1.2 Topography and climate

The topography of the district is divided into three zones: the highlands zone which runs north-south and is part of the Eastern Arc mountains with an altitude of up to 2 200 metres above sea level (m.a.s.l.); the plateau zone located in the north of the district around Gairo has an altitude of 1 100 m.a.s.l.; and flood plains zone which comprises both flat and undulating plains with altitude around 550 m.a.s.l. The rainfall is largely bi-modal with short rains in November - January and long rains in March - May with a peak in April. The average annual rainfall varies from year to year and between ecological zones. Mean annual rainfall ranges between 1000 - 1400 mm in the south flood plains, while further north (Gairo Division) annual rainfall ranges between 800 - 1100 mm. All over the district, the dry period extends from June to October. The average annual temperature is about 25°C in Kilosa town with extremes in March (30°C) and July (19°C), (Kilosa District Council, 1997). The climate of Kilosa district is characterized by having unreliable reinafall. In some parts of the district such as Gairo division receive little rainfall, causing it to experience a semi-arid type of climate. Due to this type of climate the incidences of crop failure is very common, which influence utilization of EWPs by the rural communities.

3.1.4 Vegetation and soils

Kilosa district has a vegetation cover comprising mainly four types of vegetation including natural forests, woodlands, bushlands and grasslands (Lovett and Pocs (1993). These four vegetation cover types are mainly distinguished by the

percentage of tree cover and the dominant tree height. The natural forest is defined as a continuous stand of trees, many of which may attain a height of 50 m and with 80 to 100% canopy cover; dense woodlands consist canopy which cover a range from 40 to 80%; open woodland/bushland with 20 to 40% canopy cover and grassland with canopy cover below 20% (Shishira et al., 1997).

Lovett and Pocs (1993) reported that, there are ten catchment forest reserves in the district. Five of these (Ikwamba, Mamboto, Mamiwa-Kisara (North), Mamiwa-Kisara (South) and Uponera are located on the steep high rainfall peaks and ridges of the Ukaguru Mountains. These cover the important Ukaguru Mountain Forests, which are of the Eastern Arc type, and are rich in species of restricted distribution and have high biodiversity values. The reserves experience various degree of pressure from logging, cutting for building poles and grazing. It is anticipated that such pressure on the forests is likely to increase with increasing population density in the district. The other five catchment forests cover isolated peaks capped by forest and surrounded by woodlands. Mamboya forest reserve covers an isolated mountain north east of the Ukaguru; Italagwe covers an isolated mountain further north and Palaulanga forest reserve covers a peak of Palaulanga mountain, east of Mikumi (Plate 2). Ukwiva covers an extensive area of the east facing escarpment and plateau of the Rubeho Mountains. Kihiliri covers a hill just south of Kilosa town. All these forest reserves are experiencing varying levels of human pressure, depending on easiness of access.

Plate 2: Palaulanga Mountain Catchment Forest Reserve (left photo) and Peak of Palaulanga Mt. (right photo) in Kilosa district, Tanzania (Photo: E. Mujillah 2005).

For example, illicit logging was reported in Mamboya forest reserve, while in Palaulanga Mountain forest reserve experience little human pressure, as it is situated in a remote area (Lovett and Pocs, 1993). According to Shishira *et al.* (1997) woodlands of Kilosa district were categorized into three types including: dense, open and woodland with scattered cropland. Most of these woodlands are situated on hilly areas. Dense woodland constitutes about 31.5% of the land area in the district. This is the highest proportion compared to other types of land cover. Open woodland and woodland with scattered cropland cover 9.8% and 10% respectively, of the total land in the district. Misana *et al.* (1997) reported that, the degradation of woodlands into secondary bushland, open woodland and wooded or bushed grassland is quite common throughout the district. In many places, many of the large trees have been logged for timber and charcoal opening up woodlands and sometimes transforming them into wooded grassland. Annual fires, intensive

clearing for permanent or shifting cultivation and overgrazing in some places have all accelerated the degradation of the original vegetation into secondary bushland. In some areas the vegetation has been completely transformed into cropland with few scattered remnant of trees and shrubs (Plate 3).

Plate 3: Miombo woodlands being transformed into agricultural fields in Kilosa district, Tanzania (Photo: E. Mujillah 2005)

Shishira *et al.* (1997) pointed out that, there are open woodlands which are not human induced, but rather natural. This could be due to the nature of the soil or climate. For example, in areas with frequent rock outcrops the vegetation tends to be sparse. This could be the case for the open woodlands on steeply sloping areas. The vegetation of Kilosa is typically characterized by miombo woodlands in the mountainous and hilly areas and small patches in the plains, while bushland and grassland are found in the alluvial plains (Misana *et al.*, 1997). Dominant tree species include *Brachystegia microphylla, Brachystegia bohemii, Brachystegia speciformis,*

Commiphora spp., *Combretum* spp. and *Albizia* spp. (Shishira *et al.*, 1997), while dominant grass genera include: *Andropogon, Heteropogon, Panicum* and *Themeda.*

3.1.5 Socio-economic activities

The main economic activity is peasant farming, producing both food and cash crops. Food Crops produced include: maize, rice, beans, cassava, sweet potatoes and coconuts. Cash crops include simsim, sunflower, cowpeas, pigeon peas and sisal. However the production level is generally low. Most of the crops produced are sold outside the district, causing the communities to face frequent food shortages (Shishira *et al.*, 1997). Livestock keeping is also important and widespread with most households having poultry and/or goats. The pastoralists are the Maasai who comprise about 2.5% of Kilosa's population and depend mainly on livestock (cattle) keeping while the Kaguru in the Northern part of Kilosa are agro-pastoralists (Shishira *et al.*, 1997).

The rural population mostly comprises smallholder farmers and is the main agricultural producers. Sisal is grown in plantations around Kilosa and Kimamba town centers and sugar cane is grown by a combination of plantations and smallholder outgrowers in the southern part of the district. A number of agro-processing industries provide off-farm employment including sugar production (Kilombero sugar factory) and cotton ginnery (in Kilosa). Other employers include government and small trading businesses in urban areas, saw-milling (Ukaguru Mountains) and service industries such as guest houses (KDC, 1997).

3.1.6 Social services

Kilosa district has a number of social services. Educational institutions include: primary, secondary and vocational schools. Both private and public health centres and hospitals are available. The district is served by both tarmac and earth roads. Railway line and Telecommunication facilities are available. The well-maintained roads and railway line facilitate transportation of both crops and forest products to the markets; they therefore encourage large-scale farming and forest products extraction for cash (KDC, 1997).

3.1.7 Hydrology

The main rivers of Kilosa district drain eastwards. The miombo woodlands and montane forests of the district constitute an important catchment basin for the Wami and Great Ruaha river systems, which are of great importance at the national level. The main rivers include the Mkondoa, the Miyombo and the Mkata which drains into Wami system. The Southern part of the district drains into Great Ruaha River (KDC and Irish Aid, 1996 and Shishira *et al.*, 1997).

3.2 Research Methods

3.2.1 Sampling procedure

A cross-sectional design as suggested by Casley and Kumar (1988) and de Vaus (1993) was employed in this study. Multistage sampling technique was used to select sample units. This procedure was preferred because it facilitates sampling from a large population whose members are not known. Also it made it easier to select respondents from a large geographical area. A simple random sampling

technique was used to select the sampling units in order to avoid bias. This technique allows selection of a sample from the entire population in such a way that every member of the population has an equal chance of being selected. The sampling frames for this study were the village registers containing the list of households. Sampling unit for the study was a household. The household here is taken as the unit of analysis because it is where all decisions about production, 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).

3.2.1.1 Sample size

According to Boyd *et al.* (1981) a recommended and reasonable representative sample size for particular population under study should be at least 5%, therefore in this study, the sample size for questionnaire survey was 5.03% of all the households in each study village. A total of 91 out of 1820 households were interviewed.

3.2.2 Data collection

Both primary and secondary data were collected. Secondary data were obtained from various publications and unpublished sources. Primary data were collected using different methods as indicated below.

3.2.2.1 Reconnaissance survey

Reconnaissance survey was conducted in order to get a general knowledge about the study area. During this stage, the questionnaire was pre-tested in Mwade village, which was not among the selected villages for the study. This helped to cross check the validity and reliability of the questions.

3.2.2.2 Participatory rural appraisal (PRA)

PRA was used to facilitate situation analysis. It opened up discussions and facilitated the collection of key information. The approach allows interactive learning, sharing of knowledge, and flexibility. PRA techniques were applied to 30 participants in each of the eight study villages. The method utilized PRA tools including participatory mapping, transect walk and timelines. This approach helped to familiarize researcher with the local people and situations pertaining to the utilization of EWPs.

3.2.2.3 Key informants interview

The key informant discussions were conducted based on their knowledge and their experience. Key informants are people who are accessible, willing to talk and have great depth of knowledge on issues under discussion (Katani, 1999). They included village leaders, village elders, traditional healers, Kilosa district forest officers, and district development workers. Semi-structured and group interviews were employed to acquire information from the local people (Appendix 1c to 1f).

3.2.2.4 Ethnobotanical survey

The ethnobotanical survey of EWPs was performed by carrying out transect walk from the village centre to a selected woodland. This assisted the researcher in obtaining information on species diversity and use values, conditions of individual plants, parts of plants being utilized, products for home consumption and sale, harvesting season and volumes, sales and their prices (Makonda, 1997). A group of four villagers was involved in the identification and providing information on the uses of different EWPs. A checklist of questions was used for this survey (Appendix 1 Section B). The useful plant species were recorded using vernacular names and where possible scientific names.

3.2.2.5 Questionnaire survey

Both open and closed-ended questions were employed as a tool for interviewing selected respondents. The questionnaire was designed to include both qualitative and quantitative information (Appendix 1A to 1F). Structured questionnaires were designed to reflect the specific objectives. The questionnaires were translated into Swahili language, and where necessary local languages were used for easy communication with local people.

3.3 Data Analysis

3.3.1 Qualitative data analysis

Data collected through PRA were analyzed with the help of local people during PRA exercises and the results were communicated back to them for verification and custody. For some collected plant specimens, they were identified with the

assistance of experts from National Tree Seed Agency Herbarium, Morogoro. Identification was also aided by consulting various books such as Holm *et al.* (1977), Palgrave (1983), Rao (1987), Mbuya *et al.* (1994) and Ruffo *et al.* (2002).

Content and Structural-Functional Analysis techniques were employed to analyze qualitative data. Content analysis is a set of methods for analyzing the symbolic content of any communication. The basic idea is to reduce the total content of communication to some set of categories that represent some characteristics of research interest (Singleton *et al.*, 1993). Information collected through verbal discussions with key informants was analyzed in detail using this method, and the recorded dialogue was broken down into smallest meaningful units of information. The technique helps in ascertaining values and attitudes of the respondents, thereby generating themes and tendencies (Kajembe and Luoga, 1996).

3.3.2 Quantitative data analysis

Quantitative data gathered through questionnaire were subjected to both descriptive and inferential statistical analyses. Data obtained through closed questions were coded, cleaned and data from open-ended responses were categorized and transformed to enable further analysis. All quantitative analyses were performed using Statistical Package for Social Sciences for Window (SPSS 11.5) computer programme. Inferential data analysis was used to provide an idea of the applicability of the sample patterns in the population under study (Kajembe, 1994). In this regard, cross tabulations and logistic regression were used.

The use value analysis was performed on all the miombo woodland species to determine the utility of the resources. In the analysis, uses were categorized into three classes: no use, minor use, and major use, and the use value scores assigned to these classes were 0, 0.5 and 1 respectively (Prance *et al.*, 1987). To minimize the investigator's value judgements as associated with this method (Phillips and Gentry 1993), information gathered through PRA was corroborated with information obtained through transect walk, questionnaires and informal surveys. The familial use value was determined to evaluate the importance of different plant families to the local people and was calculated as the average of the use values of the species belonging to that family (Prance *et al.*, 1987; Phillips and Gentry, 1993) (Appendix 2).

Logistic regression is the method of analysis in which the parameters of the model are estimated using the maximum-likelihood method. That is, the coefficients that make the observed results most likely are selected. Logistic regression estimates the probability of an event occurring. The model is used to analyze binary dependent variables. The binary dependent variable used was the collection of EWPs which was assigned a value of '1' if the response was 'YES' and '0' if the response was 'NO'. Using the coefficients (β), the prediction model was developed and used for estimating the probability of occurrence and non-occurrence of collection and use of EWPs in the study area. The socio-economic factors underlying collection, processing and utilization of EWPs in the study area were distance from homestead to the miombo woodlands, Farm size, EWPs used as hunger foods, tribe, age, occupation and religion. A linear combination of these independent variables was

established for prediction purposes. The following prediction model was developed (Equation 1).

$$\text{Log (Odds)} = \ln\frac{P(Y_i = 1)}{1 - P(Y_i = 1)} = \beta_0 + \Sigma\,\beta_k X_{ik} + \ldots + e_i = Z_i \ldots\ldots (1)$$

$$\text{Odds}_i = \frac{P(Y_i = 1)}{1 - P(Y_i = 1)} = \exp(\beta_0 + \Sigma\,\beta_k X_{ik}) = \exp(Z_i)$$

$$\text{Probability} = P_i = \frac{\text{Odds}_i}{1 - \text{Odds}_i} = \frac{\exp(Z)}{1 + \exp(-Z_i)}$$

$$\text{Threfore} \quad P_i = \frac{1}{1 + \exp(-Z_i)}$$ (Griffith *et al.*, 1993; Woodrige, 2003) ..... (2)

Where:

Odds = is the ratio of natural log of the probability of the dependent variable that the dependent = 1 divided by the probability that the dependent = 0. Is used in the logistic regression equation to estimate (predict) the log odds that the dependent variable equals 1 (binomiallogistic regression) the natural log of the probability that when the dependent variable is a dichotomy and the independent variables are of any type. Thus estimates the probability of a certain event occurring or not.

Y_i = The i^{th} observed value of the dependent variable representing a linear combination of independent variables indicating the collection and use of EWPs in the studv area. which stand for a non-standardized

logistic regression equation. This was then used for prediction purposes. Y_i is a binary variable with the value of 1 if the respondent reported to collect EWPs and 0 if otherwise.

X_1 to X_k = Independent or explanatory variables (distance from homestead to the miombo woodlands, farmland size, EWPs used as hunger food, tribe, age, occupation and religion)

β_0 = Constant term of the model without the independent variables (intercept).

β_1 to β_k = Coefficients (β) of independent variables showing the marginal effects (positive or negative) of the unit change in the independent variables on the dependent variable and these were used in developing prediction equations on collection and/or use of EWPs.

e_i = Random error term.

i = 1, 2, 3 ... n (Total number of respondents; Sample size)

k = Total number of independent variables (k = 13).

For more than one independent variable the model can be written as:

$$\text{Prob(event)} = \frac{e^z}{1 + e^{-z}}$$ Prance *et al.*, 1987

or equivalently,

$$\text{Prob(event)} = Y_i = \frac{1}{1 + e^{-z}} \quad \text{.....(3)}$$

$$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta_p X_p$$

Where:

Z = is the linear combination; also Z represents the dependent variable (collection of EWPs).

e = is the base of the natural logarithms, approximately 2.718,

X = is the independent variables;

β_0, β_1 to βp = are coefficients estimated from the data.

The probability of the event not occurring is estimated as:

Prob (no event) = 1 – Prob (event)

The empirical model is specified as follows:

Collection of EWPs = $\beta_0 + \beta_I$ (AGE) + β_2 (FARM SIZE) + β_3 (DISTANCE) + β_4 (HUNGER FOOD) + β_5 (GENDER) + β_6 (EDUCTION) + β_7 (INCOME) + e_i

From the above, the independent variables included in the model were:

X_1 = Age of the respondent in years. Collection and use of EWPs was hypothesized to be a positive function of age. Old people were expected to have more experience in their environment, on the use and changes (trends) in availability of EWPs than younger ones (Adesina and Baidu-Forson, 1995,

Laper and Pandey, 1999). Therefore, positive relationship was hypothesized between age and utilization of EWPs. Thus this was expected to bear a positive logistic regression coefficient (+β).

X_2 = Farm size in hectares owned by a respondents. Farm size was hypothesized to have a negative relationship with collection and use of EWPs in the study area. Usually households with small farm size, faces food shortage because they normally have little harvests. Thus during hunger periods the only way of surviving hunger is through collection of EWPs products. Thus farm size was assumed to bear a negative logistic regression coefficient (-β).

X_3 = Distance in Kilometers from homestead to the woodlands. Negative relationship was expected between collection of EWPs and distance from home to the woodlands. Distance is assumed to have negative relationship with collection of EWPs because, distance increases costs of collection of EWPs, hence, if a distance from homestead to the sources of EWPs becomes large, this limit many people from accessing them. As a consequence, this reduces the chances of many people from utilizing EWPs. This causes a negative relationship between distance and collection of EWPs. Thus was assumed to bear a negative logistic regression coefficient (-β).

X_4 = EWPs used as hunger food was a dummy variable whereby, respondents were asked if there are edible wild plant products used during hunger periods. If response was "YES" was given a value of 1 and if responce was

"NO" was given a value of 0. Hunger food was hypothesized to have positive influence on collection of EWPs, because collection of EWPs is associated with hunger periods. During hunger periods (normally occuring in November to March in the study area) most of the households usually face food shortages due to crop failure caused by unreliable rainfall and sales of food crop to meet family necessary needs. Hence the only way of coping with food shortages is through collection of EWPs such as roots and tubers, wild fruits, vegetables and nuts and selling labour to get cash to buy food. Thus, hunger foods were hypothesized to have a positive relationship with collection of EWPs in periods of food scarcity. Thus this was expected to bear a positive logistic regression coefficient (+β).

X_5 = Gender of the respondents was hypothesized to have positive relationship with collection of EWP products in the study area. The term gender include two categories of people, that is, men and women. For this case, in order to assass which gender is more involved in collection of EWPs, men wer given a value of "1", while women were given a value of "0". This is because; during the study period men were identified to be the main actors in collection of EWPs and also more men were contacted than women. As mentioned earlier in section 2.1.2, EWP products have been vitally important to forest dwellers and rural communities for centuries. Local people collect, process and market fruits, mushrooms, gums, nuts, tubers, edible leaves, oil seeds and medicinal plants and herbs. Both rural and increasingly urban communities both men and women draw upon EWPs for a variety of needs

(FAO, 2000). Women often have little access to land and capital. Thus, miombo woodlands provide a source of raw materials and products for cash sale. Women often combine cash earning activities with woodland based subsistence activities such as food and medicine collection (FAO, 1991). Thus this was expected to bear a positive logistic regression coefficient (+β).

X_6 Education in years of stay in schools. Education was hypothesized to have a negative relationship with collection of EWPs. Educated people are assumed to have acquired a lot of knowledge which enable them to get employment or to be involved in other more advanced activities; hence do not have time to go to the woodlands for EWPs collection. As EWPs products are perceived to be consumed by rural poor and uneducated people hence, educated people are perceived not consuming EWPs. Several authors have noted that, lack of interest among the younger generatinon (who are believed to be more educated than adults) has led to substantial losses in knowledge about edible wild plants (FAO, 1991). Modern formal education removes children from their environment and thus reduces their exposure to the use of wild food plant (FAO, 1991). This factor was expected to bear a negative logistic regression coefficient (-β).

X_7 Income in Tanzanian shillings (TAS). Income was hypothesized to have a negative relationship with collection of EWPs. Higher-income households are capable to overcome problems of food shortages as they can cultivate big farms using tractors or hired labour. Also higher-income households are

able to purchase food to fill the gap of food shortages. Campbell (1996) examined the woodland resource use within the context of the total household economy that, socio-economic differentiation leads to significant differences in woodland resource use and value. The variation of woodland share across households is that, the importance of miombo resources increases as total income decreases and also lower-income households depend proportionately more on the consumption of wild foods than higher-income households. Studies of children in miombo areas have demonstrated how wild fruits form a crucial source of foods for children from poorer households while at school (those from better-off households being sent to school with food or money) or while herding (Campbell *et al.*, 1991; McGregor, 1995). Thus the factor was expected to bear a negative logistic regression coefficient (-β).

The probability distributions were therefore calculated for all respondents to determine their probability of collection and utilization of EWPs under different levels of variables influencing the collection of EWPs (Appendix 8). To test whether the logistic regression coefficients are significantly different from zero, the Wald statistic that asymptotically (i.e. in large samples) follows a Chi-Square distribution was used. The Wald statistic is distributed as Chi-square with degree of freedom (df) equal to the number of constrained parameters (r). With single parameter, the Wald statistic is simply the square of the t-ratio. The odds ratios represented by Exp (β) from logistic regression analysis were used in explaining the likelihood of collection and use of EWPs. To test the goodness of fit of the regressions model to

the data, three methods were used namely the model chi-square, the log likelihood ratio test denoted by -2LL and the classification tables. By using the model Chi-square test, the significance level of the model was tested at 0.05 probability level. The magnitude of the -2LL value also determined the goodness of fit of the model to the given data set. The smaller value of -2LL, the better the goodness of fit is the model. For proper interpretation of logistic regression model, results that the researcher needed a careful look:

- at the Wald statistic to see whether the effect of a particular variable is statistically significant or not.
- at the sign of effect (β), to see whether the increase in the independent variable increased or decreased the probability of success (collection of EWPs),
- at the magnitudes of the similarly measured variables, to determine which of the independent variables seemed to have a greater impact on collection of EWPs.
- at the exp (β), to see how much a 1-unit increase in X_p changed the Odds of success (this is because the Odds of success is not the same as probability of success).
- finally, assessed the results of different values of independent variables (X) and made mathematical calculations to see how changes in the value of a particular independent variable, affects the probability of success.

This is because the interpretation of the parameters in logistic regression is not a straightforward and as easy as other cases of ordinary least square (OLS) methods (Norusis, 1990; Pampel, 2000; Power and Xie, 2000 cited in Mayeta, 2004).

The t – test

The t – test is often desired to compare means of two groups of observations representing different populations to find out whether the populations differ with respect to their locations (Jayaraman, 2000). In this case, the method was used to analyze and compare the ethnobotanical knowledge between males and females in the study area. A two tail t – test 0.05 levels of significance was used, that is Ho: was rejected if $P < 0.05$.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Edible Wild Plants Available in the Miombo Woodlands of the Study Area

4.1.1 Types of EWP products

Table 1 present a wide range of EWP products mentioned by respondents. All the interviewees in the study area reported to use wide range of EWP products. Detailed lists of EWPs products have been provided in Appendices 4 to 7.

Table 1: Types of EWPs available in Kilosa, Tanzania with percent responses

	Number of Species Mentioned by Respondents					Total	No
Types of Product	1 – 5	6 – 10	11 – 15	16 – 20	21 – 25	response	Response
Fruits	64	31	2	1		98	2
Vegetables	76	20	1			97	3
Mushrooms	75	13				88	12
Medicines	61	12	3		1	77	23
Roots & Tubers	37	5				42	58
Wild Stems	22					22	8
Nuts	18					18	82
Climbers	5	9				14	86
Gums	6	3				9	91
Wild Barks	8					8	92
Wild Spices	8					8	92
Wild Seeds	5					5	95
Wild Grain	3					3	97

The main concern is that, EWPs are seasonally available, but very important in periods when agricultural products are not yet available and/or when food stocks have all been exhausted (Ogden, 1991; Ogle and Grivetti, 1985, Kangalawe *et al.*,

2007). Usually, hunger periods starts from October to March. Sometimes hunger periods may start from August to March, depending on the availability of rainfall in that year.

(a) **Fruits**

Edible wild fruits were the first category to be mentioned by many respondents in this study. Table 1 indicates that, 98% of all respondents reported to utilize various species of wild fruits from surrounding miombo woodlands. Fifty one different species of wild fruits were mentioned by the respondents (Appendix 6). Among the respondents, 64% mentioned 1 - 5 and 1% mentioned 16 - 20 different species of wild fruits (Table 1). From these results one could argue that wild fruits are very commonly eaten by most people in the study area. Fruits are either utilized as food supplements or used for cash generation. During hunger periods, fruits are mostly used as food supplements in the study area. Fruits of *Ficus* spp., *Tamarindus indica, Adansonia digitata, Uapaca kirkiana, Sorindeia madagascariensis, Ximenia caffra* and *Vitex ferruginea* were mentioned to be much utilized during food shortage periods (Plate 4 & 5).

Plate 4: **Ripe fruits of *Ximenia caffra*, Kilosa district, Tanzania (Photo: E. Mujillah 2005)**

The result also implies that, most of the people in a study area are very knowledgeable about different types of edible wild fruits. The fact that study villages are located closer to the miombo woodlands which make them more familiar with different species of wild fruits. Fruits are most commonly consumed raw, as snack food. Fruits are also good sources of minerals and vitamins and sometimes contribute significant quantities of calories (Ruffo *et al.*, 2002).

Plate 5: Edible wild fruits of *Ximenia caffra* in Kilosa district, Tanzania (Photo: E. Mujillah 2005)

Ruffo *et al.* (2002) found that, some wild fruits such as *Adansonia digitata, Annona senegalensis* and *Parinari curatellifolia* are high in protein and fat, furthermore, the fruits of *Adansonia digitata* and *Ximenia caffra* have a higher vitamin C content than mango (*Mangifera indica*) or orange (*Citrus sinensis*). Campbell (1986) in his study on the use of wild fruits in Zimbabwe found that, though there were many fruit species, three species (*Diospyros mespiliformis, Strychnos cocculoides,* and *Azanza garckeana*) were the most frequently consumed and also the most highly prized.

(b) Vegetables

Vegetables were mentioned by 97% of respondents in the study area, and it was a second category from fruits to be mentioned by many respondents (Table 1). This implies that, vegetables are widely utilized by the majority of

people in the study area. About 43 different species of vegetables were identified. This type of EWP products include edible leaves from large trees, herbs, weeds and climbers (6 & 7).

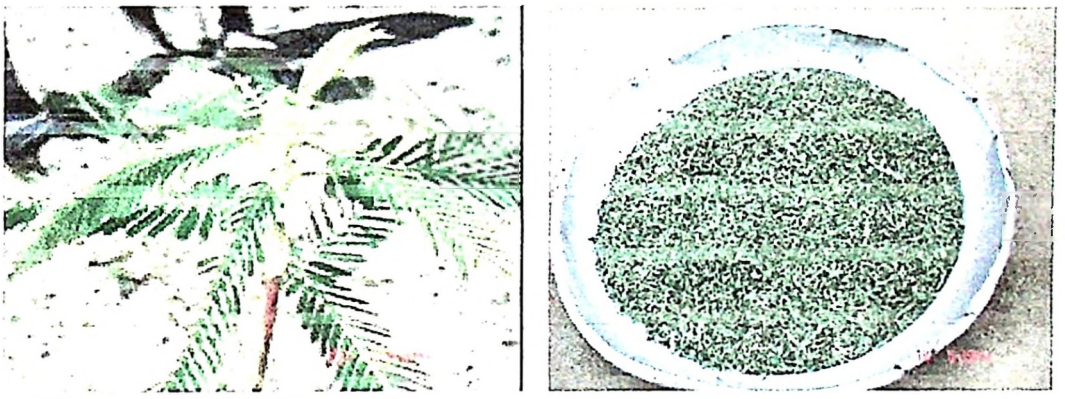

Plate 6: *Sesbania goetzei* (mwage) in the field (left photo); *Sesbania goetzei* in **dried form (right photo) in Kilosa District, Tanzania (Photo: E. Mujillah 2005)**

A detailed list of edible wild vegetables found in the study area has been indicated in Appendix 5. Some of the wild vegetables commonly utilized during hunger periods include: *Bassella alba* (Delega), *Bidens schimperi, Coccinia grandis* (mungulugutu), *Amaranthus spinosus, Vigna unguiculata* (Safe pori, Ng'ungulugutu), *Sonchus luxurians* (mchunga), *Bidens pilosa* and *Sida chrysantha* (mlenda mtoni).

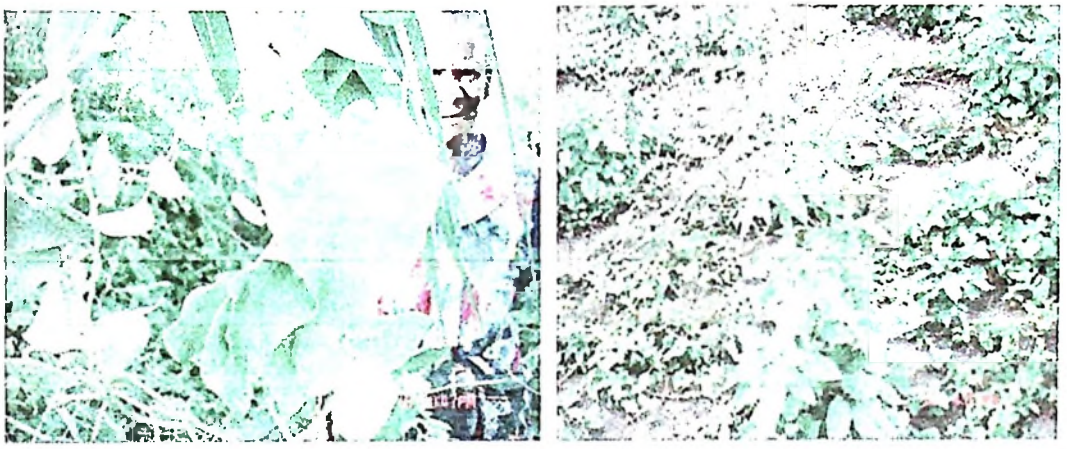

Plate 7: *Bassella alba* (Delega) along riverine area (left photo) and *Bidens schimperi* (Pwimbwiii/Mhaka) (right photo) Kilosa, Tanzania (Photo: E. Mujillah 2005)

Most of local communities depend on wild vegetable as a relish. During hunger periods, sometimes vegetables are eaten as a main meal. Hence, during food deficit periods, vegetables serve as a food security for most of the household in the study area. But most of these products are seasonal; they are available during the rain season (January – May). Due to the problem of processing and storage facilities, very few people manage to process and preserve some of these EWPs products.

Similar studies from different parts of miombo region show that, wild leaf vegetables are among the most frequently used wild plants (Fleuret, 1979; Ogle and Grivetti, 1985; Kagya 2002 and Mapolu, 2002). Wild leaves, either consumed fresh or dried, are one of the most widely consumed forest foods in the study area. They are used as soups, stews and relishes which accompany carbohydrate foods such as rice and maize. This combination is

important as they add nutritional value and flavour to staple diets thereby encouraging greater food consumption (Ruffo et al., 2002).

(c) **Traditional Medicines**

About 162 different medicinal plants were identified in the study area. Out of these, 150 species were scientifically identified while 12 species were not and therefore, have been presented in their local names as indicated in Appendix 4. The medicinal plant species identified in the study area are used to treat various diseases including diarrhoea, skin diseases, convulsion, hernia, asthma, people suffering from bad spirit possession, venereal diseases, gynecological-diseases and many others (Appendix 4). The most commonly utilized medicinal plants are *Albizia anthelmintica, Spirostachys Africana, Cassia abbreviata, Acacia manbigmani* and *Convolvulus farinosus* (Plate 8).

Plate 8: Medicinal plant: *Albizia anthelmintica* in Twatwatwa village (left photo) and medicinal climber: *Convolvulus farinosus*, in Ihombwe village (right photo) Kilosa, Tanzania (Photo: E. Mujillah 2005)

The parts of plants being used include stems, roots, leaves, barks, tubers and fruits. Sixty one percent of respondents mentioned between 1 - 5 different types of medicinal plants; and only 1% mention 21 - 25 (Table 1). Seventy seven percent of sample population responded to utilize and have some knowledge on traditional medicines, while the rest (23%) reporte to have not collected, utilized and/or have knowledge on traditional medicines. The major reasons for this response were religious beliefs, availability of modern medicines in the villages and young people having less knowledge on medicinal plants. Christians particularly, the saved ones, are not allowed to use traditional medicines or attend to traditional practitioners, as they related the practice with satanic things (bad evil). The young people believe that, traditional medicines are not effective for example in treating some diseases like malaria, cholera and typhoid. Also they believe that, modern practitioners are confident on what they are doing, because they normally carry out blood screenining and tests before treatment. However in some parts of the country traditional medicines are regarded as the first aid to treating malaria by all categories of people (Yanda *et al.*, 2006).

Similar observations have been reported by Chidari *et al.* (1992) cited in Campbell (1996) who argued that as is the case with a number of traditional products, among some people there is a stigma attached to using traditional medicines which are considered not modern. Bringham, (1994) reported that one traditional healer interviewed in Zimbabwe noted that, the use of

medicinal herbs had declined over the past two decades largely due to the preference of younger people for western medicine, and that religion also appeared to be a factor in people's attitudes towards herbal medicines. The author found a number of households which are not using or participate in the trade of medicinal plants because of their religious beliefs. Contrary to that, most old people in the study area believe that, traditional medicines are fast in treating some diseases like diarrhea, teeth-pain, convulsion (degedege), spinal-cord bending (kibiongo), hernias (ngili), venereal diseases and asthma.

Most of the respondents acquired knowledge on traditional medicines from their parents and through ancestoral-spirits. Similarly, Augustino (2002) reported that majority of men and women traditional healers in Morogoro and Iringa urban districts, acquired their knowledge on medicinal plant practices through inheritance from their grand parents.

This indicates that, the majority of the respondents in this study area utilizes and depends on traditional remedies for treating various common diseases and ailments. Also it implies that miombo woodlands in those areas are rich in medicinal plants. This was proved by a long listing of medicinal plants and the readiness of respondents in mentioning different types of medicinal plants they know (Appendix 4). Another explanation is that, some of the villages such as Maguha, Kwambe, Ihombwe and Madizini did not have

modern health service centres. Residents of Maguha and Kwambe villages for example, walk 6 to 8 hours to the modern health service or paid not less than TAS 1 000 per single trip to Belega hospital, about 35km away. Also most people claimed that, modern services were very expensive, especially if one gets admitted at the hospital, as one was is required to pay TAS10 000 per bed per night and not less than TAS 3 000 for a check-up and normal treatment for out patients. Thus, they find that it is easy to collect and use traditional medicines which are available in their localities. Similar observations were reported by Yanda et al., (2006) in Muleba and Biharamulo districts, especially regarding treatment of malaria.

The study identified that, traditional healers could earn from TAS 2 000 to 60 000 per disease per person depending on the type of disease and availability of medicinal plants (i.e. time used to collect the medicines). Sometimes, traditional healers were given other items such as food, goats, chickens and the like instead of cash as payments for the service. Several studies have been conducted on medicinal plants and revealed similar findings. Celander (1983) for example, in his study on miombo woodlands in Africa identified medicinal plants such as *Brachystegia boehmii, Julbernardia globiflora* and *Julbernardia paniculata* which treat various human diseases. Campbell (1996) said that the roots, leaves and barks of many different species are used in health care.

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Mushrooms were much preferred by almost all people in the study area and have got good market as one could earn from TAS 300 to 3000 per day. Certain species of mushrooms were dried up and stored for future use. Some people collected and dried them in large quantities for household use and for selling. Those mushroom species which occured in woodlands far away from homestead were normally collected by men, while women and children collected those which were found near homesteads and in the farms. Majority of the households in the study area collect 10 and 20 kilogrammes of mushrooms per year (Figure 3).

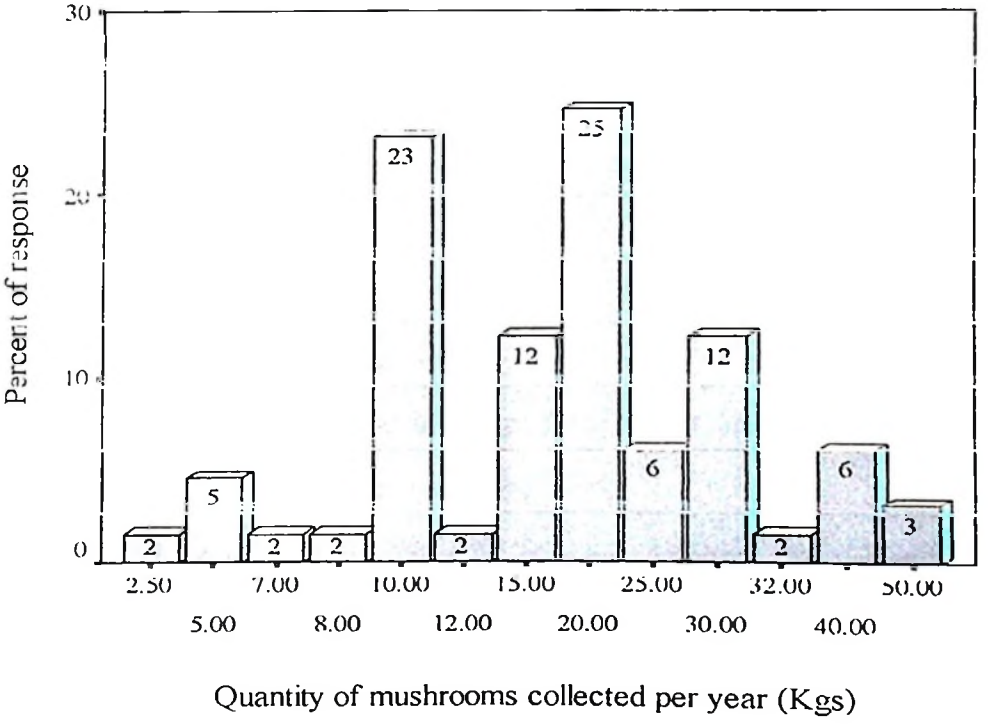

Figure 3: Amount of mushrooms collected per year Kilosa, Tanzania

It was also observed that, people who were mostly involved in the marketing of mushrooms in the households of the study area were men. This is due to their ability to travel longer distances and penetrate dense forests for mushroom collection (Figure 4). Harkonen et al. (2003) found that mushrooms were sold at market places and along roadsides mostly as fresh, but also dried.

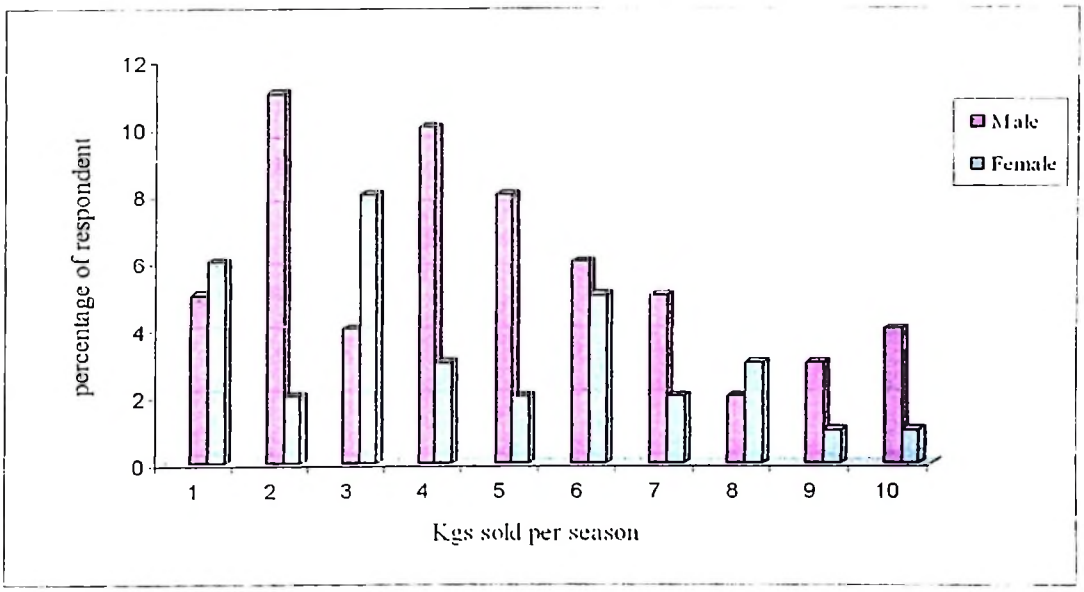

Figure 4: Seasonal sales of Mushrooms by gender in Kilosa District, Tanzania

In their interview with some professional mushroom pickers, they reported that they were regularly collecting mushrooms for certain dealers in market place. In remote mountainous areas, mushrooms were collected only for domestic consumption. Parent (1977) found that, mushrooms were gathered during rainy season and at least 20 tons were consumed by the

approximately 700 000 inhabitants of Upper Shaba, Democratic Republic of Congo.

(e) **Roots and Tubers**

In this study, few respondents were able to mention edible wild roots and tubers found in the study area. Table 1 indicates that, 42% of all interviewees seemed to know different types of roots and tubers, while 58% did not respond. Adults were more knowlegeable than young ones. This is because some of these roots and tubers were used in the past, for example, *Dioscorea* spp., *Encephalartos poggel* (ummbuna) and *Thylachium africanum* (mdudu). In total, 14 types of roots and tubers were listed by respondents (Table 3).

Table 3: Edible Roots and Tubers Identified in Kilosa District, Tanzania.

Local Name	Scientific Name	Family Name
Oloishimi/Ngobwa	*Commiphora africana*	*Burseraceae*
Lushelembwe/Olkishelembwe	*Commiphora mossambicensis*	*Burseraceae*
Mihogo pori	*Manihot glaziovii*	*Euphorbiaceae*
Viazi vikuu pori/Itugu	*Dioscorea* spp.	*Dioscoreaceae*
Ndigali/Ndiga/Matugu	*Dioscorea* spp.	*Dioscoreaceae*
Mingede	*Eriosema burkei var. burkei*	*Fabaceae*
Vigonjo/Kigonzo	*Dioscorea odoratissima*	*Dioscoreaceae*
Mdudu, Kizenza, Kidungwe	*Thylachium africanum*	*Capparaceae*
Mabombwe	*Commiphora africana*	*Burseraceae*
Ulanga	*Tacca leontopetaloides*	*Taccaceae*
Ummbuna	*Encephalartos hildebrandtii*	*Zamiaceae*
Madaka	*Tacca leontopetaloides*	*Taccaceae*
Mihogo mpira	*Manihoti glaziovii*	*Euphorbiaceae*
Majimbi pori (wild cocoyams)	*Dioscorea* sp.	*Dioscoreaceae*

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Madaka	*Tacca leontopetaloides*	*Taccaceae*
Mihogo mpira	*Manihoti glaziovii*	*Euphorbiaceae*
Majimbi pori (wild cocoyams)	*Dioscorea* sp.	*Dioscoreaceae*

Carrently, roots and tubers are not much commonly used in times of food shortage. This is because currently there are many alternatives to overcome food shortages such as food aid and commercial food supplies which minimized the use of these types of food in times of hunger. However roots and tubers contain a lot of water and carbohydrates hence providing nutritious materials for the body. They can be eaten raw, thus serves as food supplement in places where there is no food. The pastoralists when herding their cattle away from homesteads and people who work in the fields or walking in the woodlands were the ones who mostly ate these products. Roots and tubers which were commonly eaten raw included *Eriosema burkei* var. *burkei*, and 'Mingomwa'. Roots and tubers which are commonly used as food supplements during food shortages include *Dioscorea* spp., *Thylachium africanum*, *Encephalartos poggel* (Ummbuna), *Tacca leontopetaloides* (Madaka), *Manihoti glaziovii* (wild cassava) and wild cocoyams. Similar findings have been reported by several researchers about roots and tubers as important sources of food derived from miombo woodlands (Fleuret, 1979; Malaisse, 1978; Missano *et al.*, 1994 and Nyingili, 2003).

(f) **Nuts**

Six different types of nuts were identified during the study (Table 4). Eighteen percent of the respondents acknowledged knowing some of the edible wild nuts found in the surrounding miombo woodlands (Table 1). Wild nuts were identified in three wards only: Rudewa (Kimamba division),

Magubike (Magole division) and Kisanga (Mikumi division). Most of these edible nuts are found in undisturbed woodlands. The results indicate that, the three wards consists of undisturbed miombo woodlands. The main collectors of these nuts are men, because women and children are scared to enter dense woodlands. Wild nuts have both home use and cash generation in the study area. Wild nuts are types of food eaten as snacks before or after main meals. In periods of food shortages, nuts are used as famine food in the study area, where they play an important role of food security in the household.

Table 4: Edible Nuts Identified in Kilosa District,Tanzania.

Local Name	Scientific Name	Family Name
Mikoche	*Hyphaene petersiana*	*Arecaceae/Palmaceae*
Nng'hungu	*Dalbergia nitidula*	*Fabaceae*
Kweme pori	*Telfaria pedata*	*Cucurbitaceae*
Migude	*Sterculia appendiculata*	*Sterculiaceae*
Mbia	*Synsepalum ceraciferum*	*Sapotaceae*
Madegeha	*Antiaris toxicaria*	*Sapotaceae*

Nyingili (2003) reported that, species of *Parinari curatelliforia* and *Telfaria pedata* provide oil seeds which have a wide application in cooking vegetables and other relishes in Mbozi district, Tanzania.

(g) Gums

The utilization of gums is not common in the study area. Gums are mainly utilized in Twatwatwa (Kimamba division) and Kwambe (Magole division) villages. In Twatwatwa village the Maasai pastoralists normally use them as chewing gums while herding their cattle in the woodlands. In Kwambe village only two respondents acknowledged about knowing these wild gums. They revealed that in the past, Kwambe villagers were collecting gums up to one tin of 20 liters for selling, but currently, there were no market for gums. Hence very little, about 0.5 to 3.0 kgs of gums are collected per day for home use. In total 9% of the respondents adimited to know various species of trees which produce gums and 91% did not respond (Table 1). A total of 8 different species were mentioned by the respondents in the study area (Table 5).

Table 5: List of Edible Gums Identified in Kilosa District, Tanzania.

Local Name	Scientific Name	Family Name	Uses
Olerai	*Acacia xanthophloea*	*Fabaceae*	Food, glue, medicine
Oldepesi	*Acacia tortilis*	*Fabaceae*	Glue
Endukai/Endugai	*Strychnos innocua*	*Loganiaceae*	Food
Eitii	*Acacia mellifera*	*Fabaceae*	Food, glue, sealant, medicine
Mkambala	*Acacia nigrescens*	*Fabaceae*	Glue
Mkelegembe/Mtunduru	*Dichrostachys cinerea*	*Fabaceae*	Glue
Mtalula/Muwindi	*Acacia polycantha*	*Fabaceae*	Glue, sealant, medicine
Mlama mweusi/mtitu	*Combretum molle*	*Combretaceae*	Sealant, glue

Gum is often the staple food for the gum collectors while in the field. Kagya (2002) in her study carried out in Meatu district, Shinyanga, Tanzania revealed that gum Arabic from *Acacia senegal* and *Acacia seyal* are of great importance in Tanzania. Chihongo (2000) reported that, in Tanzania, the annual production capacity of gum Arabic is 1 000 tonnes, out of which 50% are exported.

(h) Climbers

Only one climber *Rhoicissus revoillii* (Ikama) in the family *Vitaceae* was mentioned by the respondents. Such a climber provide a lot of water, whereby, in dry areas such as Mamboya and Rudewa wards of the study area, people usually use this type of climber to provide water when they walk or work in the woodlands including herders, pit sawyers, timber harvesters and woodland product collectors. Pastoralists in Twatwatwa village utilize several climbers as thirst quenchers but, they were unable to mention their names. Among the interviewees, 14% reported to be aware of the edible climbers (Table 1). This implies that, edible climbers were available in the study area though in a limited amounts. This is because, edible climbers were normally found in dense forests that are not always or easily accessible.

(i) Spices

These are foods which are added to other foods so as to increase taste, flavour and stimulating appetite. They are used in small quantities as food

seasoning. Four types of wild spices were identified in the study area (Table 6). It seems that wild spices are not commonly utilized in the study area. Only 8% of the respondents seemed to know few wild spices (Table 1). This could mean that wild spices are less preferred compared to domesticsted ones. It could also reflect the difficulties in processing them, which could render them less popular. The small number of respondents reporting to have used these wild spices indicates that this type of EWP has little contribution to the rural livelihood of local people.

Table 6: Edible Spices Identified in Kilosa District, Tanzania.

Local Name	Scientific Name	Family Name
Mdaha	*Diospyros fischeri*	*Ebenaceae*
Ihankwe	*Aframomum angustifolium*	*Zingiberaceae*
Pilipili ukwale	*Capsicum frutescens*	*Solacaceae*
Pilipili pori	*Capsicum frutescens*	*Solacaceae*

(j) Grains

Three types of wild grains were identified by the respondents in the study area (Table 7). Only 3% of the respondents reported to know some of the wild grains (Table 1). However, local informants indicated that wild grains were used in the past as famine food. Species that were commonly used in the study area are presented in Table 7. During the tie of study, people had many alternatives to overcome food shortages; hence, these types of famine foods were not commonly used.

Table 7: List of Edible Grains Identified in Kilosa District, Tanzania.

Local Name	Scientific Name	Family Name
Lunindi	*Sorghum purpureo-sericeum*	*Poaceae*
Dihunga	*Oryza punctata*	*Poaceae*
Pungapunga	*Oryza punctata*	*Poaceae*

(k) Stems

These are wild stems usually used during hunger periods. Three types of species providing edible stems were identified during the research survey (Table 8). Among the respondents 22% reported to be familiar with edible wild stems. These species were not available in the nearby areas. They were found in undisturbed woodlands which were located far away from human settlements. During famine periods people collected these stems from woodlands. Some of the plant species whose stems are edible also provide edible tubers/roots such as "Umbuna" and "Madaka" (Table 3).

Table 8: List of Edible Stems Identified in Kilosa District, Tanzania.

Local Name	Scientific Name	Family Name
Ummbuna	*Encephalartos hildebrandtii*	*Zamiaceae*
Madaka	*Tacca leontopetaloides*	*Taccaceae*
Mingomwa	Un identified	Un identified

The very few species identified may mean that stems are not a very reliable EWP, or its utilization may not be sustainable because of over-exploitation.

(l) Seeds

Wild seeds were also used in the study area as side dishes and sauces. Three types of wild seeds were identified during this study (Table 9).

Table 9: List of Edible Seeds Identified in Kilosa District, Tanzania.

Local Name	Scientific Name	Family Name
Wild beans	*Leguminus* sp.	*Fabaceae*
Kunde mbala	*Vigna pubescens*	*Fabaceae*
Makatunga, Lungatungu	*Dolichos trilobus*	*Fabaceae*

Five percent of the respondents acknowledged that, they were aware of the utilization of wild seeds by some of local people in the area (Plate 9). Some of these seeds needed special treatments before cooking and eating them. Normally they are boiled first in large quantities of water and after boiling for few minutes the water is drained out and then cleaned in fresh water and then cooked as common beans.

Plate 9: Wild leguminous seeds (Makatunga)

Nyingili (2003) reported that, species of *Parinari curatelliforia* and *Telfaria pedtata* provide oil seeds which have a wide application in cooking vegetables and other relishes. Utilization of these edible wild seeds have also been reported by Malaisse (1978) who found that, miombo woodlands of Lubumbashi region in the Democratic Republic of Congo produce edible flowers and seeds of *Stenostylis* spp.

(m) Barks

The barks of some trees provide essential elements for human diet. The study identified that the back of *Acacia nilotica* was used by Maasai in the study area to enhance food flavour and also is used to make tea. Only one species of *Acacia nilotica* ("Olkiloriti" - Maasai, "Chimwinya" - Kaguru and "Mfuku" - Gogo) was identified in the study area that provides such essential barks. The Gogo and Kaguru people use this type of EWP to make tea. Pastoral communities are the one who mostly utilize this type of barks by mixing them with food such as meat soup and milk to increase taste and stimulate appetite. Table 1 shows that, 8% of the respondents in the study area, had a positive response towards edible wild barks, among them, the majority were the Maasai.

4.1.2 Local uses of EWPs

The local communities in Kilosa district, Tanzania are well knowledgeable about the uses of various edible wild plants (EWPs) found in their surrounding areas.

About 380 EWPs were mentioned by the local people in the study area, and all of them (100%) have use values. Out of these species 327 (86%) have been scientifically identified by their botanical names while 53 (14%) were not, hence have been presented in their vernacular names (Kaguru, Sagara, Luguru, Vidunda, Maasai and others) (Appendix 3 to 7). The number is higher than that of Luoga *et al.* (2000), who found that, only 69% out of 133 tree species had use values, although the study considered only trees and shrubs excluding herbs and mushrooms. Appendix 2 presents EWPs in their families with their use values, while, Appendix 3 presents EWPs species with their local names and their uses.

From the use value analysis, about 13 uses were identified of which medicines had the highest contribution to the total use (27.5%) followed by famine food (19.7%), while thirst quencher had a least use value (1%) (Appendix 2). Species which were mostly used for medicinal remedies were in the families *Fabaceae, Euphorbiaceae, Tiliaceae, Anacardiaceae, Lamiaceae and Rubiaceae.* A total of 50 out of 66 families had use values greater than one, while the families of *Basellaceae, Cecropiaceae, Commelinaceae, Cyperaceae, Euphorbiaceae, Myrtaceae, Rhamnaceae* and *Vitaceae* had use values of 0.5 each (Appendix 2). Species of *Hyphaena petersiana* (*Arecaceae*), *Adansonia digitata* (*Bombacaceae*), *Dalbergia nitidula* (*Fabaceae*), *Sterculia appendiculata* (*Sterculiaceae*) and *Telfaria pedata* (*Cucurbitaceae*) had the highest total use values, each with a score of 7.5, 6.0, 5.5, 5.0 and 5.0 respectively and highest uses per species each with 11, 9, 6, 9 and 7 uses respectively (Appendix 3). This implies that these species are most preferred because of their multiple uses (Table 10).

Table 10: Some of identified species with multiple uses in Kilosa, Tanzania.

Species Name	Family Name	Main Uses
Hyphaena petersiana	*Arecaceae*	Fruits, kernel, juice, Palm wine, Medicine (treats intestinal worms and stomach-ache) Fibre (for making mats, hats, baskets, fans) and for thatching houses.
Adansonia digitata	*Bombacaceae*	Fruits, Juice making, Relish (edible leaves), Medicine, Flavouring (Ice creams), Famine food, Appetizer and fruits for sale.
Dalbergia nitidula	*Fabaceae*	Vegetable, medicine, building poles, pegs, fence poles, combs, clubs, tool handles and walking sticks.
Sterculia appendiculata	*Sterculiaceae*	Seeds used as snack, flavour or used in place of cooking fats or groundnuts cooked with vegetables, medicine
Telfaria pedata	*Cucurbitaceae*	Seeds used as snack, flavour or used in place of cooking fats or groundnuts cooked with vegetables.

The multiple uses of these species can result into over-utilization as some of the uses are destructive. The production of palm wine from *Hyphaena petersiana*, for example, involves tapping from the tip of the main stem which may cause stunted growth or the failure to produce more fruits. Prolonged wine production and cutting of leaves for mat and other products may cause palm trees to die away. Woodland destruction like fires, illegal harvesting and clearing which take place in the study area, pose a big threat to these useful EWPs. Most of them are not easily available in the nearby places, they are only found in undisturbed woodlands which normally are located at the peaks of mountains and riverine forests.

Other important species that were mentioned to contribute to local livelihood in the study area include *Solanum nigrum, Sesbania* sp. and *Sonchus luxurians* which are useful vegetables in most rural households; *Vangueria infausta, Vitex furuginea* and *Tamarindus indica* are important fruits; and *Albizia anthelmintica, Convolvulus farinosus, Cassia abbreviate,* and *Spirostachys Africana,* are useful traditional medicines. Similar findings have been reported in other parts of Tanzania (Ruffo *et al.*, 2002).

4.1.3 Comparison of ethnobotanical knowledge by gender

The study identified that there is a significant difference on ethnobotanical knowledge between men and women (Table 11). Results indicate that, men seem to know more tree species used for various purposes than women. During the household interview on types of EWP products they know, men tended to mention more species than women. For example, men had a mean of 5.23 for knowledge on wild fruits, 4.53 mean for traditional medicines, and 4.25 mean for wild vegetables; while corresponding figure for were women 4.72, 2.16, and 4.05 respectively (Table 11). The results clearly indicated gender-based knowledge difference in the use of EWPs in the study area. These differences were statistically significant and were clearly shown on medicinal plants ($P < 0.00$), gums ($P = 0.03$) and roots and tubers ($P = 0.044$) (Table 11). The major reason for these differences in gender knowledge on types of EWPs for household use is based on the role-played by that particular product. It was observed that, products that were for direct consumption were

under women's responsiblity while men delt with products that had direct cash income.

Table 11: Comparison between men and women on knowledge of number of EWP products used for various Purposes in Kilosa. Tanzania

Uses	Male (n = 53) Range (min- max)	Mean ± SE	Female (n = 38) Range (min-max)	Mean± SE	t- value	P
Vegetables	1 - 13	4.25 ± 0.29	0 - 8	4.05 ± 0.29	0.406	0.343
Fruits	1 - 19	5.23 ± 0.38	0 - 13	4.72 ± 0.43	0.897	0.186
Medicinal plants	0 - 20	4.53 ± 0.52	0 - 8	2.16 ± 0.39	3.650	<0.00***
Mushrooms	0 - 9	4.09 ± 0.29	0 - 9	3.5 ± 0.33	1.369	0.087
Roots & Tuber	0 - 6	1.34 ± 0.25	0 - 4	0.76 ± 0.22	1.722	0.0443*
Nuts	0 - 2	0.21 ± 0.07	0 - 1	0.18 ± 0.06	0.251	0.401
Gums	0 - 7	0.57 ± 0.23	0 - 2	0.11 ± 0.07	1.913	0.030*
Spices	0 - 2	1.13 ± 0.07	0 - 2	0.16 ± 0.09	0.233	0.408

* = Significant (at significant level of p = 0.05),
*** = Highly Significant (at significant level of p < 0.00)

Medicinal plants and gums had some economic significance in the study area (See section 4.1.3 on traditional medicines and gums). Hence more men were involved in collecting and selling them, thus gaining more knowledge and experience than women. Roots and tubers are mostly eaten by men while working in woodlands. Men were also observed to handle many diseases while women mainly handled emergency cases such as child births and women sickness that do not allow time for someone to move a long distance in order to collect medicinal plants or seek medical help. Women have more responsibilities of household care, as women play a significant role in determining and guaranteeing food and well being for the

entire household, hence have less time for collecting medicines, gums, roots and tubers from woodlands. These limitations had also some impacts on women for having limited knowledge on medicinal plants. Hence gender related needs and responsibilities affect resource use patterns and knowledge.

These findings are in agreement with the findings of Luoga *et al.* (2000) who found that, generally men tended to know more tree species for particular uses than women. Augustino (2002) found that variations in gender knowledge on medicinal plants between men and women could be attributed by some factors including cultural factors (whereby women are not encouraged to practice in traditional medicines unless otherwise), low level of education, income generation, geographical locations, migration of men to urban towns as well as traditional cultures and beliefs. Urio *et al.* (1996) observed that in northeast Tanzania few women take part in medicinal plant practices if the parents had no son or if there was no other member of the family available for inheritance. On the other hand, the study contradicts with studies by Chidari *et al.* (1992) who found that in two Mhondoro villages in Zimbabwe, women and men used trees for similar purposes, but women tended to know more uses for individual tree species than men.

The results from this study also identified that there was no significant difference on knowledge between men and women for products including vegetables, fruits, mushrooms, nuts and spices (Table 11). Both men and women in the study area collect these products, but women were actively engaged in collecting EWPs for

subsistence use. Gender division of labour is also clearly reflected in number of species used and working place. Usually, women utilize resource found closer to homestead, while men mostly perform their activities in the woodlands far away from homestead. Similar findings have been reported in various studies in other parts of the world. In Uganda, Neumann and Hirsch (2000) reported that both men and women were involved in collection of fibers, gum arabic and medicine but differed in amount collected and distance walked for collection. World wide, rural women are known to be extensively involved in subsistence activities, such as woodlands - based gathering, processing and marketing enterprises. Such activities provide a source of income to supplement the costs of feeding and clothing the family and other needs that arise (Falconer, 1994).

4.1.4 Availability of EWPs in the study area

Respondents estimated the current availability of edible wild plants found in the area as compared with the past twenty or more years ago. When assessing the current availability of EWPs in the study area, three measures were used: decreasing, increasing and same (Table 12). The results were as follows: 64% reported of decreasing availability of EWPs as opposed to only 0.8% who thought that there was an increased availability of EWPs (Figure 5). Wild fruits, wild nuts and medicinal plants were reported to have significant decreased in the past twenty years while, there was no significant change in wild barks and spices (Table 12).

Table 12: Availability of EWPs for the last twenty years in percentage in Kilosa, Tanzania

Product	Category	Division: Kimamba n= 13	Ulaya n= 10	Magole n= 20	Mikumi n= 48	Total response	No response	Chi-square	P
Vegetables	Decreasing	7.7	4.4	16.5	45.3	74.0			
	Same	6.6	3.3	5.5	7.7	23.0			
	Total	14.0	8.0	22.0	53.0	97.0	3.0	7.234	0.065ns
Fruits	Decreasing	4.4	5.5	16.5	46.2	72.5			
	Same	9.9	2.2	5.5	5.5	23.1			
	Total	14.0	8.0	22.0	52.0	96.0	4.0	18.901	0.000***
Mushroom	Decreasing	3.3	5.5	6.6	37.4	52.8			
	Same	4.4	4.4	13.1	15.3	37.2			
	Total	7.7	9.9	19.7	52.7	90.0	10.0	8.443	0.038*
Medicines	Decreasing	2.2	5.5	2.2	22.0	31.9			
	Increasing	0.0	0.0	1.1	1.1	2.2			
	Same	11.0	3.3	15.4	16.5	46.2			
	Total	13.0	9.0	19.0	40.0	80.0	20.0	19.683	0.003***
Roots tubers	Decreasing	5.5	0.0	9.9	11.0	26.4			
	Same	2.2	1.1	8.8	0.0	12.1			
	Total	7.8	1.1	18.7	11.0	38.5	61.5	8.719	0.033*
Climbers	Decreasing	3.3	0.0	5.5	1.1	9.9			
	Same	3.3	0.0	0.0	0.0	3.3			
	Total	6.6	0.0	5.5	1.1	13.2	86.8	4.00	0.135ns
Wild nuts	Decreasing	0.0	0.0	4.4	0.0				
	Same	6.6	0.0	1.1	0.0				
	Total	6.6	0.0	5.5	0.0	12.1	87.9	18.312	<0.00***
Wild gums	Decreasing	4.4	0.0	0.0	0.0	4.4			
	Same	2.2	0.0	5.5	00	7.7			
	Total	6.6	0.0	5.5	0.0	12.1	87.9	5.238	0.022*
Wild barks	Decreasing	2.2	0.0	1.1	0.0	3.3			
	Same	4.4	0.0	3.3	0.0	7.7			
	Total	6.6	0.0	4.4	0.0	11.0	89.0	0.079	0.778ns
Wild seeds	Decreasing	1.1	3.3	2.2	1.1	7.7			
	Total	1.1	3.3	2.2	1.1	7.7	92.3	Constant	0
Wild-spices	Decreasing	0.0	0.0	2.2	1.1	3.3			
	Same	0.0	0.0	1.1	0.0	1.1			
	Total	0.0	0.0	3.3	1.1	4.4	95.6	0.444	0.505ns
Wild stems	Decreasing	0.0	0.0	3	0				
	Total	0.0	0.0	3.3	0.0	3.3	88(96.7)	Constant	0
Wild-grains	Decreasing	1.1	0.0	1.1	1.1	3.3			
	Total	1.1	0.0	1.1	1.1	3.3	96.7	Constant	0

* = Statistically Significant at 0.05; ** = statistically very Significant at 0.01;
*** = Statistically Highly Significant at 0.001 level of significance.
ns = statistically non significant at 0.05; 0.01 and 0.001 level of significance

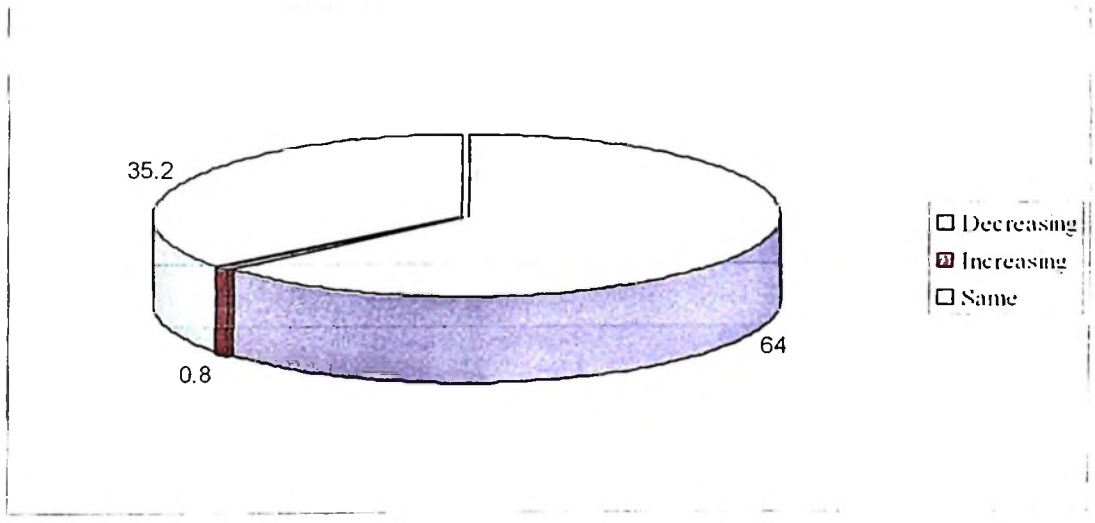

Figure 5: Summary of Percent Responses of Availability of EWPs in the Study Area

This has an implication that there are some factors which are associated with this decrease (Section 4.1.4.1). Currently villagers walk long distances searching for these products, and some EWPs products are not readily available. Some useful traditional medicines have disappeared in the nearby areas. In Twatwatwa village, villagers reported that, sometimes they buy traditional medicines from the market or walk long distances to Mandege or Vidunda Mountains (approximately 100km away) for 'Kitaraswa' and other medicines, where it takes them up to two days on foot to reach there. Medicines like *Embelia schimperi* (Ilodwaa) and *Warburgia salutaris* (Osokonoi) were collected from Arusha region and sold at local market at a price of TAS 1000 to 1500 per bundle (approximately 0.5 kgs).

Traditional healers in Rudewa-Gongoni village reported that, most important medicinal plants were obtained from Lumage Forest Mountains, where it took them 6 hours on foot. In Madizini villagers claimed that, medicinal plants like *Spirostachus africana* (Mwalaka or Msalaka) were obtained from Dodoma region and

other parts of Kilosa district including Malolo forest reserve, Chonwe woodland and Vidunda mountain forest which were far away from the village. In Rudewa-Gongoni a piece of *Spirostachys africana* was sold at a price of TAS 200, while in Mamboya village, one table spoon of dried powder of traditional medicine is sold at a price of TAS 100; those which are put in small bottles was sold at a price of TAS 500 at the village market. The majority of the local people are aware of the decrease in availability of EWPs; this implies that, local communities rely very much on these EWPs for their livelihoods, especially in times of hardships. The disappearance of these resources will lead into poor livelihoods for the majority of the local communities.

The results concur with studies from other parts of Tanzania as they reported that there is a significant decrease in availability of Non-Wood Forest Products (Mapolu, 2002; Kagya, 2002; Nyingili, 2003). EWPs have been decreasing over time may be due to excessive woodlands destruction. The inavailability of EWPs have a significant impact on the household food security, income and health since rural people depend on EWPs for food, income and income in times of hardship. Some of the EWP products such as wild nut, fruit trees, roots/tubers, climbers and medicinal plants, which were available in the past currently they are noteasily availabe. Over-exploitation and destruction pose a big threat to these woodlands, which may result into poor rural livelihoods.

A considerable portion 35.2% of the respondents repoted the situation to have remained the same (no change). For such generalized question which was given to

respondents who were engaged in harvesting various woodland products such as charcoal, timber, honey, medicne and wild fruits for cash income, some of them became scaptical in answering such a question as they thought that, if the government realizes that the woodland is diminishing due to overexploitation, the government will close the woodland and restrict them from gathering any woodland product so as to safeguard the woodlands. Thus some of them provided irrelevant answers in order to make sure that they will not be affected, from the research outcomes. Most of such answers were provided by villagers from Dumila and Mikumi wards that depended much on those woodlands for their livelihoods. On the other hand, woodlands in the two wards were somehow still intact, and EWP products such as medicine, mushrooms, vegetables and wild fruits did not show any vivid decline to them.

4.1.4.1 Causes of inavailability of EWPs

Respondents provided various reasons which they thought that were the causes of inavailability of EWPs in the study area (Table 13). Drought was assumed to be the major cause of inavailability of EWP products as mentioned by 43% of the respondents. Increase of human population was reported as a second cause due to clearance of woodlands for settlements and agricultural expansion which was reported by 41% of the respondents.

The third reason for the inavailability was woodlands destruction reported by 21% and the fourth one was an increase in wild animal population as reported by 16% of the respondents. An increase in wild animal population in Madizini village,

Mikumi division was reported by respondent to be a threat to the availability of EWPs. This is because Mikumi division comprises the Mikumi National Park, in which a number of wild animals are conserved. These wild animals normally depend on these EWPs as source of food. Therefore there is a big competition between human beings and wildlife (such as baboon and monkeys) on the use of these EWPs.

Table 13: Causes of change of availability of EWPs in percentage in Kilosa, Tanzania

Efforts to Sustain EWPs	Divisions				Total Responses	No Response
	Kimamba n = 13	Ulaya n = 10	Magole n = 20	Mikumi n = 48		
Drought/Climate change	3.3	2.2	9.9	27.5	43.0	57.0
Increased human population	4.4	5.5	6.6	24.2	41.0	59.0
Increased forest destruction	1.1	1.1	1.1	17.6	21.0	79.0
Increased population of wild animals	0.0	0.0	0.0	15.0	15.0	85.0
Increased demand on forest produce	1.1	1.1	1.1	8.8	12.0	88.0
Commercialization of forest products	1.1	0.0	3.3	3.3	7.7	92.3
Due to land degradation	1.1	1.1	3.3	2.2	7.7	92.3
Agricultural expansion	0.0	0.0	0.0	6.6	6.6	93.4
The forest is still intact, no change	1.1	1.1	1.1	1.1	4.4	95.6
Development demands	0.0	0.0	1.1	3.3	4.4	95.6
Youth don't value forests	0.0	0.0	0.0	1.1	1.1	98.9

The researcher observed during this study that, most of the wild fruits including *Sorindeia madagascariensis* (usulupi) and *Annona senegalensis* were eaten by these wild animals. There was also a big problem on forest destruction in Palaulanga

forest reserve which was caused by illegal harvesting of forest products, forest fires and agricultural activities (Plate 10 & 11).

Plate 10: Agricultural and human settlements expansion into miombo woodlands in Kilosa, Tanzania

Plate 11: Forest fires set by timber dealers in Palaulanga Forest Reserve in Kilosa district, Tanzania

The results concur with that of Nduwamungu (2001) who found that a great majority of respondents (81%) showed that the forested area has decreased during the past two and a half decades. Mapolu (2002) found that, major causes of decreasing in availability of NWFPs include overexploitation of resources, deforestation, low rainfall and population increase. Same findings were observed by Kagya (2002) who found that, drought and deforestation are the main reasons for decrease in availability of NWFPs.

Respondents in Rudewa ward; Dumila ward and Ulaya wards reported that, useful EWPs such as medicinal and fruit trees were not cut down, but, they are well conserved by the community (Table 13). These reasons may hold true because, the miombo woodlands (in Lumage hill) in Rudewa-gongoni which is a major source of these EWPs is situatead far away (about 30 kms) from the human settlements, limiting most of the villagers from extracting forest products from this woodland.

Hence, few people such as traditional healers and mushroom gatherers usually go there to collect some traditional medicines and mushrooms. And also the three wards on the other hand, are surrounded by natural vegetation which provided them with goods like firewood, charcoal and building poles. Only 5% of the respondents claimed that the forest is still intact, thus there is no change in the availability of EWPs.

4.1.4.2 Recommendations on how to sustain the availability of EWPs

When respondents asked to provide their views on how to sustain availability of EWP products, different suggestions were provided as indicated in Table 14. The most cited suggestion accounting for about 52% of the respondents was on protecting the forests against fires and illegal harvesting. One of the approache would be to enhance tree planting (agroforestry) so as to reduce pressures on the wild resources.

Table 14: Contributions on how to sustain the availability of EWPs in percentage in Kilosa District

Efforts to Sustain EWPs	Divisions				Total Response	No Response
	Kimamba n = 13	Ulaya n= 10	Magole n = 20	Mikumi n = 48		
To protect forests destruction	6.6	4.4	13.2	27.5	51.7	48.3
Environmental conservation education	5.5	3.3	5.5	18.7	33	67.0
Encourage afforestation efforts	2.2	2.2	7.7	49.5	29	71.0
Awareness creation on environ. conservation	0.0	1.1	6.6	14.0	22.0	78.0
To enforce forest laws	0.0	1.1	1.1	7.7	9.9	90.1
Planting edible wild plants at home garden	0.0	1.1	1.1	2.2	4.4	95.6
To apply traditional laws	0.0	0.0	1.1	2.2	3.3	96.7
To conserve useful trees	0.0	0.0	1.1	2.2	3.3	96.7
To establish Laws & Regulations on forel use	0.0	0.0	0.0	2.2	2.2	97.8
Elders to educate youngs on forests issues	0.0	0.0	0.0	2.2	2.2	97.8
Should practice irrigation cultivation	0.0	0.0	0.0	2.2	2.2	97.8
Planting exotic plants at homestead	0.0	1.0 1.0	0.0	0.0	1.1	98.9
To perform rituals	0.0	0.0	1.1	0.0	1.1	98.9
To ask forgiveness from our ancestors	0.0	0.0	1.1	0.0	1.1	98.9
To use dry/dead wood & bamboos	0.0	0.0	0.0	1.1	1.1	98.9
To control population growth through education	0.0	0.0	0.0	1.1	1.1	98.9
To stop clearing and cultivating on water sources	0.0	0.0	0.0	1.1	1.1	98.9
To apply village by-laws	0.0	0.0	0.0	1.1	1.1	98.9

Some villagers are already practicing this. During the this study, some villagers in Ihombwe village in Mikumi ward, Mikumi division; two villagers in Madizini village in Kisanga ward, Mikumi division and one villager in Nyameni village in Ulaya ward, Ulaya division reported to have transplanted and retained some useful indigenous tree species such as fruit and medicinal trees in homegardens; For example, one villager in Madizini village transplanted *Phoenix reclinata* in-home garden, because they realized that, some of useful indigenous plants were diminishing from their natural habitat; hence the only way of sustaining them was to plant them at home gardens. Many other villagers retained wild fruits and medicinal plants in their farms. A good example was noted in Ihombwe village, where a good number of indigenous fruits and medicinal plants were left in the fields like home-gardens or as agroforestry systems. Also, another villager in Ihombwe village showed his efforts in transplanting indigenous medicinal plants and wild seeds into his homegarden including *Convulvulus farinosus,* wild beans (makatunga), *Dioscorea* spp and *Pterocarpus tinctorius.*

Suggestions and efforts which are being undertaken by some of the respondents in the conservation of some of useful EWPs indicate that communities are very much aware with the current disappearance of these EWPs. Such local initiatives need to be encouraged and supported by providing them with necessary technical expertise on how best they can conserve or propagate these indigenous spicies with EWP values.

4.2 Method of Collection, Frequency, Processing, Preservation and Utilization of EWPs

4.2.1 Method of collection of EWPs

Edible wild plants were harvested using various methods depending on the type of product. Also to overcome the problem of seasonal availability of some EWPs, local people have developed traditional systems of processing and preserving them. During the study, the harvesting and processing methods were observed for the following major EWP products.

(a) **Vegetables**

Common method used in harvesting vegetables is by picking out some leaves. This method is applied to pick out edible leaves from larger trees such as *Adansonia digitata, Scelerocarya birrea,* and *Sesbania* sp.; also for some climbers like *Ornithopus viciifolia, Cucumis metuliferus, Vigna pubescens* and *Ipomea* spp. Other vegetables are harvested by cutting out the tender tips; these include *Corchotus tridens, Sonchus luxurians, Emilia coccinea, Solanum nigrum,* and *Bidens schimperi.* The third method is by uprooting the whole plant; the method is applied to vegetables like *Amaranthus spinosus, Sesamum angolense, Asystasia* sp., *Sida chrysantha, Celosia trigyna and Bidens pilosa.* The last two methods are destructive, because part or the whole plant is removed. In areas with rainfall scarcity, the methods may cause reduction in availability of these vegetables during the season. As these types of vegetable were harvested when they were still too young, that is before

producing seeds. Regeneration of these species may be reduced, hence leading to unsustainable utilization of the products. In order to ensure sustainability of these resources, there should be an effort to address effectively the problem of bad methods of harvesting such products which leads into depletion and degradation will mitigate/reduce those bad practices. This can be achieved through good miombo woodland governance and sound management practice.

(b) **Fruits**

Fruits are harvested by climbing up a tree and picking ripe fruits only, or by pulling down branches containing ripe fruits and then picking them out and also by waiting until the ripe fruits fall down and then collect them from the ground. In some cases, fruits are harvested by cutting down the whole branch containing ripe and unripe fruits. This method is mostly used by those people who harvest in large quantities for commercial purposes particularly in villages situated along the main roads where middle-men from urban areas go there to buy them in large quantities for selling in towns. The method is mostly applied to fruits of *Tamarindus indica* and *Sclerocarya birrea*. The method is very destructive; and in most cases causes trees to fail to produce more fruits. In order to control the situation, there is a need to investigate the real cause, address the problem and adopt effective remedial strategies through sound forest management practices and good governance. Hobley (1996) cited in Abdallah and Monela (2007). observed

that livelihood enhancement is by involving all key stakeholders in the process of woodland management, understanding their needs and situations, allowing them to influence decisions and receive benefits and increasing transparency and consequently curb the current high destraction rate.

(c) Medicinal plants

Medicinal plants are harvested by firstly digging out and cutting out few roots from the mother plant so as to make sure that the plant will not die away; secondly, is by cutting a piece of bark from one side of the tree; thirdly, by picking few leaves from the medicinal tree plant. The quantity harvested is quite small, because they normally take the amount which is required to treat one disease at a time. Traditional medicines are usually used while they are fresh as they are believed to be more effective compared to the dried ones or those which are stored for a long period as they loose a lot of active ingredients (extracts). Lager quanties, about 3 to 5kgs are harvested, processed and stored for future use.

A study by Augustno (2002) expressed that most men herbalists interviewed in Morogoro and Iringa urban districts, Tanzania harvested medicinal plants by uprooting and debarking. However, almost all herbalists from the two districts disagreed on existence of poor harvesting practices (i.e. practices that result into over exploitation of the plants including debarking,

defoliating and uprooting) of medicinal plants. The poor harvesting techniques reported emphasize the need for more extension education to both men and women herbalists on sustainable way of harvesting medicinal plants to avoid loss of valuable tree species. The harvesting of medicinal plants should be done in a sustainable way with the view of returning the site to its original condition (Augustno 2002).

(d) **Mushrooms**

Majority of people in the study area harvest mushrooms by uprooting them. The method is commonly used for mushrooms growing in farms, fallows and homesteads. Very few mushrooms are harvested by cutting leaving out the portion of root which is underground. This method is mostly applied to mushrooms which grow in miombo woodlands. For mushrooms like *Termitomyces singidensis, Coprinus cinereus* and *Termitomyced letestui,* their fruit bodies can be dug up from the soil during the germination period.

4.2.1.1 Frequency of collection of EWP products

Figure 6 shows that majority of the respondents 46% collect EWP products weekly; 25% quarterly; 15% collect on monthly basis and 12% reported to collect daily in times when they are available. Some species of mushrooms such as *Aminata losii, Termitomyces microcarpus, Termitomyces letestui and Termitomyces aurantiacus* and some vegetables such as *Amaranthus spinosus, Sonchus luxurians, Gynandropsis*

gynandra and Solanum nigrum germinate soon after the first rains. Most of fruits are ripe in March – April. Medicines are available throughout the year.

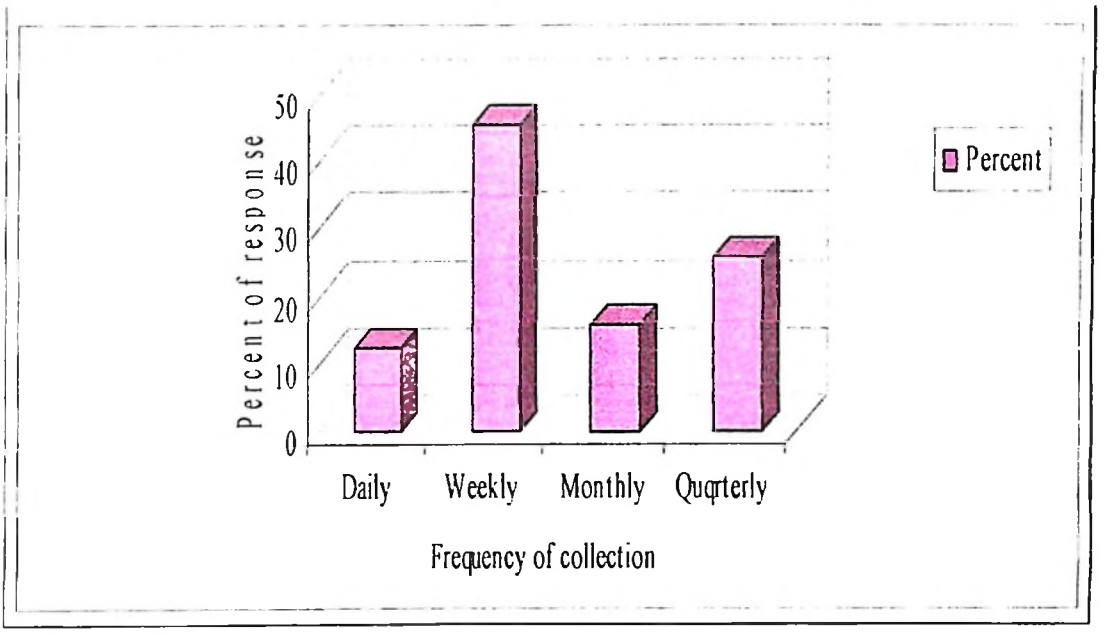

Figure 6: Percent of collection of EWPs by the respondents in Kilosa, Tanzania

Table 15 shows the response of interviewee towards collection and utilization of EWP products available in the area. Vegetable had a high percentage of collection 97% of the respondents while, wild grains with a percentage of 3 (3%) was the least. The high percentage of respondents in collection and utilization of wild vegetables indicates that most of the local communities depend on wild vegetable as a relish. During hunger periods, sometimes vegetables are eaten as a main meal. Hence, during food deficit periods, vegetables serve as a food security for the affected households. But most of these products are seasonal; they are available during the rain season (January – May).

Table 15: Responses in collection of EWPs in percentage in Kilosa District, Tanzania

Product	Divisions				Total Responses	No responses
	Kimamba n = 13	Ulaya n=10	Magole n = 20	Mikumi n = 48		
Vegetables	14.0	7.7	22.0	53.0	96.7	3.3
Fruits	14.0	7.7	22.0	52.0	95.6	4.4
Medicines	12.0	8.8	21.0	43.0	84.6	15.4
Mushrooms	7.7	11.0	20.0	53.0	91.2	8.8
Root-tubers	7.7	1.1	18.7	13.2	40.7	59.3
Nuts	6.6	0.0	5.5	11.0	23.1	76.9
Gums	4.4	0.0	4.4	0.0	8.8	91.2
Climbers	6.6	0.0	3.3	3.3	13.2	86.8
Spices	6.6	0.0	3.3	3.3	13.2	86.8
Grains	1.1	0.0	1.1	1.1	3.3	96.7
Stems	0.0	0.0	6.6	0.0	6.6	93.4
Seeds	1.1	0.0	2.2	4.4	7.7	92.3
Barks	6.6	0.0	3.3	0.0	9.9	90.1

4.2.2 Methods of processing and preservation of EWPs

Due to seasonal availability of some of EWPs, the villagers usually collect, process and preserve some of these products. Products which are commonly preserved in the study area include: vegetables, mushrooms, wild nuts and traditional medicines (Table 16). Methods used to process these products include sun drying, boiling and soaking in water for medicines, boiling and then sun drying of some EWP Products (medicinal plants and vegetables) and lastly by drying and then grounding them into powder form. Leaves of vegetables such as *Sesbania goetzei* (Mlenda mwage) and *Corchorus olitorius* (Mlenda mgunda) are collected, dried in sun, pounded, sieved and kept in dry containers.

Table 16: Mean annual amount of EWPs preserved per household in Kilosa District, Tanzania.

Edible Wild Plant Products		
Indigenous name	**Scientific/Common name**	**Amount (volume in litres)**
Vegetables:		
Kunde mbala	*Vigna pubescens*	10 to 20
Mwage	*Sesbania* sp.	3 to 5
Pwimbwiji	*Bidens schimperi*	20 and more
Mnavu	*Solanum nigrum*	20
Disogo/sogo	*Ornithopus viciifolia*	3
Ubuyu (vegetable)	*Adansonia digitata*-leaves	3
Mushrooms	Various	20 or more
Seeds		
Kweme pori	*Telfaria pedata*	20 or more
Medicines:		
Msalaka/Mharaka	*Spirostachys Africana*	1 to 2kgs
Kimugudumi	*Convolvus farinosus*	0.25 kgs
Iilodwaa	*Balanites aegyptiaca*	1 to 2kgs
Osokonoi	*Warburgia salutaris*	1 to 2kgs

Leaves of vegetables such as *Sesbania goetzei* (Mlenda mwage) and *Corchorus olitorius* (Mlenda mgunda) are collected, dried in sun, pounded, sieved and kept in dry containers. The powder can stay for almost a whole year and is used during dry periods when wild vegetables are off-season. Due to the problem of processing and storage facilities, very few people manage to process and preserve some of these EWPs products. Several studies have identified that, edible wild plants and mushrooms are processed in a variety of ways including simple drying and the production of beverages (Gumbo *et al.*, 1990; McGregor, 1995 and Campbell, 1996).

The products are preserved for future use in times when they are not available such as during dry seasons and heavy rains. Sometimes they are preserved for selling them in order to generate cash income. Processed and preserved EWPs products help ensure a year round food security. The study identified that, EWPs products are not processed and stored in large quantities due to a number of reasons. Local

people have no good facilities and technologies for processing and storing them. In most cases, these products are available during rainy seasons; during these times it becomes very difficult to process them in large quantities, especially for easily perishable products like mushrooms, fruits and some vegetables. The processed EWPs are stored in locally available containners like big pots, calabash, gourds, sisal bags and bottles depending on the nature of the product. Due to these reasons, there is a need for the government to prepare programmes for training rural communities on appropriate technologies on how to harvest, process, pack and store EWPs. They can be processed into various products such as juices, jams, wines, local beer, pickles, and canned fruits. This will help the local people to sell their products at the supermarkets and food stores hence, local people may gain high profits. Thus, extension services and campaigns on these products are required.

4.3 Socio – Economic Factors Underlying Collection of EWPs in Kilosa District, Tanzania

Collection of EWP products by the community is considered to be associated with various factors. In order to assess socio-economic factors which influence the collection of EWPs in the study area, a logistic regression model was employed. The logistic regression model fitted well the research data on edible wild plants by 99%. A model has a chi-square value of 19.187 with a df of 7, which was significant at P = 0.008 and a -2log likelihood of 13.169 indicating the goodness of fit of the model. The classification power of the model was 95.3% for the respondents who had positive and negative responses towards collection of edible wild plants in the

study area. The Wald statistic as shown in Table 17 has non-zero values implying that the logistic regression coefficients are significantly different from 0, using a significance level of 0.05. Also this indicates that, there is interaction between the dependent and independent variables. The results on Table 17 indicate that all the explanatory variables included in the logistic regression model have a direct relationship between dependent (i.e. collection of edible wild plants) variable and the independent (i.e. the socio-economic factors) variables. Hence the null hypothesis is rejected in favour of the alternative hypothesis (at 5% level of significance) that EWPs have significant contribution to the rural livelihood in Kilosa district.

Table 17: Logistic regression results

Socio-economic factors	β	S.E.	Wald	df	Sig.	Exp(β)
Age φ/years of residence, Education, Gender, Occupation.	.177	.088	4.064	1	.044*	1.194
Farm size φ/Income, Family size	-.270	.129	4.402	1	.036*	.764
Distance	-.865	.406	4.547	1	.033*	.421
Hungerfood	-2.516	1.763	2.037	1	.154ns	.081
Constant	4.335	3.310	1.715	1	.190ns	76.301

Number of cases = 86, Exp (β) = odds ratio (probability of success/probability of failure), SE = standard error of the estimate, * = Statistically significant at 0.05 level of significance, ns = statistically non significant at 0.05 level of significance, Sig = significance or P – values, e = 2.718, β = regression coefficients which stand for the odds ratio of probability of success to the probability of failure and Wald statistics = $\beta/(SE)^2$ and t-ratio = β/(SE) according to (Norusis, 1990 and Powers and Xie 2000 cited by Mayeta, 2003). φ = a surrogate to; e.g. Farm size is surrogate to income and Family size.

4.3.1 Age of the respondent

Table 17 reveals that, age of the respondent has a positive logistic regression coefficient (β) of 0.177 which is statistically significant (P = 0.044) implying that an increase in one year of the respondent increases the odds ratio (Expβ) by a factor of 1.194. That is, the event of collection of EWPs increases with the increase in age of respondents. Hence the event of collection of EWPs is directly correlated with an increase in age of the respondents. This implies that adults have long experience on the uses of EWPs. That is, adults have accumulated a lot of ethno-botanical knowledge compared to young ones. This study revealed that age was highly correlated with other independent variables, a factor which brought strong multicolinear effects to the model (Table 18). To minimize this effect therefore age was used as a surrogate to other variables including years of residence, education, gender and occupation.

In this study adults seemed to know more different types of EWPs like medicinal plants and wild foods eaten during hunger periods compared to young people, for example, many young people were not aware about edible roots (*Thylachium africanum*) and *Encephalartos hildebrandtii* (ummbuna) that were used as food during hunger periods. Adults could distinguish between poisonous and non-poisonous species of mushrooms, roots and tubers hence are responsible for the collection of these products, while children mostly collect fruits. According to these findings, most of the traditional healers in the study area are old people. Eighty percent of the traditional healers interviewed were old people while, 20% were young people.

Table 1: Pearson Correlation results for socio-economic variables

VARIABLE		Gender	Age	Education level	Occupation	Family size	Years of Residence	Farm size	Distance	Income	Hunger Food
Gender	Correlation	1	-0.316**	-0.115	0.012	-0.130	-0.092	-0.320**	0.066	-0.134	-0.177
	P-value		0.002	0.278	0.910	0.223	0.387	0.003	0.539	0.219	0.100
Age	Correlation	-0.316**	1	-0.337**	-0.316**	0.129	0.626**	-0.327**	0.139	-0.018	0.172
	P-value	0.002		0.001	0.002	0.226	0.000	0.002	0.191	0.871	0.109
Education Level	Correlation	-0.115	-0.337**	1	0.065	-0.344**	-0.171	-0.073	-0.211*	-0.331**	-0.034
	P-value	0.278	0.001		0.542	0.001	0.106	0.514	0.046	0.002	0.751
Occupation	Correlation	0.012	-0.316**	0.065	1	-0.139	-0.315**	-0.070	-.082	0.035	0.070
	P-value	0.910	0.002	0.542		0.190	0.002	0.527	0.443	0.749	0.519
Family size	Correlation	-.130	0.129	-0.344**	-.139	1	0.032	-0.437**	-0.219*	0.628**	0.040
	P-value	0.223	0.226	0.001	0.190		0.761	0.000	0.039	0.000	0.712
Years Residence	Correlation	-0.092	0.626**	-0.171	-0.315**	0.032	1	0.193	0.155	-0.123	-0.343**
	P-value	0.387	0.000	0.106	0.002	0.761		0.080	0.144	0.260	0.001
Farm size	Correlation	-0.320**	-0.327**	-0.073	-0.070	-0.437**	0.193	1	0.187	0.418**	-0.184
	P-value	0.003	0.002	0.514	0.527	0.000	0.080		0.091	0.000	0.089
Distance	Correlation	0.066	0.139	-0.211*	-0.082	0.219*	0.155	0.187	1	0.251*	0.077
	P-value	0.539	0.191	0.046	0.443	0.039	0.144	0.091		0.020	0.479
Income	Correlation	-0.134	-0.018	-0.331**	0.035	0.628**	-0.123	0.418**	0.251*	1	0.200
	P-value	0.219	0.871	0.002	0.749	0.000	0.260	0.000	0.020		0.067
Hungerfood	Correlation	-0.177	-0.172	-0.034	-0.070	0.040	-0.343**	-0.184	0.077	0.200	1
	P-value	0.100	0.109	0.751	0.519	0.712	0.001	0.089	0.479	0.067	

** = Correlation is significant at the 0.01 level (2-tailed).

* = Correlation is significant at the 0.05 level (2-tailed).

4.3.2 Years of residence in the village

Age has a high correlation with years of residence of respondents in the study area (Table 18) hence; age has been used as a surrogate to years of residence. The variable has a positive logistic regression coefficient (β = 0.177) which is statistically significant (P = 0.044) implying that an increase in one year of residence of the respondent increases the odds ratio (Expβ) by a factor of 1.194 (Table 17). This indicates that an increase in years of residence in the village by a respondent increases the chance of collection of edible wild plants by the respondent by a factor 1.194. This implies that as an individual lives in a same village for many years acquires more knowledge on EWPs, hence gets involved more in collection and utilization of EWP products.

The residencial duration was grouped into seven categories according to years one stayed in the area. Years of residence were a good determinant of individual's knowledge and experience on the utilization of EWPs. Those who lived in the study area for between 20 and above 60 years knew more than 20 types of fruits and 25 types of medicinal plants while, those who lived between 1 to 10 years knew only 15 types of fruits and 15 types of medicinal plants. About 24% of respondents reported to have lived between 31 - 40 years while, 4% have lived between 51 - 60 years (Table 19).

Table 19: Percent of Years of Residence by respondents in Kilosa, Tanzania

Years of residence in the village	Name of division			
	Kimamba	Ulaya	Magole	Mikumi
1 - 10	15.4	0.0	25.0	16.7
11 - 20	7.7	10.0	5.0	10.4
21 -30	15.4	0.0	15.0	22.9
31 - 40	15.4	40.0	10.0	29.2
41 - 50	38.5	50.0	20.0	4.2
51 - 60	0.0	0.0	5.0	6.2
above 60	7.7	0.0	20.0	10.4
Total	**100.0**	**100.0**	**100.0**	**100.0**

During the study, it was observed that individuals who lived in the same area for a number of years had a good knowledge of the types of EWPs available in the area (Table 20). Hence they are very knowledgeable about the ethnobotanical than new-comers (immigrants).

Table 20: Total types of fruits known by respondents in relation to years of residence in percentage in Kilosa District, Tanzania.

Years of residence in the village	Total types of fruits known by respondents				Total
	1 - 5	6 - 10	11 - 15	16 - 20	
1 -10	12.0	3.3	1.1	0.0	16.4
11 - 20	6.6	2.2	0.0	0.0	8.8
21 -30	11.0	5.5	1.1	0.0	17.6
31 - 40	16.5	7.7	0.0	0.0	24.2
41 - 50	13.2	4.4	0.0	0.0	17.6
51 - 60	3.3	1.1	0.0	0.0	4.4
Above 60	3.3	6.6	0.0	1.1	11.0
Total	**66.0**	**30.7**	**2.2**	**1.1**	**100.0**

4.3.3 Education

Education has a positive logistic regression coefficient ($\beta = 0.177$) and the odds ratio ($Exp\beta$) equal to 1.194, which is statistically significant ($P = 0.044$) implying that an increase in education level increases the odds ratio ($Exp\beta$) by a factor of 1.194. But education has a negative correlation with age (-0.337). This implies that education

responds negatively with age in the act of collection of EWP products. Hence an increase in educational level of the household head decreases the chance of collection of EWP products. But since age has a negative correlation with education level; it also implies that young people are more educated than adults in the study area. Most of the respondents in the study area (79%) had formal primary education, about 11% had adult education and 10% had non formal education (Table 21). No single interviewee had secondary and post secondary education.

Table 21: Level of Education of Respondents in percentage in Kilosa District, Tanzania

	Name of division				
Level of Education	**Kimamba**	**Ulaya**	**Magole**	**Mikumi**	**Total**
None	3.3	0.0	2.2	4.4	10.0
Adult Education	5.5	1.1	3.3	1.1	11.0
Primary Education	5.5	9.9	16.5	47.3	79.0
Total	**14.0**	**11.0**	**22.0**	**53.0**	**100.0**

These findings are in contrast with the views of Kamwenda (1998) who pointed out that level of education is considered as an important factor in relation to natural resource utilization and conservation. The increase in education level also increases options of respondents to meet their livelihoods (Mayeta 2004). Katani (1999) argued that, an increase in education level increases the level of awareness and thereby creating positive attitude, values and thereby motivating people to manage natural resources sustainably. Mbwilo (2002) as cited in Mayeta (2004) pointed out that, people go to school to enhance their income, producing capabilities and to develop an understanding and appreciation of how the physical world and human societies interact. Thus, high level of education of the head of household increases the welfare of the household members.

4.3.4 Gender

In this case gender has a positive logistic regression coefficient (β = 0.177) and the odds ratio (Exp β) equal to 1.194, which is statistically significant (P = 0.044) implying that an increase in one number of a man increases the odds ratio (Expβ) by a factor of 1.194 (Table 17). That is, the incidences of collection of EWPs increase with an increase in number of men involved in the activity of collection of EWP products. Hence the collection of EWPs is directly related to an increased involvement of men in this activity. During the study time, the study identified that men were more involved in the collection of EWP products such as mushrooms, fruits, nuts, climbers and medicinal plants than women. This is because men spent more of their time in the woodlands, while women were much engaged with in-door activities. Hence, when assessing the collection of EWPs against gender, men were given a value of 1 while, women were given a value of 0. This is because; the probability of getting more men who collect EWPs was higher than that of women.

Table 22: Percentage Collection of EWPs by respondents in Kilosa District, Tanzania

Product	Husband	Wife	Children	Husband & Wife	All H/H members	Total response	No response
Vegetables	2.2	83.5	3.3	3.5	2.2	94.5	5.5
Fruits	9.9	6.6	30.8	13..2	34.1	94.5	5.5
Medicines	41.8	2.2	2.2	14..3	1.1	61.5	38.5
Mushrooms	34.1	26.4	18.7	4.4	5.5	89.0	11.0
Root&Tuber	3.3	8.8	7.7	16.5	2.2	36.3	63.7
Wild nuts	14.3	5.5	3.3	0.0	0.0	33.0	77.0
Climbers	5.5	0.0	5.5	0.0	0.0	11.0	89.0

4.3.5 Occupation

Occupation has a positive logistic regression coefficient (β = 0.177) and the odds ratio (Exp β) equal to 1.194, which is statistically significant (P = 0.044). But, since occupation has a negative correlation with age (- 0.316), thus occupation responded negatively with the activity of collection of EWPs. Hence this implies that an increase in one additional occupation decreases the odds ratio (Expβ) by a factor of -1.194 (Table 17). This means that, an increase of occupation (such as petty business, traditional healing, pastoralism, honey hunting, to mention a few) by the respondent decreases the chance of collection of edible wild plants in the study area. As those people who may be involved in many businesses may not have enough time for collection of EWP products. The occupations of the respondents were grouped into four categories (Table 23).The main occupation of the respondents is peasantry farming (51.7%) and petty business (33%). Few respondents are pastoralists (7.7%). But observations from the study found that, some of the peasants also keep various types of livestock such as pigs, goats, chicken and duck, though they do not consider themselves as livestock keepers.

Table 23: Main Occupation of Respondents in Kilosa District, Tanzania, in percent

	Name of division					
Occupation	Kimamba	Ulaya	Magole	Mikumi	Total Response	No Response
Peasantry farming	5.5	9.9	4.4	31.9	51.7	48.3
Pastoralism	6.6	0.0	1.1	0.0	7.7	83.3
Petty business & peasantry farming	2.2	1.1	11.0	18.7	33.0	67.0
Medium busines & Peasantry farming	0.0	0.0	5.5	2.2	7.7	83.3

The study found that, 63% of all respondents keep some types of these livestocks including cattle, goats, pigs, chickens and ducks, while 37% did not. Even those keeping these livestock, they keep them in small numbers. Hence the economy of the area depends mainly on crop farming and petty business. Table 24 presents the contribution of various products (crops, livestocks and EWP products) to the household mean annual income.

The common crops sold in the study area include maize, rice, beans and simsim. EWP products being sold include vegetables, fruits, mushrooms, medicines, nuts, roots and tubers. The results indicate that, arable crops have highest annual contribution (60%) to the total annual household income followed by livestock (22%), EWP products being the least (18%). From these results, EWP products play an important role in income generation for the rural people.

Table 24: Mean Annual Income Accrued from Sales of Crops, Livestock and EWP products in Kilosa District, Tanzania

Type of Product	Mean income per year/household (TAS)	Percentage (%)
Crops	240 971.43	59.93
Livestock	89 909.09	22.35
Vegetables(EWP)	7 166.70	1.78
Fruits (EWP)	18 065.05	4.50
Mushrooms (EWP)	8 911.20	2.22
Medicines (EWP)	27 500.00	6.84
Roots & Tubers (EWP)	5 000.00	1.24
Wild nuts (EWP)	4 600.00	1.14
Total	**402 123.47**	**100.00**

4.3.6 Farm size

Farm size has a high correlation with household income and family size, a factor which brought strong multicolinear effects to the model (Table 18). To minimize this effect therefore, farm size was used as a surrogate to household income and family size. The logistic regression coefficient of farm size is negative (β = -0.270) and the odds ratio (Expβ) was equal to 0.764, which was statistically significant (P = 0.036) (Table 17). This implies that an increase in one unit of farm size (hectare) decreases the odds ratio by a factor of 0.764, implying decreasing the chance of collection of EWPs by this factor. In general, people who have large farms have little interest on collection of EWP products than those who have small farms. This is because; they have a good chance of producing enough food which may cater for the whole year round. The farm size distributions are as shown in Figure 6, where (16%) of the households had 10 acres (4 ha), 13% had farm size equal to 2 acres (0.8 ha) and 1% had 0.5 acres (0.02 ha) and 25acres (10 ha) respectively (Figure 7). The result indicates that, there is a great variation in farm sizes among households in the study area, with most people having very small farms.

Nduwamungu (2001) found that, the average farm size owned by each household is about 6 acres (2.4 ha) of which an average of 4 acres (1.6 ha) is annually farmed. He also discovered that, 45% of the respondents own less than 5 acres (2ha), 39% own 5 to 10 acres (2 - 4 ha) and 16% own more than 10 acres (4 ha).

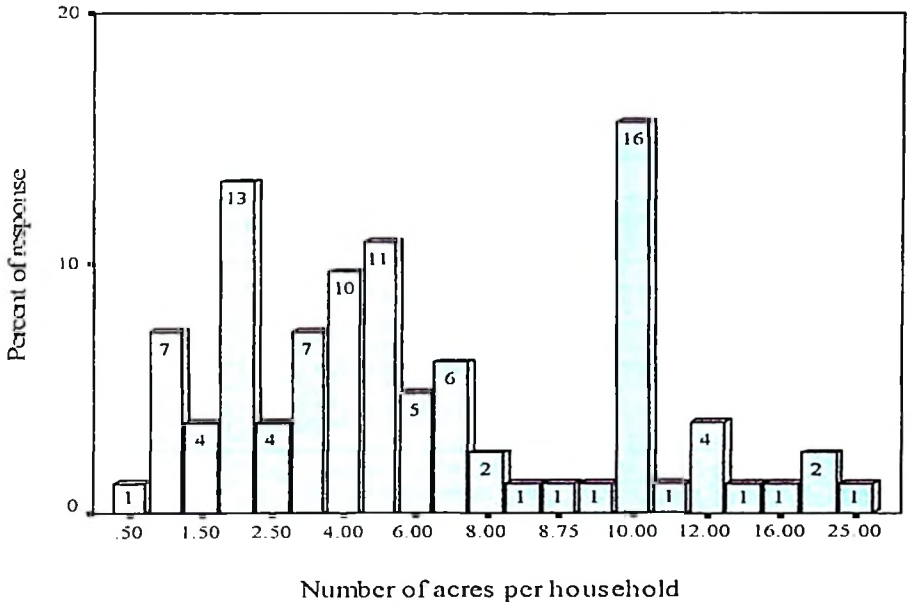

Figure 7: Farm size distribution per household in Kilosa District, Tanzania

4.3.7 Household income

Household income has a high correlation with farm size. The logistic regression coefficient for income is negative (β = -0.270) and the odds ratio (Expβ) was equal to 0.764, which was statistically significant (P = 0.036) (Table 17). Income has a positive correlation with farm size (Table 18) implying that, as farm size increases, income of the household also increases. Income has a negative logistic regression coefficient implying that, an increase in income per household decreases the chance of collection of EWP products. Hence households which are economically well-off are not much interested in collecting EWP products. This is because these families are always food secure as they are capable in buying food from food stores in periods of food shortages and by cultivating big farms using modern methods such as tractors and industrial fertilizers.

It was very difficult to assess income earnings per household because, this was a sensitive issue. Thus the main assessment was conducted basing on the sales of crops, livestock and other businesses like petty business and handcraft businesses. Findings from the study showed that, 35 % of the respondents can earn between TAS 10 000 - 100 000 per annum, 31% can earn between 100 001 – 200 000 per year, 22% can earn between 200 001 – 500 000, 7% can earn between 500 001 – 1 000 000.00 and only 5% can earn more than TAS 1 000 000.00. From these results it is clear that, most of the households in the study area are poor, thus the amount of income they get can not support them for family welfare. As a result, most of families fail to meet their basic needs. Hence, the importance of miombo resources for the rural communities increases as total income decreases.

The findings concur with that FAO (1991) which reported that, forest foods are often important for poor groups of rural people and that woodland activities provide some means of income earning for a large number of rural poor. Abdallah and Monela (2007) pointed out that the rural communities recognize and consume a varity of edible fruits, which are normally gathered and within locality, while some are sold in the local market. They make a significant contribution to the income of rural communities. Tanzania produces about 138 000 tonnes of honey and 9 200 tones of bees wax per year an industry which take place in miombo woodlands FBD (1999). Most of the honey and bees wax produced is consumed locally and only small amounts are exported to Germany, Japan, United Kingdom and the United Arab Emirates. The non-wood forest products from miombo are therefore important as they form alternative source of

livelihood, contribute to poverty alleviation through generation of income and provid foreign exchange earnings (Makonda and Gillah, 2007).

4.3.8 Family size

Farm size has a high correlation with family size (Table 18); hence farm size has been used as a surrogate to family size. Therefore the logistic regression coefficient for family size is negative (β = -0.270) and the odds ratio (Expβ) was equal to 0.764, which was statistically significant (P = 0.036) (Table 17). Family size has a negasitive correlation with farm size (Table 18) implying that, as family size increases, farm size of the household decreases. This is because the portion of land is being divided among the household members, hence the farm size becomes smaller and smaller as the family size increases.

Family size has a negative logistic regression coefficient implying that, increases in family size per household decreases the chance of collection of EWP products. This is because, households with large families have a good chance of distributing labour power among them, and diversifies their livelihood activities which make the household self-safficient in terms of income and food requirements (See section 2.1.1.2 above). Also larger fmilies have sufficient labour force to cultivate bigger farms than smaller families. Family size had a range of 1 – 22 people per household (Figure 8). Among this range, most of the household (60%) had a family size between 1 - 5 people and very few (3%) had a family size

of 16 - 22 people per household. The highest number of family size was observed to be 22 people per household.

Family size determines per capita collection and utilization of EWP products. The study found that, those families with many people utilizes more kilogrammes of EWP products compared with small size families. It was observed that, a family size of 4 people usually utilizes 1 – 2kgs per day, while those families with 6 – 7 people utilize 3kgs or more of wild vegetables per day, but possibly less frequently than those householnds with few people (that is, the relatively poor ones).

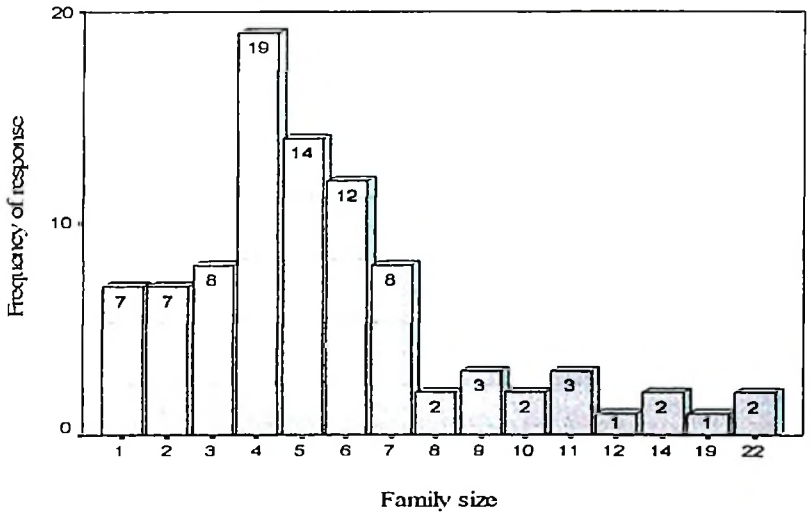

Figure 8: Family size distribution per household in Kilosa District, Tanzania

4.3.9 Distance from homestead to the miombo woodlands

The distance from homestead to the miombo woodlands have a negative coefficient (β = -0.865) and the odds ratio (Expβ) was equal to 0.421, This implies that an increase in one unit of distance (km) from homestead to the miombo woodlands reduces the odds ratio by a factor of 0.421, hence reduces the chances

of collection of EWP products by respondents. The factor is statistically significant (P = 0.033) (Table 17). This implies that distance limits many people from utilizing the naturally available EWPs found within the area.

Similar observation was noted by Grundy *et al* (1993) who examined the spatial effects of forest resources use for six villages in Mutanda Resettlement Area in Zimbabwe, where they showed that increased distance to woodland resources raises collection costs and thus mediates resource demands. Fortmann and Nabane (1992) found a clear relationship between spatial factors, gender and woodland resource use. They noted that women were significantly more likely to use resources found around the homesteads and fields, reflecting their work primarily as agricultural producers and domestic workers and hence the lower distance costs of collecting woodland resources from woodland areas.

4.3.10 Edible wild plants used as hunger food (famine foods)

Table 17 shows that edible wild plants which are used as hunger foods has a negative regression coefficients (β = -2.516) and the odds ratio (Exp β) equal to 0.081, meaning that it decreases the odds ratios by a factor of 0.081. This indicates that increases of incidences of hunger periods in the study area may decreases the chance of collection of edible wild plants by the local communities by the factor 0.081. However the variable is statistically not significant (P = 0.154). This result contradicts with what was hypothesized earlier, whereby it was expected that this factor will bear a positive regression coefficient because it is believed that

during hunger periods most people collect EWPs products to fill the gap of food shortages. But, according to the study findings this did not hold true. The reason behind this fact is that, currently during hunger periods, there are many other food sources such as food aid, food stores, markets and work for food which provide food for local communities. Hence, people do not depend much on EWPs from the woodlands. In addition, during hunger/famines there is usually scramble to harvest those EWP products. Such situation may cause over-exploitation in some parts making the collection cost too high. The latter may consequently reduce the number of people going to collect EWPs in favour of other alternatives. Similar findings have been reported by FAO (1991) that, emergency role of forest food products may be changing with increased commercialization and food relief programmes. Nonetheless, for many poorer people, forest emergency foods may be essential components of their diets in hard times.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

From the study it can be concluded that EWPs contributes significantly to the rural livelihood in Kilosa district. They contribute to household food security, local health care, they generate income and sometime used for exchange with other goods (i.e. barter trade) in the villages. Women were observed to be more responsible in collection of vegetables while men mostly collect medicines and children mainly collect fruits. Although all family members are involved in collection of EWP products, women are the main actor in processing many of EWPs except for traditional medicines where men are more responsible. The study has clearly shown that there is a difference about ethnobotanical knowledge between men and women, whereby men were more knowledgeable than women. The study further showed that an increase in distance from homestead to the woodland reduces the chance for villagers to collect EWP products, because, it increases the costs of collection in terms of time and energy. This my have a positive conservaton effect to the woodlands as it tends to minimize distruction. Households with small farm sizes had a positive relationship with collection and use of EWP products as shown by logistic regression results mainly associated with inability to cultivate large farms and ensure household food security. The study concludes that the annual contribution of EWP products to overall household food security, traditional medicines and to total household income is immense. This conforms that EWP

products have a great contribution to the rural livelihoods in Kilosa district. However, the sustainability of the utilization/expoitation of EWPs is questionable, especially with the growing population.

5.2 Recommendations

(i) Further studies be conducted on how to domesticate and conserve genes of these useful plants (natural regeneration and in-situ conservation); produce fast growing and high yielding species of EWPs to ensure sustainable supply of these products. Research findings should be disseminated back to the local communities for implementation.

(ii) There is a need to encourage and promote the use of EWPs to a wider range of consumers. This is because; EWP products are free from chemical contamination.

(iii) Research and market promotion for EWPs is very important. This will solve the problem of marketing of these products and solve the problem of high wastage of these products which occur during peak seasons of these products, which normally occur during rainy seasons.

(v) The government and other stakeholders to prepare programmes for training rural communities on new and appropriate technologies on

how to harvest, process, package and store EWPs. They can be processed into different products such as juices, jams, wines and pickles. This will help to provide added value to these products, hence providing high profits to the sellers.

(vi) Finally there is need for more engagement of rural dwellers in the conservation and /or sustainable utilization of different EWPs.

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APPENDICES

Appendix 1: Household questionnaire

Village..... Date.....

Division..... Ward.....

Household's identification number.....

SECTION A: HOUSEHOLD DATA

1. Name of household head.....
2. Gender

   01 Male..... 02 Female..... 03 Age.....
3. Marital status

   01 Single..... 02 Married..... 03 Widow.....

   For males number of wives .....
4. Religion

   01 Christianity

   02 Islamic

   03 Traditional

   04 Others (specify).....
5. Tribe

   01 Sagara.....

   02 Kaguru.....

   03 Others (specify).....
6. a) Level of education

   01 None

   02 Adult education .....years

   03 Primary education .....years

   04 Secondary education .....years

   05 College .....years

   06 Others (specify).....

   b) Occupation.....

7. Household composition

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

For how long have you been residing in this village?.....years

8. (a) How much land do you own?.....(acres)

   (b) How much land do you cultivate each year?.....(Acres)

   (c) If not all the land what do you use for uncultivated land?.....

(d) How did you acquire the land? .....

9. Does the available land satisfy your annual household food requirements?

   01 Yes

   02 No

10. If no in question 9 above, what do you do to fill the deficit?

   01 Purchase food

   02 Collect wild foods

   03 Others (specify)

11. What is the main source of food in the household?

   01 Own produce

   02 Purchase from the market

   03 Gathering from miombo woodlands

   04 All of the above

   05 Other sources (specify).....

SECTION B: ETHNOBOTANY/UTILIZATION AND AVAILABILITY OF EWP PRODUCTS

1. Is there any natural forest/miombo woodland in your village?

   01 Yes

   02 No

2. If yes in 1 above, what the legal status? How far is it from the homestead?

   01 Government reserve Distance (Km/mile/hrs).....

   02 General land Distance (Km/mile/hrs).....

   03 Others specify Distance (Km/mile/hrs).....

3. What types of edible wild plants (EWPs) are available in the woodlands

4. Do you collect/use any EWPs

   01 Yes.....

   02 No.....

5 If yes in question 4 above how do you rate your frequency of colleting EWPs?

   a. Daily

   b. Weekly

   c. Monthly

   d. Occasionally

6 If no in question 4 above why?

7 If yes in 4 above which type of edible wild plants do your household collect? Can you guess how far, the level of availability and species most preferred?

Forest product	Source: 1. Forest reserve 2. General land 3.Private land 4. Markets 5.Others	How far? Km/mile/hrs	Availability: 1.Plenty; 2. Fair; 3.very little	Species preferred
1. Vegetables 2. Fruits 3. Medicinal plants 5. Mushrooms 6. Roots/tubers 7. Wild grains				

8. How many times do you harvest the product per year?

Product	Harvest per day	Harvest per week	Harvest per month	Quantity collected per harvest (Kg)
Medicines				
Food				
Mushrooms				
Fruits				
Gums				
Others (specify)				

9. What is the current availability of edible wild plants as compared to the past twenty years ago?

Type of product	Decreasing	Increasing	Same
Vegetables/Leaves			
Fruits			
Roots/Tubers			
Nuts			
Wild grains			
Mushrooms			
Medicines			

10. What do you think might be the reason for the answer of question 9 above? .....

11. What do you consider to be the best way of improving/sustaining the availability of edible wild plants? .....

12. Types of mushrooms collected

    01.....

    02.....

    03.....

13. If you collect, give reasons for the choice

    01 Part of the diet

    02 Option during food shortage

    03 Source of income

14. Are these products available throughout the year?

    01 Yes.....

    02 No.....

15. If yes in 14 above, mention the time of the year when the product is available (Months).....

16. Specify if it is dry or wet season

    01 Dry.....

    02 Wet.....

SECTION C: UTILIZATION OF EDIBLE WILD PLANTS

1. Types of plants used

Name of plant/ Common name	**Vernacular/Swahili Name**	**Type of use Medicine/Food**	**Part of the plant used (Fruit, leaves roots, bark, tuber)**

12. How much do you collect for household use (estimate by weight)?

Type of EWPs	Enough for a meal	Enough for a day	Enough for a week	As much as possible	Amount (Kgs)
Vegetables/Leaves					
Fruits					
Roots/Tubers					
Nuts					
Wild grains					
Mushrooms					
Medicines					

13. How much money do you get per week from selling edible wild plants?

Type of EWPs	Sales per day (kgs/tins)	Sales per week (kgs/bags)	Sales per month (kgs/bags)	Price per unit (Tshs/unit)	Total amount (Kgs)
Vegetables/Leaves					
Fruits					
Roots/Tubers					
Nuts					
Wild grains					
Mushrooms					
Medicines					

14. Out of this money how much is used to buy food items in a household?
15. What are the items bought?
    01 Cereal grains
    02 Legumes
    03 Meat/fish
    04 Others (specify)
16. What was the area cultivated in the last crop season?

S/N	Crop	Area (acres)	Bags produced	Income (Tshs)
1				
2				
3				
4				
5				

Total area acres.....

12. What is the common meal in the household?

Meal	Frequency		
	Twice per day	Once per day	More than once per week
Maize			
Rice			
Potatoes			
Cassava			
Others (specify)			

14. What are the cultivated vegetables used in the household?

01 .....

02.....

03.....

16. What is the main relish to accompany the main meal?

Meal	Frequency		
	Twice per day	Once per day	More than once per week
Vegetables - Wild - Cultivated			
Mushroom			

17. How much money do you spend to buy cultivated vegetables enough for one meal?
18. How much by weight is it enough for one meal (estimate weight)
19. Do you sometimes buy wild vegetables?
20. If it is to buy how much money do you spend to buy enough for one meal?
21. How much by weight is it enough for one meal (estimate weight)
22. Which one do you prefer?

    01 Wild

    02 Cultivated

23. If wild, state why?

    01 Taste

    02 Availability

    03 Cheap prices

    04 Others (specify)

24. If cultivated, state why?

01 Taste

02 Availability

03 Cheap prices

04 Others (specify)

25. Are edible wild plants valued as important foods e.g. can you serve the guest with this type of food?

Explain.....

.....

.....

26. Have you ever experienced hunger periods?

01 Yes.....

02 No.....

27. If yes in 2 above, what types of food do you use during the hunger periods?

S/N	Type	Quantity (Kgs)	Source
1			
2			
3			
4			
5			

28. Are there any wild plants used during hunger periods? If yes which types?

Common name	Vernacular name/swahili	Scientific name	Parts used e.g. Leaves, roots	Form used – main meal, relish, snack	Amount Kgs
1. 2. 3. 4. e.t.c.					

29. Do you own livestock?

01 Yes

02 No

30. If yes in 29 above, which kind of livestock?

31. How much money per year do you earn from selling your livestock?

SECTION D: INFORMATION ON MEDICINAL PLANTS

1. Which trees/shrubs species and parts of the tree do you use for medicines/remedies?

Tree	Diseases	Parts of the plant collected				
		Stem	Barks	Roots	Leaves	Fruits
1						
2						
3						
4						
5						

2. Which type of medicine is more effective for common disease?

   01 Modern

   02 Indigenous

   03 Both

3. How is the availability of modern and traditional medicine in the area?

4. How do you acquire the indigenous medicines?

   01 Own collection

   02 From traditional practitioners

5. If you do your own collection, where do you collect them?

   01 Forest reserve

   02 Miombo woodlands

   03 Both

6. If you buy from the traditional practitioner, how much money on average does your family spends on medicines/remedies?.....

   (vii) How does this amount compared with monthly costs of modern medicines?

SECTION E: GENDER ROLES IN COLLECTION & PROCESSING OF EDIBLE WILD PLANTS

1. Who is responsible in the collection of edible wild plants

Type of EWPs	Husband	Wife	Children	
			Boys	Girls
Vegetables/Leaves				
Fruits				
Roots/Tubers				
Nuts				
Mushrooms				
Medicines				

2. Which methods do you use in harvesting edible wild plants?

Type of EWPs	Tree species name	Method used
Vegetables/Leaves		
Fruits		
Roots/Tubers		
Nuts		
Wild grains		
Mushrooms		
Medicines		

3. Who mostly consume the wild foods within the household?

   01 Men

   02 Women

   03 Children

   04 All household members

4. Who mostly is involved in the business of edible wild plants within the household?

   01 Men

   02 Women

   03 Children

   04 All household members

5. Do you preserve some of the collected products?

   01 Yes.....

   02 No.....

6. If yes in question 5 above how is the preservation done? .....

7. How much is preserved.....

8. If yes in 4 above, why do you opt to preserve EWPs?

   01 To use during food shortage periods

   02 For sale

   03 Others (specify)

9. Who is responsible in processing of EWPs?

Type of EWPs	Husband	Wife	Children	
			Boys	Girls
Vegetables/Leaves				
Fruits				
Roots/Tubers				
Nuts				
Mushrooms				
Medicines				

10. Who is responsible in preservation of EWPs?

Type of EWPs	Husband	Wife	Children	
			Boys	Girls
Vegetables/Leaves				
Fruits				
Roots/Tubers				
Nuts				
Wild grains				
Mushrooms				
Medicines				
Others (specify)				

SECTION F: SOURCE OF INCOME IN THE HOUSEHOLD

1. What kind of income generating activities do you engage yourself?
2. How much do you earn per month from these activities?
3. When you collect the EWPs are they only for food or both food and sell?

If yes how much do you sell per unit.....

4. How much do you spend on average per month?.....
5. What are the agricultural crops do you produce?

   01 Maize

   02 Rice

   03 Cassava

   04 Sweet potatoes

   05 Others (specify)

6. Do you sell some of the agricultural products you harvest?

   01 Yes.....

   02 No.....

If yes why?.....

7. If yes in question 6 above, how much?

Crop	Harvest per season	Amount sold	Amount reserved for food	Price (Tshs) per unit bags/basket/tin/kgs
Maize (ugali)				
Rice				
Potatoes				
Cassava				
Others (specify)				

8. Where do you get extra income outside the farm?

   01 Employement

   02 Casual labour

   03 Selling foods

   04 Others (specify).....

APPENDIX 1b: MARKET SURVEY QUESTIONNAIRE

INFORMATION ON THE VENDOR

1. Name of the village market..... Date.....
2. Name of vendor.....
3. Type of vendor structure (permanent stall or temporary stall).....
4. How long have you been selling in this market?.....
5. How often do you sell here.....and in other markets?.....
6. Do you collect on your own what you sell or you buy and sell?.....
7. If you are collecting on your own where do you collect your products?.....
8. If you are buying where do you buy the products

INFORMATION ON SALES

1. Types of edible wild plants sold

Type of EWPs sold	Local/swahil name	Scientific name	Quantity sold per day
Vegetables/Leaves			
Fruits			
Roots/Tubers			
Nuts			
Wild grains			
Mushrooms etc.			

2. Form of sales:

   01 Dry

   02 Fresh

3. The status of product sold:

   01 Cultivated

   02 Wild

4. What are the quantities available, frequency and price per unit for each product?

Type of products	How often sold (daily, weekly, occasional)	Quantity sold (kgs)	Period of availability (months)	Price per unit
Vegetables				
Fruits				
Roots/Tubers				
Nuts				
Wild grains				
Mushrooms				
Medicines				
Barks				
Others-specify				

5. How much is sold now compared to the past ten years ago?

   01 More

   02 Less

6. What do you think is the reason for the above answer?

   01 Availability

   02 Demand

   03 Others (specify).....

7. How do you rate the product?

   01 High demand

   02 Low demand

   03 Average

APPENDIX 1c: QUSTIONNAIRE FOR FOREST EXTENSION OFFICER

Date.....

Name..... Male/Female

Ward.....

Village.....

1. For how long have you been in this village/ward?
2. What are the general conditions of the forests/woodlands?
3. What do people collect/use from forest/woodlands other than wood?

   Mention them

4. Are these products from miombo woodland or general land?
5. Which seasons do they collect these products?

   Mention the product and the season

6. What could be the reasons for collecting these products?
7. How do you compare the availability of edible wild plants from the forests for the past five or ten years ago?
8. What might be the reason for the above answer?
9. For how long do you think the forests will continue to provide edible wild plants?
10. What are the threats to miombo woodlands in the area?
11. Who are the main actors in the EWPs business and their trends?
12. Are there any conservation actions taken towards the woodlands?
13. How is the rate of deforestation and indicatorsof woodland disturbances?
14. Is there any licensing system that is used to control extraction of edible wild plants from the woodlands?
15. What do you think should be done for sustainability of edible wild plants?
16. Is there any attempt to domesticate plants / trees that provide these products? For example, planting fruit trees and medicinal plants?
17. Is there any specific area you know where the edible wild plants grow e.g. mushrooms?
18. Is any one allowed to protect or own the area?

APPENDIX 1d: QUESTINNAIRE FOR TRADITIONAL HEALERS:

Village..... Date.....

Name..... Male/Female Age .....

Level of education.....

1. For how long have you been in this village?
2. When did you start your activities?
3. Which plants do you know to be medicinal? For which diseases?
4. Which tree species do you use in your activities?

Species	Disease	Parts used
1. 2. 3. etc		

5. How do you harvest medicinal plants from miombo woodlands?
6. How do you prepare the medicinal plants before giving the patient?
7. How do you store the remainder of the medicinal plants after giving the patient?
8. Where did you get the knowledge of using the medicinal plants?
9. How is the situation with respect to the availability of medicinal plants?
10. How far is the woodland from which medicinal plants are collected?

11. Is there any taboo with regard to harvesting, processing, storing and using medicinal plants?
12. Is there any indigenous knowledge associated with medicinal plant conservation? For which species?
13. Could life be possible without medicinal plants?
14. For how long do you think the forest will continue providing medicinal plants?
15. What is the average number of diseases attended per day, then per month?
16. How many patients do you treat per day, then per month and per year?
17. What are the common diseases affecting most people in this village?
18. How do you treat the diseases mentioned above?
19. Where do your customers come from?
20. How much money do you get per day?
21. How much money do you use for buying food item per day?
22. Do you have any other economic activities?

    01 Yes

    02 No

If yes, list them .....

.....

.....

.....

APPENDIX 1e: CHECKLIST FOR WARD/DISTRICT COMMUNITY DEVELOPMENT OFFICER OR NUTRITIONIST

Date.....

Name..... Male/Female

Ward/Village.....

1. Common food found in the village
2. The economic status of the household in the study area
3. Causes of hunger in the are
4. Uses of wild food e.g. vegetables, fruits, mushrooms in the study area
5. How often do they use these products?

APPENDIX 1f: CHECKLIST FOR VILLAGE LEADERS:

1. General information

Village..... Date.....

Ward..... Division.....

Name..... Male/Female

Level of education.....

2. Demographic data

2.1 Total village population

2.2 Actively working adults (Male..... Female.....)

2.3 Children (< 16 years)

2.4 Elders (> 60 years)

2.5 Number of households

2.6 Average family size

2.7 In and out migration

3. Land use, social and economic activities

3.1 Social service in the village

3.2 Main economic activities in the village

3.3 Average earnings from each activity

3.4 Land acquisition and expansion

4. Forest activities

4.1 Benefits villagers get from the forests

4.2 Source of forest products and condition of the forests

4.3 Consumption of EWPs in the village (kgs/bags /yr)

4.4 Sales of EWPs (kgs/bags/yr)

4.5 Peoples involvement in woodlands management

4.6 Extraction activities for forest products and availability

4.7 Actors in the edible wild plants business and their trends

4.8 Dependency on EWPs and reasons for dependency

4.9 Trends on edible wild plants pricing

APPENDIX 1g: CHECKLIST FOR VILLAGE ELDERS:

Village..... Date.....

Name..... Male/Female

1. The situation with respect to the availability of edible wild plants in the past twenty years ago.
2. The commonly used edible wild plants in the village
3. Periods of the year when edible wild plants are mostly used
4. Taboos on the use of some of edible wild plants
5. The traditional use of woodlands for ritual activities.

Appendix 2: Familial Use Values of EWPs Species in the Study Area, Kilosa District, Tanzania

(Med = Medicine, Sn = Snack, Re = Relish, Ol = Oil, Jc = Juice, Lb = Local brew, Th = Thirst quencher, Sp & Fl = Spices & Flavouring, Fd = Food seasoning, Fm = Famine food, Ap = Appatizer, Sal = EWPs for Sale)

S/N	Family name	No. of species	Med.	Sn.	Re	Ol	Jc	Lb	Th	Ch	Sp & Fl	Fd	Fm	Ap	Sal	Total use value	Familial	Uses/spp.
1	*Acanthaceae*	3	2	0.5	0	0	0	0	0	1	0	0	0.5	0.5	2	6.5	2.17	2
2	*Agaricus*	11	5.5	3.5	0.5	0	0.5	0	0	4	2	1	2.5	4	5.5	29	2.64	0.91
3	*Aloaceae*	1	0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	1	1	2
4	*Amaranthaceae*	2	1	0.5	1	0	0	0	0	0	0	0	1	0	0.5	4	2	2.5
5	*Anacardiaceae*	5	1	1.5	2	0	0	0	0	0	0	0	2.5	0.5	1.5	9	1.8	1.2
6	*Annonaceae*	1	0	1	0	0.5	0	0	0	0	0.5	1	0.5	0.5	0	4	4	6
7	*Apocynaceae*	6	3.5	1	1	0	0	0	0	0	0	0	1	0	1.5	8	1.33	0.83
8	*Arecaceae*	3	1.5	1	1.5	0	0	0	0	0	0	0	1.5	0	0.5	6	2	1.67
9	*Asparagaceae*	2	0.5	0	2	0	0	0	0	0	0	0	1.5	0	0	4.5	2.25	1.5
10	*Asteraceae*	6	3	1	0	0	0	0.5	0.5	0	0.5	0	0.5	0.5	0.5	7	1.67	1.33
11	*Balanitaceae*	2	1.5	0	0	0	0	0	0	0	0	0	0	0	1	2.5	1.25	1
12	*Basellaceae*	1	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.5	0.5
13	*Bignoniaceae*	2	1	0	2	0	0	0	0	0	0	0	1	0	0.5	4.5	2.25	2
14	*Bombacaceae*	1	1	0	0	0	0	0	0	0	0	0	0	0	0.5	1.5	1.5	2
15	*Boraginaceae*	2	0	0	1.5	0	0	0	0	0	0	0	1	0	0	2.5	1.25	1
16	*Burseraceae*	3	1	0.5	1	0	0	0	0	1	0	0	1	0	1	5.5	1.83	2
17	*Canellaceae*	1	1	0.5	0.5	0	0	0	0.5	0.5	0	0	0.5	0	0.5	4	4	7
18	*Capparaceae*	6	3	0.5	2	0	0	0	1	1	0	0	2	0	1.5	11	1.83	1.17
19	*Cecropiaceae*	1	0.5	1.0	0	0	0	0	0	0	0	0	0.5	0	1.0	3.0	3.0	3.0
20	*Celastraceae*	1	0.5	0.5	0.5	0	0	0	0	0	0	0	0	0	0	1.5	1.5	3
21	*Chenopodiacea*	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1
22	*Combretaceae*	4	3	1	1	1	0	0	0	0	0	1	0	0.5	0	7.5	1.88	1.5
23	*Commelinaceae*	1	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.5	0.5
24	*Compositae*	3	2.5	0.5	0	0	0	0	0	1	0	0	0.5	0.5	0.5	5.5	1.83	2
25	*Convolvulaceae*	4	2	0	0.5	0	0	0	0	0	0	0	1.5	0	0	4	1	0.75
26	Crassulaceae	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1

27	*Cucurbitaceae*	4	1.5	0	0	0	0	0	0	0	0	0	2	0	0.5	4	1	0.75
28	*Cyperaceae*	1	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.5	0.5
29	*Dioscoreaceae*	7	3.5	0.5	0.5	0	0	0	0	0	0	0	1	0	0	5.5	0.79	0.57
30	*Ebenaceae*	4	1.5	0	1	0.5	0	0	0	0	0	0	2	0	2	7	1.75	1.25
31	*Euphorbiaceae*	14	10.5	1	1	0	0	0	0.5	0.5	0	0	3	0	1.5	18	1.29	0.5
32	*Fabaceae*	42	14.5	5.5	13	0	1	1	0.5	0	0	0	14.5	1.5	10.5	62	1.48	0.21
33	*Flacourtiaceae*	2	1.5	1.5	0	0	0.5	0.5	0	0	0	0	1	0	1	6	3	3
34	*Lammiaceae*	3	2	0	0	0	0	0	0	0	0	0	0	0	0.5	2.5	0.83	0.67
35	*Lauraceae*	1	0.5	0	1	0	0	0	0	0	0	0	0.5	0	0.5	2.5	2.5	4
36	*Loganiaceae*	3	1	0	1	0	0	0	0	0	0	0	2	0	0.5	4.5	1.5	1.33
37	*Malvaceae*	3	1	1	0.5	0	0	0	0	0	0.5	0	1.5	0	0	4.5	1.5	1.67
38	*Meliaceae*	1	0.5	1	0	0	0.5	0	0	0	0	0	0.5	0	0	2.5	2.5	4
39	*Moraceae*	4	1	0	2	0	0	0	0	0	0	0	2	1	2	8	2	1.25
40	Musaceae	1	1	0	0	0	0	0	0	0	0	0	0	0	0.5	1.5	1.5	2
41	*Myrsinaceae*	2	1.5	1	0	0	0	0	0	0	0	0	0.5	0	0	3	1.5	1.5
42	*Myrtaceae*	2	1.5	0	0	0	0	0	0	0	0	0	0	0	0	1.5	0.75	0.5
43	*Ochnaceae*	1	0.5	0.5	0	0	0	0	1	1	0	0	0.5	0	0	3.5	3.5	5
44	*Olacaceae*	4	1.5	0.5	2	0	0.5	0	0	0	0	0	2	1	2.5	10	2.5	1.75
45	*Pedaliaceae*	3	2.5	0.5	0	0	0.5	0.5	0	0	0	0	0.5	0.5	1	6	2	2.33
46	*Piperaceae*	1	0.5	0.5	0	0	0	0	0	0	0	0	0	0	0	1	1	2
47	*Pleurotoid*	2	0.5	0	1.5	0	0	0	0	0	0	0	1	0	1	4	2	2
48	*Poaceae*	3	1	0	1.5	0	0	0	0	0	0	0	1	0	1	4.5	1.5	1.33
49	*Rhamnaceae*	1	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.5	0.5
50	*Rubiaceae*	5	2	1	1	0	0	0	0	0	0	0	2.5	0.5	2	9	1.8	1.2
51	*Rutaceae*	2	1.5	0	0	0	0	0	0	0	0	0	0	0	0.5	2	1	1
52	*Salvadoraceae*	2	1.5	2	0	0	1	0	0	0	0.5	0.5	1	0.5	0	7	3.5	3.5
53	*Sapindaceae*	5	1	3.5	0	0.5	0	0	0	1	0.5	1	2	1	0.5	10.5	2.1	1.8
54	*Sapotaceae*	3	1	1	0	0	1	0	0	0	0	0	1	0.5	1	5.5	1.83	2
55	*Simaroubaceae*	1	0	1	0	1	0	0	0	0	1	1	0.5	0.5	0	5	5	6
56	*Solacaceae*	6	1.5	1	3	0	0	0	0	0	0	0	3	1.5	4	14	2.33	1
57	*Sterculiaceae*	4	1	0.5	2	0	0	0	0	0	0	0	3	1	2.5	10	2.5	1.5
58	*Taccaceae*	1	1	0	0	0	0	0	0	0	0	0	0	0	0.5	1.5	1.5	2
59	*Tiliaceae*	10	2.5	3	2.5	0	0.5	0.5	0	0	0	0	4.5	0	2	15.5	1.55	0.7
60	*Typhaceae*	1	0.5	1	0	0	0	0	0	0	0	0	0.5	0	1	3	3	4
61	*Umbelliferae*	2	1	1.5	0	0	0	0	0	0	0	0	1.5	0	1	5	2.5	2
62	*Urticaceae*	1	1	0	0	0	0	0	0	0	0	0.5	0	0.5	1	3	3	4

63	*Verbenacea*	4	2	2	0	0	0	0	0	0	0	0	1	0	0	5	1.25	0.75
64	*Vitaceae*	1	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.5	0.5
65	*Zamiaceae*	1	1	0	0	0	0	0	0	0	0	0	0	0	0.5	1.5	1.5	2
66	*Zingiberaceae*	1	1	0.5	0	0	0	0	0	0	0	0	0.5	0	0	2	2	3
	Total	233	107	45.5	51.5	3.5	6	3	4	11	5.5	6	76.5	17	59	395.5		
	Percentage of total use value		27.1	11.5	13	0.88	1.51	0.76	1.01	2.78	1.39	1.51	19.3	4.3	14.9	100		

Total use values for individual species are shown in Appendix 3.
*.All species of the family present in the area, as mentioned by respondents
** Total use value for the family, divided by number of all species in the family
*** All uses of the family, divided by number of all species in the family.

Appendix 3: Total Use Values of EWP Species in the Study Area, Kilosa District, Tanzania

Scientfic name	Vernacular name(s)	Family name	Total use value	Main uses
Abrus precatorius	Lufambo, Lufwambo (K)	*Fabaceae*	1.5	Med, Sal
Acacia manbigmani	Munga mkulu (Sg, Vd)	*Fabaceae*	2.0	Med, Sal
Acacia mellifera	Eitii (Ms)	*Fabaceae*	3.0	Sn, Ch, Fm, Ap, Sal
Acacia nigrescens	Mkambala (K, G)	*Fabaceae*	3.5	Med, Sn, Ch, Fm, Ap, Sal
Acacia nilotica	Olkiloriti (Ms), Chimwinya (K, G), Mfuku (G, K), Ngiloriti (Ms)	*Fabaceae*	4.0	Med, Sp & Fl, Fd, Ap, Sal
Acacia pentagona	Kaselewa (K)	*Fabaceae*	0.5	Med
Acacia polycantha	Mtalula (Sg, G, K), Muwindi (G, K)	*Fabaceae*	3.0	Sn, Ch, Fm, Ap, Sal
Acacia rubusta	Mkongowe (Z, K)	*Fabaceae*	0.5	Med,
Acacia seyal subsp. *fistula*	Mlulugha (Ng), Mluziluzi (K)	*Fabaceae*	0.5	Med
Acacia tortilis	Oldepesi (Ms)	*Fabaceae*	3.0	Sn, Ch, Fm, Ap, Sal
Acacia xanthophloea	Olerai (Ms)	*Fabaceae*	3.0	Sn, Ch, Fm, Ap, Sal
Adansonia digitata	Mbuyu (Sw), Masela	*Bombacaceae*	6.0	Med, Sn, Re, Jc, Sp & Fl, Fm, Ap, Sal
Aframomum angustifolium	Ihankwe (K), Masumayu (Ms)	*Zingiberaceae*	3.5	Med, Sp & Fl, Fd, Ap, Sal
Albizia anthelmintica	Olmkutani (Ms), Mfuleta (Ms)	*Fabaceae*	2.0	Med, Sal
Albizia versicolor	Mpilipili (Be), Mkingu (Z)	*Fabaceae*	1.0	Med, Sn

Allophylus rubifolius	Masele, Makarati (G, Sg, Vd)	*Sapindaceae*	1.0	Sn, Fm
Aloe sp.	Dikoli (K), Chikoli (K), Itembwe	*Aloaceae*	3.0	Med, Re, Fm, Sal
Amaranthus spinosus	Mchicha pori (Sw), Izaza (Sg, Y)	*Amaranthaceae*	2.0	Re, Fm, Sal
Aminata losii (Aminata Zambiana)	Uyoga lelema (K, Sg), Uyoga Mkubwa (Sw)	*Agaricus*	3.5	Re, Fm, Ap, Sal
Ancylobotrys petersiana	Molwe (K)	*Apocynaceae*	1.0	Sn, Fm
Andropogoni shirensis	Ngugu (K)	*Poaceae*	0.5	Med
Annona senegalensis	Mtopetope (Sw), Matomokwe (K), Zang'we(G, Kv)	*Annonaceae*	2.5	Med, Sn, Fm
Antiaris toxicaria	Madegeha (G, He)	*Sapotaceae*	4.0	Sn, Ol, Sp & Fl, Fd, Fm, Ap
Antidesma venosum	Msekela (Ny)	*Euphorbiaceae*	1.0	Med, Sal
Asparagus abyssinicus	Mnamile(K)	*Asparagaceae*	1.0	Med, Sal
Asparagus flagellaris	Mhwangasale, Mkwangasale (K)	*Asparagaceae*	1.5	Med, Sal
Aspili mossambicensis	Mmotomoto (Vd)	*Asteraceae*	0.5	Med
Asystasia sp.	Mwidu (L, Sg)	*Acanthaceae*	2.0	Re, Fm,Sal
Azanza garckeana	Matowo (Mg, Sg), Matoyo?	*Malvaceae*	2.5	Med, Sn, Fm, Sal
Balanites aegyptiaca	Olng'osway (Ms), Mvamba ngoma (Ny), Mkonga (K)	*Balanitaceae*	1.0	Med
Balanites rotundifolia	Mkonga, Mkola (K), Olng'osway (Ms)	*Balanitaceae*	2.5	Med, Sn, Re, Fm
Bassela alba	Delega (K, Vd), Dikongo (K)	*Basellaceae*	2.5	Re, Fm, Sal
Bidens pilosa	Chinyuli (Ng)	*Compositae*	2.0	Re, Fm
Bidens schimperi	Mbangwe, Mangwi/Mangwe (Sg), Nyakatwanga (Md) Pumbwiji/Bwimbwiji/Pwimbwiji (K)	*Asteraceae*	2.5	Med, Re, Fm, Sal
Bryophiltum pinnatum	Ua la kupandwa (Sw), (Life plant) (Eng)	*Crassulaceae*	1.0	Med, Sal
Borassus aethiopum	Mhama (Sw), Mfuma ?	*Arecaceae*	2.0	Med, Lb, Th, Fm, Sal
Boscia salisfolia	Mguluka (K, Z)	*Capparaceae*	0.5	Med
Burkea africana	Muluati , Mkarati	*Fabaceae*	0.5	Med
Capsicum frutescens	Pilipili ukwale (K), Pilipili pori (Sw)	*Solacaceae*	3.0	Sp & Fl, Fd, Ap
Carissa edulis	Olyamuryak (Ms)	*Apocynaceae*	2.0	Med, Sn
Cassia abbreviata	Mkizingwi (P, K), Mkundekunde (Sw), Igaso (Vd), Mkakatika (G, Vd)	*Fabaceae*	2.0	Med, Sal
Cassysa filiformis	Ndandabingu (Md),Namurungu (Nd), Mlangamia (Sw)	*Lauraceae*	0.5	Med
Catunaregom spinosa	Mpongole (Ny)	*Rubiaceae*	0.5	Med
Celosia trigyna	Lifwena (He), Songolo maridadi (Y), Isongoro (Y), Mgange (Sg, Vd)	*Amaranthaceae*	2.5	Med, Re, Fm, Sal
Ceratotheca sesamoides	Mlenda mbata (Mg), Mbata ?	*Pedaliaceae*	2.0	Re, Fm, Sal
Chenopodium opulifolium	Mfunguo (Sg)	*Chenopodiacea*	1.5	med, Sal

Chenopodium opulifolium	Mfunguo (Sg)	*Chenopodiacea*	1.5	med, Sal
Cleome hirta	Mhilili (G, He)	*Capparaceae*	1.0	Re, Fm
Coccinia grandis	Mungulugutu (Sg, Vd)	*Cucurbitaceae*	1.5	Re, Fm
Combretum molle	Mlama mtitu/mweusi (K, G)	*Combretaceae*	3.0	Med, Sn, Ch, Fm, Sal
Combretum zeyheri	Msana (K)	*Combretaceae*	0.5	Med
Commelina africana	Nhongo (K)	*Commelinaceae*	2.0	Re, Fm, Sal
Commiphora africana	Oloishimi (K), Ngobwa (K), Njokuwo (Ms), Dibombwe (K), Mabombwe (K)	*Burseraceae*	4.5	Med, Re, Sn, Th, Ch, Fm, Sal
Commiphora edulis	Mgombagomba (Sg)	*Burseraceae*	1.5	Med, Fm
Commiphora mossambicensis	Lushelembwe/Olkishelembwe (Ms), Mtonto (Ny)	*Burseraceae*	3.5	Med, Sn, Th, Ch, Fm
Convolvulus farinosus	Kimgudumi (Sg, Vd)	*Convolvulaceae*	1.5	Med, Sal
Corchorus pseudocapularis	Luvamba (K)	*Tiliaceae*	0.5	Med
Corchotus tridens	Mlenda pori (Sw)	*Tiliaceae*	2.5	Re, Fm, Sal
Corchotus trilocularis	Mlenda lanzi ?	*Tiliaceae*	1.5	Re, Fm
Croton sp.	Mkambako (Z, K)	*Euphorbiaceae*	0.5	Med
Cucumis dipsaceus	Ubangazi ?	*Cucurbitaceae*	1.5	Med, Sn, Re
Cucumis metuliferus	Mtanga porini/zizini (Ms)	*Cucurbitaceae*	1.0	Re
Cyperus rotundus	Ndago (Kv), Ndagho (Nd)	*Cyperaceae*	0.5	Med
Dalbergia boehmim	Mjeamanga/Mjelemanga (Sg)	*Fabaceae*	1.0	Med
Dalbergia melanoxylon	Mpingo (Sw), Muhunga, Muhuga, Muhingo (K)	*Fabaceae*	0.5	Med
Dalbergia nitidula	Nng'hungu (K)	*Fabaceae*	5.5	Med, Sn, Re, Ol, Fd, Ap
Dalbergia obovata	Mfimbo (K), Mhungulu	*Fabaceae*	0.5	Med
Deinbollia borbonica	Mmoyomoyo (Sg), Mbwakabwaka (Z)	*Sapindaceae*	1.0	Med
Dichrostachys cinerea	Mchelegembe (Vd), Mkulagembe, Mkelegembe (G, K), Mtunduru	*Fabaceae*	2.5	Med, Sn, Ch, Fm, Ap, Sal
Dioscorea spp.	Kiazi kikuu pori (Sw), Vigonjo (Z), Kigonzo, Ndigali, Ndiga(Z),Matugu(K, Sg),Majimbi pori(Sw), Itugu (Ny)	*Dioscoreaceae*	1.5	Med, Fm, Sal
Diospyros fischeri	Mgoto (G, K), Mdaha (K), Ngenege (Nd)	*Ebenaceae*	3.5	Med, Sn, Sp & Fl, Fd, Ap
Diospyros sp.	Msuwe (Vd)	*Ebenaceae*	0.5	Med
Diplorhynchus condylocarpon	Mndimila (Vd), Mtogo (Be, K)	*Apocynaceae*	0.5	Med
Dobera loranthifolia	Msungwe (Be, Ny)	*Salvadoraceae*	1.0	Med
Dolichos trilobus	Kunde mbala (K), Nyungulugutu (Mg), Makatunga (Md), Lungatungu (Ng)	*Fabaceae*	2.0	Re, Fm
Dombeya rotundifolia	Msosowana (K)	*Sterculiaceae*	0.5	Med
Dombeya cincinnata	Chisongali (K)	*Sterculiaceae*	0.5	Med

Duosperma crenatum	Chigugale (K)	*Acanthaceae*	0.5	Med
Ehretia amoeana	Mkirika (Sg), Mdyamwofu (K), Mtukila (Vd)	*Boraginaceae*	0.5	Med
Embelia schimperi	Ilodwaa (Ms)	*Myrsinsceae*	2.5	Med, Ol, Sal
Encephalartos hildebrandtii	Ummbuna (Vd)	*Zamiaceae*	1.0	Fm
Ensete ventricosum	Ndizi pori (Sw), Mafija (K)	*Musaceae*	1.0	Fm
Entada abyssinica	Mfumbasi (K), Mvumbavumba	*Fabaceae*	1.5	Med, Sal
Eriosema burkei var. *burkei*	Mingede (K)	*Fabaceae*	2.5	Sn, Th, Ch, Fm
Erythrococca kirkii	Chinguvu kulukundu (K, Be)	*Euphorbiaceae*	1.5	Med, Sal
Euclea dixinorum	Olekakaya (Ms)	*Ebenaceae*	1.5	Med, Sal
Euphorbia tirucalli	Mnyaa (Sw)	*Euphorbiaceae*	1.0	Med
Faidherbia albida	Mkololo (K)	*Fabaceae*	1.0	Med
Ficus exasperata	Msasa (Ny, Vd), Mlembu	*Moraceae*	0.5	Med
Ficus sycomorus	Mkuyu (Sw)	*Moraceae*	2.0	Med, Sn, Fm
Ficus thoningii	Mtamba (Sg), Ndola (Nd)	*Moraceae*	1.0	Med
Flacourtia indica	Mwangangoma (K)	*Flacourtiaceae*	1.0	Med
Flaveria bidentis	Mhaka (Vd), Mashona nguo(Sw)	*Compositae*	2.0	Re, Fm
Flueggea virosa	Mkwambe kwambe (K)	*Euphorbiaceae*	1.0	Med
Gerdenia ternifolia	Chilemela nembo (K)	*Rubiaceae*	0.5	Med
Grewia bicolor	Nkole (Za), Mkole (L,)	*Tiliaceae*	1.0	Med, Fm
Grewia fallax	Mgukwe (G, Vd)	*Tiliaceae*	0.5	Med
Grewia goetzeana	Makolebwabwa (G)	*Tiliaceae*	1.0	Med, Fm
Grewia mollis	Makole ?	*Tliaceae*	1.0	Sn, Fm
Grewia platyclada	Mnangu (K)	*Tiliaceae*	1.0	Re, Fm
Grewia similis	Mtafuta (G, Vd), Eirii (Ms), Mnango ?	*Tiliaceae*	2.5	Med, Sn, Re, Fm, Sal
Grewia villosa	Mhembahemba ?	*Tiliaceae*	0.5	Sn
Gynandropsis gynandra	Mgagani (Sw)	*Capparaceae*	1.0	Re, Sal
Harissonia abyssinica	Mkunju (K)	*Simaroubaceae*	1.5	Med, Sal
Heteromorpha trifoliata	Mgombagomba ((Sg)	*Umbelliferae*	0.5	Med
Hewittia sublobata	Chikwejukweju (K)	*Convolvulaceae*	1.5	Med, Sal
Holarrhena pubescens	Imelemele	*Apocynaceae*	0.5	Med
Hoslundia opposita	Kinyamgoha (Sg), Mmolwe (K)	*Lamiaceae*	1.0	Med, Sal
Hyphaena compressa	Nkoko (Za, K)	*Arecaceae*	1.0	Sn, Fm
Hyphaene petersiana	Mikoche (Sw)	*Arecaceae*	7.5	Med, Sn, Ol, jc, Lb, Th, Sp & Fl, Fd, F
Ipomaea prescarrae	Likorobwe (Ms), Dikorobwe (K)	*Convolvulaceae*	2.0	Re, Fm
Ipomea sp.	Tembele pori (Sw)	*Convolvulaceae*	1.5	Re, Fm
Julbernardia globiflora	Mgina (G), Mguti	*Fabaceae*	0.5	Med

Julbernardia globiflora	Mgina (G), Mguti	*Fabaceae*	0.5	Med
Justicia flava	Mwidu (L, Z)	*Acanthaceae*	3.0	Re, Fm, Sal
Kigeria africana	Mwegea (K), Masumu	*Bignoniaceae*	2.5	Med, Sn, Lb, Sn
Lactarius kabansus	Uyoga fisi (Sg, K)	*Agarics*	3.5	Re, Fm, Ap, Sal
Lactarius luteopus	Uyoga Unguyugu (Ng)	*Agarics*	3.5	Re, Fm, Ap, Sal
Lactarius volemoides	Uyoga hani (Y, Sg)	*Agarics*	3.5	Re, Fm, Ap, Sal
Landolphia kilimanjarica	Mabungo(G, Vd), Vimbulimbuli	*Apocynaceae*	1.5	Sn, Jc, Fm
Lannea humilis	Mlingalinga (Z, Ny)	*Anacardiaceae*	1.5	Med, Sal
Lannea schweinfurthi	Muhungilo	*Anacardiaceae*	0.5	Med
Leguminus sp.	Wild beans (Eng)	*Fabaceae*	1.0	Re
Leonotis nepetifolia	Chindukuli (K)	*Lamniaceae*	1.5	Med, Sal
Leptactinia benguellensis	Chifulofulo (K)	*Rubiaceae*	0.5	Med
Lycium Europaeum	Ngokroi (Ms)	*Solanaceae*	1.0	Med, Sal
Lycopersicon lycopersicum	Nyanya pori (Sw)	*Solanaceae*	2.0	Re, Fm, Sal
Maerua grantii	Mfagila ndole (Vd, Z)	*Capparaceae*	0.5	Med
Maerua triphylla	Msangusangu (Sg), Madudu (Z)	*Capparaceae*	2.0	Med, Sn, Fm
Malva rotundifolia	Mvujevuje (Vd)	*Malvaceae*	1.5	Re, Fm
Manihoti glaziovii	Mihogo mpira (Vd), Mihogo pori (Sw)	*Euphorbiaceae*	1.0	Fm
Markhamia abstifolia	Mtalawanda (Vd), Mpapa (Ny)	*Bignoniaceae*	1.5	Med, Sal
Maytenus senegalensis	Mwamba ngoma (Ny)	*Celastraceae*	0.5	San
Medigago arabica	Ndelema k.m. Tembele	*Leguminosae*	1.5	Re, Fm
Microglossa pyrifolia	Chisongati (K)	*Asteraceae*	0.5	Med
Milicia excelsa	Mvule (Sw)	*Moraceae*	0.5	Med
Mimusops kummel	Mugama, Olkalei/Olkirenyi (Ms), Kirikiriani (Ms)	*Sapotaceae*	4.0	Med, Sn, Jc, Lb, Fm, Sal
Myrianthus arboreus	Matomokwe (K), Mlowelowe (L) Mfutsa (He), mswisa (Nd), Mkonde(Z)	*Cecropiaceae*	3.0	Med, Sn, Fm, Sal
Myrsine Ofricana	Osingway/Lasingway (Ms)	*Myrsinaceae*	1.5	Med, Sal
Ochna longipes	Mhatakwa ?	*Ochnaceae*	0.5	Med
Ocimum suave	Mafumbasi (K)	*Lamiaceae*	0.5	Med
Ormocarpum kirkii	Mhombohombo (Vd), Chilumbulumbu (K), Emsindo (Ms), Msinda (Mlenda)	*Fabaceae*	2.5	Med, Re, Fm, Sal
Ornithopus viciifolia	Sogo/Isogo/Disogo (K)	*Leguminosae*	2.0	Re, Fm
Oryza punctata	Dihunga (K), Pungapunga (Md)	*Poaceae*	1.0	Fm
Ozoroa insignis	Mkoma chuma/Mkama chuma (K, Z)	*Anacardiaceae*	1.5	Med, Sal
Parinari excelsa	Saula (, Mbula, Mula, Mbura	*Sapindaceae*	2.5	Sn, Fd, Fm
Parkia filicoidea	Makundi (K)	*Fabaceae*	1.0	Re, Fm

Phyllanthus reticulatus	Mkwambe maji	*Euphorbiaceae*	1.0	Med
Piliostigma thonningii	Msegese (Z, Sg, Vd), Mbamba ngoma(Sw), Mvamba ngoma(He), Msapala, (Ny, Vd)	*Fabaceae*	2.0	Med, Sn, Fm, Sal
Piper capensis	Lumoto (K)	*Piperaceae*	0.5	Med
Pleurotus djamor	Uyoga wa jiti lilooza (Sg)	*Pleurotoid*	3.5	Re, Fm, Ap, Sal
Pleurotus sajor-caju	Uyoga talula (Sg)	*Pleurotoid*	3.5	Re, Fm, Ap, Sal
Premna oligoticicha	Kinyamgoha (Sg)	*Verbenacea*	0.5	Med
Pseudolachnostylis maprouneifolia	Mtungulu (Ny)	*Euphorbiaceae*	1.5	Med
Psidium guajava	Mpera pori (Sw)	*Myrtaceae*	2.5	Med, Sn, Fm
Pterocarpus angolensis	Mninga (Sw)	*Fabaceae*	0.5	Med
Pterocarpus tinctorius	Mninga maji (Sw)	*Fabaceae*	0.5	Med
Rauvolfia caffra	Olchanionyokye (Ms)	*Olacaceae*	1.0	Med
Rhoicissus revoillii	Ikama (K, Vd), Mikamba maji (Z, K, Ngd)	*Vitaceae*	3.5	Med, Sn, Th, Ch, Fm
Ricinus communis	Nyonyo (Sw), Mnyemba (Ny, Vd)	*Euphorbiaceae*	0.5	Med
Russula ciliata	Uyoga Ilimi/dilimi dya nholo (K)	*Agaricus*	3.5	Re, Fm, Ap,Sal
Russula compressa	Uyoga sapi (Sg, K, Y, V)	*Agaricus*	3.5	Re, Fm, Ap, Sal
Saba commorensis subsp. *Florida*	Mabangu, Mabungo (Ny, Vd)	*Apocynaceae*	0.5	Med, Sn, Sal
Salvadora persica	Olremit/Oremit (Ms), Mswaki (Ms)	*Salvadoraceae*	1.5	Med, Ap
Schrebera trichoclada	Mputika (Ny)	*Oleaceae*	0.5	Med
Sclerocarya birrea subsp. *Cafra*	Mabwegele (K), Mng'ongo pori (Sw)	*Anacardiaceae*	4.0	Me, Sn, Jc, Lb, Fm, Ap, Sal
Senna singueana	Mhumbahumba (Sg)	*Caesalpiniaceae*	1.0	Med, Sn
Sesamum angolense	Mlenda mgunda (Be, Ng, Sg. K)	*Pedaliaceae*	3.0	Med, Re, Fm, Sal
Sesamum calycinum var.*angustifolium*	Mlenda ufuta (K)	*Pedaliaceae*	1.0	Re, Fm
Sesbania sesban	Mvale (Ny), Vulengo	*Fabaceae*	1.0	Med
Sesbania sp.	Mwage (K)	*Fabaceae*	2.5	Re, Fm
Sida chrysantha	Mlenda mtoni (He, Sw)	*Malvaceae*	1.0	Re, Fm
Solanum incanum	Mtuletule(Ny), Tunguja(Vd), Tulatula(Ng)	*Solanaceae*	0.5	Med
Solanum nigrum	Mnavu (Sw)	*Solanaceae*	3.5	Re, Fm, Ap, Sal
Solanum schumannianum	Mjui (K, G)	*Solanaceae*	0.5	Med
Sonchus luxurians	Mchunga (Sw), Sunga (K, L)	*Asteraceae*	3.0	Re, Fm, Sal
Sorghum purpureo-sericeum	Lunindi (Sg)	*Poaceae*	1.0	Fm
Sorindeia madagascariensis	Usulupi, Msurupi (Vd), Masugwe	*Anacardiaceae*	2.0	Med, Sn, Fm
Spirostachys africana	Mwalaka(P) Mharaka (K) Msalaka (Vd)	*Euphorbiaceae*	2.0	Med, Sal
Steganotaenia araliaceae	Mnyongamembe (Ny, Sg), Mhogola nziku (Vd)	*Umbelliferae*	1.5	Med, Sal
Sterculia africana	Mlulusi, Ndandabingu (Md)	*Sterculiaceae*	0.5	Med
Sterculia appendiculata	Mgude (Sg, G, He), Mfune (Ny)	*Sterculiaceae*	5.0	Med, Sn, Re, Ol, Sp & Fl, Fd, Fm, Ap

Strychnos innocua	Endukai/Endugai (Ms)	*Loganiaceae*	3.0	Sn, Ch, Fm, Ap, Sal
Strychnos spinosa subsp. *lokua*	Madonga, Mtongatonga(K), Zang'we(G, Kv)	*Loganiaceae*	2.0	Med, Sn, Fm, Jc
Suregada zanzibariensis	Chimbulimbuli/Fimbulimbuli	*Euphorbiaceae*	0.5	Sn
Synsepalum ceraciferum	Mbia (Vd)	*Sapotaceae*	4.0	Sn, Ol, Sp & Fl, Fd, Fm, Ap
Syzygium cordatum	Zambarau pori (Sw)	*Myrtaceae*	1.0	Re, Fm
Tacca leontopetaloides	Ulanga (Md), Kwindila (Md), Madaka (K, Vd, Sg, Z)	*Taccaceae*	1.0	Fm
Tamarindus indica	Mkwaju (Sw)	*Caesalpiniaceae*	4.5	Med, Sn, Jc, Fm, Ap,Sal
Teclea nobilis	Mlungulungu (Ny)	*Rutaceae*	0.5	Med
Telfaria pedata	Kweme pori (Sw)	*Cucurbitaceae*	5.0	Sn, Ol, Sp & Fl, Fd, Fm, Ap
Tephrosia vogelii	Ituha (K, Sg)	*Fabaceae*	0.5	Med
Terminalia mollis	Mzima mkubwa (Ny), Mfumba (K)	*Combretaceae*	1.5	Med, Sn, Sal
Terminalia sericea	Mzima mdogo (Ny), Mtanga, Mfumba (K)	*Combretaceae*	1.5	Med, Sn, Sal
Termitomyces eurrhizus	Uyoga belege (Y), Fyipo (Nd) Uyoga Ng'owo (Sg), Fyipo (Nd)	*Agaricus*	3.5	Re, Fm,Ap, Sal
Termitomyces letestui	Uyoga kuvu(Sg, K), maduwo (K), Kantwa (Nd)	*Agaricus*	3.5	Re, Fm,Ap, Sal
Termitomyces microcarpus	Uyoga kichuguu (K, Sw),Uyoga mbua/mbowa (K), Kanyaswa (Nd) Uyoga mdogo (Sw)	*Agaricus*	3.5	Re, Fm,Ap, Sal
Termitomyces singidensis	Uyoga wa zizini/mabumba (K), Katope (Nd)	*Agaricus*	3.5	Re, Fm,Ap, Sal
Termitomyces aurantiacus	Uyoga sikio (Kv, Vd, G), Uyoga nangalulongo (K)	*Agaricus*	3.5	Re, Fm,Ap, Sal
Thylachium africanum	Mdudu (Z), Kizenza (K, Go), Kidungwe (He)	*Capparaceae*	1.5	Sn, Fm
Trichodesma zeylanicum	Isasamlanda (K)	*Boraginaceae*	1.5	Med, Sal
Turraea nilotica	Mudyamhofo (K)	*Meliaceae*	1.5	Med, Sal
Typha domingensis	Ikangaga (Nd)	*Typhaceae*	0.5	Med
Uapaca kirkiana	Maguhu (K), Makuhu (Nd), Masuku (Nd), Makusu	*Euphorbiaceae*	4.0	Sn, Jc, Lb, Fm,Sal
Uapaca sansibarica	Machungwa pori (Sw)	*Euphorbiaceae*	1.0	Sn, Fm
Ulex europaus	Dikorobwe (K)	*Leguminosaeae*	1.5	Re, Fm
Urtica massaica	Ebalugunya (Ms), Ebalugunja?	*Urticaceae*	0.5	Med
Vangueria apiculata	Ligumu, Gumu (Ms)	*Rubiaceae*	1.0	Sn, Fm
Vangueria infausta subsp. *rotundata*	Masada (Sw, Vd, Ny)	*Rubiaceae*	4.0	Med, Sn, Jc, Lb, Fm, Sal
Vernonia amycidalina	Chitugutu (K)	*Asteraceae*	1.5	Med, Sal
Vigna pubescens	Kikwajukwaju (K), Kundembala (K)	*Fabaceae*	2.0	Re, Fm, Sal
Vigna unguiculata	Safe pori/Ng'ungulugutu	*Leguminosae*	1.0	Re, Fm
Vitex ferruginea	Mfuru (Sw, Ny), Mpuru (Ms), Mfudu	*Verbenaceae*	4.5	Med, Sn, Jc, Lb, Fm, Sal
Vitex mombasae	Msungwi (Be)	*Verbenaceae*	2.0	Med, Sn, Fm, Sal

Warburgia salutaris	Osokonoi (Ms)	*Canellaceae*	3.0	Med, Fd, Ap, Sal
Xeroderris stuhlmannii	Mninga dume (Sw)	*Fabaceae*	0.5	Med
Xerononia sp.	Mtugutu (K)	*Compositae*	0.5	Med
Ximenia americana	Olamai (Ms), Mtundwi (K, G), Iloma (Ms)	*Olacaceae*	1.5	Med, Sn, Fm,Sal
Ximenia caffra	Mtundwe (K), Mpingi (Vd, Sg), Mtundwa (Ny), Mbinji	*Olacaceae*	2.5	Med, Sn, Fm
Zanha africana	Mjuwi ((K, G), Mkalya (Ny)	*Sapindaceae*	0.5	Med
Zanthoxylum chalybeum	Mhunungu (Ny, Vd)	*Rutaceae*	1.5	Med, Sal
Ziziphus mucronata	Mkunazi, Kagowole (Ny) Mgagawe, Muogola, Mogola	*Rhamnaceae*	2.0	Med, Sn, Fm

(Uses: Med = Medicine, Sn = Snack, Re = Relish, Jc = Juice, Th = Thirst quencher, Ch = Chewing, Sp & Fl = Spices & Flavouring, Fd = Food seasoning, Fm = Famine food, Ap = Appatizer, Sal = EWPs for Sale); (KEY: Be = Bena, Eng = English,G = Gogo, He = Hehe, K = Kaguru, Kv = Kwavi, L = Luguru, Md = Manda, Mg = Mguruka, Ms = Maasai, Nd = Ndali, Ng = Ngoni, Ny = Nyamwezi, P = Pogoro, Sg = Sagara, Sw = Swahili, Vd = Vidunda, Y = Yao, Z = Zigua, Za = Zaramo)

Appendix 4: List of Medicinal Plants Identified in Kilosa District, Tanzania.

Vernacula Name	Tree species	Type of diseases	Part used
Olmkutani/Mfuleta	*Albizia anthelmintica*(T)	Typhoid, Malaria, Bilharzia, All body malaise, Viral diseases, Strengthen bones, All types of worms	Roots, Barks
Osokonoi	*Warburgia salutaris*(T)	Stimulates appetite, Hernias, All types of worms, acts as viagra Reduces excess sugar in body Stomach diorders Used as tea-leave	Barks
Ilodwaa	*Balanites aegyptiaca*(T)	Laxative medication, Hernias,	Fruits
Olchanionyokye	*Rauvolfia caffra* (T)	Laxative medication	Roots
Olkiloriti/Ngiloliti	*Acacia nilotica* (T)	Blood booster, Stimulates appetite Removes stomach-gases	Barks
Osingway/Lasingway	*Myrsine Ofricana* (ST)	Abdominal disorders, All types of worms	Roots
Olekakaya	*Euclea divinorum* (T)	Viral diseases, Hernias, Bladder treatment	Roots
Kirikiriani/Olkirenyi	*Mimusops kummel* (T)	Eye treatments	Roots
Ebalugunya/Ebalugunja	*Urtica massaica* (H)	Abdominal pains	Roots
Njokuwo	*Comiphora Africana* (S, T)	Swollen legs, Backbone pain, Bone and joint pains,	Roots
Ngokroi	*Lycium Europaeum* (S)	Cough, Abdominal pains Worms	Roots
Mkonga	*Balanites rotundifolia* (S, T)	Treats infected breasts of - lactation mother	Barks
Mkizingwi/Mkundekunde	*Cassia abbreviate* (ST)	Hernias, Spleen treatment, Abdominal pains, Malaria, Hookworms	Roots, Barks
Mharaka/Msaraka	*Spirostachys Africana* (T)	Swellings/ Sores, Hernias, Stomach pains, Boils, Abscess, Haemorrhoids Stop Vomiting, Sore throat Diarrhoea, Snake-bite	Bark, Stem
Munga mkulu	*Acacia manbigmani* (S)	Diarrhoea, Convulsion,	Roots, Barks,

		Stimulates fertility in women, Allergy treatment, Stomach pains, Constipation, Sore mouth, Oral thrush, Pains at lower stomach, Pelvic pains Haemorrhoids	Leaves
Mulwati/Mkarati	*Burkea Africana* (ST, T)	Various disease, Flu, Hernias	Roots
Mkambako	*Croton* sp.	Headache	Root, Barks,Leave
Mtundwe/Mbinji	*Ximenia caffra* (S, ST)	Haemorrhoids Abdominal pains	Barks, Roots
Mikamba maji	*Rhoicissus rivoilii* (S)	Abdominal pains	Roots
Msegese	*Piliostigma thonningii* ((T)	Evil spirit, Abscess	Roots, Barks
Mng'ongo pori	*Sclerocarya birrea* (T)	Teeth, Diarrhoea, Bad evils, Vomiting Blood, (Hematernesis) Haemorrhoids, Bewitched	Barks, Roots, Leaves
Mlingalinga	*Lecaniodiscus fraxinifolius* (T)	Hernias, Malaria, Abscess, Protection from snake-bite, Menstural-overbreeding, Abdominal pains, Causes miscarriage	Roots, Barks, Leaves
Mkingu	*Albizia versicolor* (T)	Hernias, Stomach pains	Roots
Mtopetope	*Annona senegalensis* (S, ST)	Abcess, Wounds	Roots, Barks, Leav
Mpingi, Mpinji	*Ximenia caffra soundi* (ST)	Whooping cough, Dysentry Diarrhoea, Haemorrhage, Stimulates fertility in women	Roots, Leaves
Mnyongamembe	*Commiphora eminii* (ST)	Hernias, Bewitched, Heart diseases Treatment against Evil spirits	Leaves, roots
Mfagila ndole	*Cleome hirta* (S)	Laxative treatment	Roots, Leaves
Mkwambe kwambe, Mkwambe maji	*Flueggea virosa* (S, ST)	Abdominal pains, Haemorrhoids	Roots
Mtugutu	*Xerononia* sp. (S)	Abdominal pains, Gonorrhoeae, Hernias, Haemorrhoids	Roots, Leaves (for youngs)
Mhunungu	*Zanthoxylum chalybeum* (T)	Bilharzia, Syphilis, Convulsion	Roots, Barks, Sten
Mtogo	*Clerodendrum cephalanthum* (T)	Recurrent fever (Periodic fever), Abdominal pains Diarrhoea	Utomvu

Mkuyu	*Ficus sycomorus* (T)	Evils spirits, Cough, Infected breasts, infected teeth, Snake, Scorpion bite and other poisonous insects	Utomvu, Roots, Leaves, Steam
Mtamba	*Ficus thoningii(F. natalensis)* (P_t)	Broad spectrum medicine, Blood Pressure, Stomach pain Waist pain	Roots, Leaves
Mdaha, Mdaa	*Diospyros mespiliformis* (ST)	Cough, Teeth, Sore throat & mouth	Roots
Ihankwe (k.m. Iriki)	*Aframomum angustifolium* (H)	Cough	Roots
Ituha (Utupa)	*Entada abyssinica* (ST)	Dermatitis	Roots, Tuber
Lumoto	*Piper capensis*	Burns	Barks
Kaselewa	*Acacia pentagona*	Snake poison or snake-bite	Roots, Barks, Leav
Mkololo	*Acacia albida* (T)	Diarrhoea, Haemorrhoids Menstural Disorders	Barks, Roots
Mkoma chuma	*Ozoroa insignis* (S, ST)	Hernias, Gonorrhoeae, Stomach-ache Various diseases	Barks, Roots
Mbwakabwaka	*Deinbolia borbonica* (S, ST)	Fontanelle treatment	Roots
Mninga	*Pterocarpus angolensis* (T)	Fontanelle treat., Dysentry	Barks, Latex
Mkongowe	*Acacia rubusta* (T)	Improves health of pregnant mother, Haemorrhoids	Roots
Chilemela nembo	*Gerdenia ternifolia* (S, ST)	Waist pains, Haemorrhoids	Roots
Chigugale	*Duosperma crenatum*	Waist pains	Roots
Chitugutu/Mtugutu	*Vernonia amycidalina* (S)	Waist pains, Haemorrhoids Bilharzia, Hernia	Roots, Stem, Bark, Leaves
Mkunju	*Harissonia abyssinica* (S, ST)	Abnominal pains- After-delivery pains, Hernia	Roots, Leaves
Mwegea	*Kigeria Africana* (T)	Hernia, Bilharzia, Treats miscarriages, Prevents deaths for infants.	Roots, Stem, Bark, tree Sprouts
Mtongalonga	*Strychnos dysophyla* (ST)	Hernia	Roots
Mhumba	*Senna singuena*	Treats Snake-saliva	Leaves
Chindukuli	*Leonotis nepetifolia* (C)	Malaria, Hernia, Stomach pains	Roots
Mfimbo/Mhungulu	*Dalbergia obovata* (T)	Haemorrhoids Leg joints pain	Roots

Mpingo/Mhingo	*Dalbergia melanoxylon* (T)	Haemorrhoids Leg joints pain	Leaves
Mkambala	*Acacia nigrescens* (T)	Gonorrhoeae	Roots
Chifulofulo	*Leptactinia benguellensis* (H)	Bilharzia	Stem
Chinguvu kulukundu	*Erythrococca kirkii* (C)	Abdominal pains, Worms Hookworms	Roots
Mgoto	*Azanza garckaena* (T)	Cough, Teeth	Roots, Barks
Molwe	*Ancylobotrys petersiana* (L)	Diarrhoea, Dysentry	Roots, Leaves
Mjuwi	*Zanha Africana* (ST)	Gonorrhoeae	Roots
Mlama mtitu/mweusi	*Combretum molle* (S, ST)	Gonorrhoeae	Roots
Nyonyo/Mnyemba	*Ricinus communis* (S)	Celebral Malaria	Oils
Mjui	*Solanum schumannianum* (H, S)	Syphilis, Infected teeth	
Mlulusi	*Sterculia Africana* (T)	Hernias	Leave, Roots
Mninga maji	*Pterocarpus tinctorius* (T)	Dysentry	Barks
Mninga dume	*Pterocarpus angolensis* (T)	Dysentry	Barks
Msapala	*Piliostigma thonningii* (T)	Stomach-ache, Headache, Flu, Abscess, Bad evils	Barks, Roots
Mbungo	*Saba commorensis* subsp. *Florida* (C)	Syphilis, Bilharzia Neisseria gonorrhoeae, Stomach pains for infants, Biwitched, Bad evils	Roots, Leaves Utomvu (Latex),
Msasa/Mlembu	*Cordia sinensis (C. gharaf)* (T)	Skin diseases (Wring worms), Evil spirits	Roots, Leaves
Msada	*Vangueria infausta* (ST)	Periodic fever, Stimulates fertility in women treats nausea and Vomiting	Roots, Leaves
Kimgudumi	*Convolvulus farinosus* (C)	Abdominal pains, Hernias	Roots
Kilunduwusi/Kamba dume	*Aisodeiopsis schumanii* (C)	Blood Pressure (B.P.), Hypertension, Acute Malaria	Leaves, Roots
Mtuletule/Tunguja/Tulatula	*Solanum schumannianum* (H)	Syphilis, Infected teeth	Roots
Mlulugha	*Acacia Seyal* var. *fistula* (T)	Back-pains	Leaves
Mpilipili	*Albizia verscolar* (T)	Cough	Barks
Usulupi	*Sorindea madagariensis* (ST)	Skin Diseases	Barks, Stem
Mjeamanga/Mjelemanga	*Dalbergia boehmim* (T)	Abdominal pains, Sore throats Haemorrhoids	Leaves
Mfuru	*Vitex doniana* (T)	Trachoma	Leaves

		Back-pain in women	
Mtalawanda	*Markhamia abstifolia* (S, ST)	Haemorrhoids	Roots
Msuwe	*Diospyros* sp. (ST)	Sore throats (Tonsillitis?)	Bark
Mkulagembe, Mchelegembe	*Dichrostachys cinerea* (ST)	Broad spectrum, Stomach-pain, Treats various diseases if - mixed with others, Diarrhoea, Acute Head-ache, Abdominal pains	Roots, Leaves
Mhongola nziku	*Steganotaenia araliaceae?*	Hookworms	
Mwagula	*Dovyalis xanthocarpa* (S, ST)	Swelling of legs	Roots
Mndimila, Mtogo	*Diplorhynchus condylocarpon* (T)	Swelling of legs	Barks, Roots
Mgukwe	*Grewia hexamita?*	Toe or Finger abscess	Roots
Mtafuta	*Grewia similes* (S, ST)	Cut-wounds	Roots
Mtafuta	*Grewia bicolor* (S, T)	Cut-wounds	Roots
Msangusangu	*Strombosia scheffleri?*	Abdominal pains, Hernias	Roots, Leaves
Mgina/Mguti	*Julbernardia globiflora* (T)	Hernias	Roots
Igaso	*Cassia abbreviate* (S, ST)	Stimulates milk production- for lactation mother (Lactogogus medicinal plants)	Roots, Leaves
Mfunguo	*Chenopodium opulifolium* (H)	Sore- mouth, Oral thrush Lxative medicine Various diseases	Leaves
Kinyamgoha	*Premna oligoticicha* (S)	Abdominal pains	Roots
Mtowo	*Azanza garckaena* (T)	Haemorrhoids	Leaves
Mkwaju	*Tamarindus indica* (T)	Haemorrhoids	Leaves
Mpera	*Psidium guajava* (ST)	Diarrhoea	Leaves
Mafumba/Mtanga	*Terminalia sericea* (S, ST)	Convulsion, Dermatitis	Roots, Stem
Mhwangasale/Mkwangasale	*Asparagus flagellaris* (H)	Treats swelling stomach	Roots
Mudyamhofo	*Turraea nilotica* (H)	Menstural Disorder	Roots
Chikwejukweju	*Hewittia sublobata* (C)	Migraine	Roots, Leaves
Mbungo	*Saba comorensis (S.florida)* (T)	Hypertension, Rheumatism, Treats infertility in women	Leaves, Roots Leaves
Mkirika	*Ehretia amoena* (T)	Acute Diarrhoeae, Migraine	Leaves, Roots
Dikoli	Aloe sp. (H)	Eyes	Leaves, Roots
Mtunguru	*Pseudolachnostylis maprouneifolia* (T)	Gynocological diseases,	Roots
Mvale, Vulengo	*Sesbania sesban* (T)	Blood Pressure	Barks, roots, leave

		Evil spirits, Confusion	
Mlungulungu	*Teclea nobilis* (ST)	Hysteria (Mental Disorders)	Utomvu(Latex) ar
		Bone pains, Sepsis (arlegies)	groundnut-sauce
		Removes Abdominal-gases	Leaves, Roots, Bar
		Laxative medication	(Steam and drinki
Mfumbasi	*Entada abyssinica* (H)	Hysteria, fever	Barks
Mvambangoma, Msegese	*Maytenus senegalensis* (T)	Chronic wounds,	Barks
		Skin rushes (Wring worms)	
Mpapa	*Bersama abyssinica* (T)	Hysteria	Root-foam
		State of loosing memory	
Mkalya	*Zanha Africana* (ST)	Evil spirits,	Roots or Tubers
		Confusion or mental illness	
Viazi vikuu pori	*Dioscorea Doratisima* (Tb)	Treats wounds on body,	Roots or Tubers
		Viral disease, Ulcers	
Viazi vikuu pori	*Dioscorea quartiniana* (Tb)	Treats wounds on body,	Roots or Tubers
		Viral disease, Ulcers	
Viazi vikuu pori	*Dioscorea dumetorum* (Tb)	Treats wounds on body,	Roots
		Viral disease, Ulcers	Roots, Leaves
Mnamile	*Asparagus Africana* (*A. abyssinicus*) (WS)	Penile erection	
Mgombagomba	*Ensete ventricosum* (LH)	Hernias, Bewitched,	
		Menstrual-disorder,	Roots, Leaves
		Treatment against Evil spirits	
Lufwambo	*Abrus precatorius* (H)	Abdominal pains	Leaves
		Dermatitis, Convulsion	Roots, Leaves
Mafumba	*Ochna leptoclada*?	Abdominal pains	
Luvama	*Corchorus pseudocapularis*?	Improves poor health of pregnant mother,	Roots
		Abscess, Haemorrhage	Barks,Roots
Isasamlanda	*Trichodesma zeyheri* (S)	Joint-pains on legs	Roots
Mtomoko, Mtopetope	*Annona senegalensis* (S)	Migraine	Roots
Matomokwe	*Myrianthus arboreus* (S, ST)	Menstural disorders	
Chisongati	*Synaptolepis kirkii* (CS)	Boils and Abcess,	Roots, Barks
		Lactogogus medicinal plants	
Msungwe, Msungwi	*Dobera loranthifolia* (T)	Stomach-ache, Convulsion Roots	
		Blood Pressure, boils	
Mmoyomoyo	*Deinbollia borbonica* (S, ST)	Stomach-ache,	Roots
		Blood Pressure, boils	

Mmoyomoyo	*Deinbollia kilimandscharica* (S, T)	Abscess, cough bones and joint-aches	Barks
Mwegea	*Kigeria Africana* (T)	Abscess, Evil spirit (Majini)	Barks Barks
Mvule	*Milicia excelsa* (T)	Abscess, Evil spirit, Stimulates fertility in women	Roots
Mgude (Mbalamwezi)	*Sterculia appendiculata* (T)	Treats after-birth pains,	
Mhama	*Borassus aethiopum* (T)	Pneumonia, induce arbotion,	Leaves, Barks
Kagowole	*Ziziphus abyssinica* (T)	Abdominal pains Treats Bad fortune, Asthma	Leaves, Roots
Chifulofulo	*Leptactinia benguellensis* (H)	Bilharzia, Dysentry,	Stem,
Msekela	*Antidesma venosum* (S, ST)	Snake poison, Snake-saliva	Barks
Mzima	*Terminalia sericea* (T)	Teeth treatment	Leaves
Mhumbahumba	*Senna singueana* (T)	Haemorrhoids	Roots
Ndago	*Cyperus rotundus* (G)	Breasts of lactation Mother	Barks
Mtundwi	*Ximenia Americana* (S)	Snake-bite, Scopion-bite	Barks
Mkonga	*Balanites rotundifolia*	and other insects, Cough, Infected teeth	
Mtamba, Ndola	*Ficus natalensis* (Pt)	Measles	
Mbuyu	*Adansonia digitata* (T)	Prevent tooth decay, It is an antibiotic	Roots, Leaves
Olremit/Oremit/Mswaki	*Salvadora persica* (TS, ST)	Constipation, Measles,	Roots, Bark
Mlenda pori	*Sesamum angolense* (H)	Prevent vomiting, Poisoning	Roots, Leaves
Mtalula	*Acacia* sp. (T)	Asthma, Dysentry	Barks
Mpongole (Nyamwezi)	*Catunaregam spinosa* (T)	Treats Menstural disorder	Roots, Thorns, Fru
Mputika (Nyamwezi name)	*Scherebera trichoclada* (T)	Constipation, Stomach pains	
Msana (Nyamwezi)	*Combretum zeyheri* (T)	Eyes	Roots
Engiroliti (Maasai)	*Acacia nilotica* (T)	Body malaise, Allergies, Body refreshment	Roots, Leaves
Ndandabingu/Namurungu	*Cassysa filiformis* (C)	Body Protection against evils and bad wishes like poisoning	Tubers
Mmotomoto	*Aspilia mossambicensis*	Haemorrhoids	
Mhombohombo	*Ormocarpum kirkii* (S, ST)	Imroves health of- pregnant mother	Roots
Mtukila	*Ehretia amoeana*	Facilitates safe baby delivery	Roots, Leaves

Mkakatika	*Cassia abbreviate* (T)	Hernias, Malaria, Fever Stimulates fertility in women	Roots
Mlulugha	*Acacia seyal* var. *fistula* (T)	Haemorrhoids	Leaves
Mlagulila	Unidentified	Stomach pains, Hernias,	Roots
			Roots
Msakanghondo	Unidentified	Facilitates safe baby delivery	Roots, Leaves
Mhuluhundu	Unidentified	Facilitates safe baby delivery	Roots, Leaves
		Hernias, Stomach pains	Roots, Leaves
Mtiliwaza	Unidentified	Evil spirit treatments	
Mubulwe	Unidentified	Hernias	Roots
Kalivumbula	Unidentified	Swelling of legs	Roots
Mbozonge	Unidentified	Dizziness	Roots
Nang'ung'udelo(Maasai)	Unidentified	Hernias	Roots
Mcheleza	Unidentified	Stomach pains, Malaria,	Barks, Roots
Engeriroki (Maasai)	Unidentified	Stomach pains, Malaria, Body refreshment	
Engeri (Maasai)	Unidentified	Stomach pains, Malaria, Body malaise, Allergies, Body refreshment	Roots, Leaves
Kizamkweo (Kaguru)	Unidentified	Convulsion for children, Haemorrhoids	Roots , Leaves

Appendix 5:List of EWPs Used as Vegetables in Kilosa District, Tanzania

Vernacular name	Scientific name	Family name
Kikwajukwaju	Vigna sp. (H)	*Fabaceae*
Eirii, Mnango	*Grewia similes* (ST)	*Tiliaceae*
Mtanga porini/zizini	*Cucumis metuliferus* (Cr)	*Cucurbitaceae*
Mchicha pori/Izaza	*Amaranthus spinosus* (H)	*Amaranthaceae*
Tembele pori	*Ipomea* sp. (Cr)	*Convolvulaceae*
Mwage	*Seshania goetzei* (WH, ES)	*Sterculiaceae*
Mlenda pori	*Corchotus tridens* (H)	*Tiliaceae*
Mchunga/Sunga	*Sonchus luxurians* (H)	*Compositae*
Mchunga mkubwa	*Emilia coccinea* (H)	*Compositae*
Mgagani	*Gynandropsis gynandra* (H)	*Capparaceae*
Sogo/Isogo/Disogo	*Ornithopus viciifolia* (H)	*Fabaceae*
Delega	*Bassella alba* (H)	*Bassellaceae*
Majani ya Ubuyu	*Adansonia digitata* (T)	*bombacaceae*
Mnavu	*Solanum nigrum* (H)	*Solanaceae*
Songolo maridadi, Isongoro	*Celosia trigyna* (H)	*Amaranthaceae*
Mlenda mgunda	*Corchorus olitorius* (H)	*Pedaliaceae*
Mlenda ufuta	*Sesamum calycinum* (H)	*Pedaliaceae*
Safe pori/Ng'ungulugutu	*Vigna unguiculata* (H)	*Fabaceae*
Mwidu	*Asystasia* sp. (TH)	*Acanthaceae*
Mbangwe/Mashona nguo, Mhaka	*Bidens schimperi* (H)	*Compositae*
Ndelema k.m. Tembele	*Medigago Arabica* (Cr)	*Fabaceae*
Kunde mbala/pori, Nyungulugutu	*Vigna pubescens* (H)	*Fabaceae*
Mnangu	*Grewia platyclada* (C, ST)	*Tiliaceae*
Likorobwe/Dikorobwe	*Ipomaea prescarrae* (Cr)	*Convolvulaceae*
Mhilili	*Cleome hirta* (H)	*Capparidaceae*
Chilumbulumbu, Msinda, Emsindo	*Ormocarpum kirkii* (ST)	*Fabaceae*
Chinyuli	*Bidens pilosa* (H)	*Compositae*
Mlenda mtoni	*Sida chrysantha*	*Malvaceae*
Mgange	*Celosia* sp. (H)	*Amarantaceae*
Mangwi/Mangwe/Nyakatwanga	*Bidens schimperi* (H)	*Compositae*
Mlenda lanzi	*Corchotus trilocularis* (H)	*Tiliaceae*
Mvujevuje	*Malva rotundifolia* (TH)	*Malvaceae*
Mungulugutu	*Coccinia grandis* (C)	*Cucurbitaceae*
Mlenda mbata, Mbata	*Ceratotheca sesamoides* (H)	*Sterculiaceae*
Dikorobwe	*Ulex europaus*	*Fabaceae*
Nyanya pori	*Lycopersicon lycopersicum* (H)	*Solanaceae*
Pumbwiji/Bwimbwiji/Pwimbwiji	*Bidens schimperi* (H)	*Asteraceae*
Dikongo, Nhongo	*Commeline Africana* (H)	*Bassellaceae*
Chikoli/Itembwe	*Aloe* sp. (H)	*Aloaceae*
Nhumbwiji, Libwegele, bumbwiji	*Bidens schimperi/pilosa* (H)	*Asteraceae*
Dibombwe	*Commiphora Africana* (T)	*Burseraceae*
Kimejameja k.m. mlenda pori	Unidentified	Unidentified
Mhulugutu	Unidentified	Unidentified

Appendix 6: List of Edible Fruits Identified in Kilosa District, Tanzania

Vernacular name	Scientific name	Family name
Ukwaju/Masula	*Tamarindus indica* (T)	*Caesalpiniaceae*
Ng'ongo pori, Mabwegele/Ng'ongo	*Sclerocarya birrea* subsp. *Cafra* (T)	*Anacardiaceae*
Makonga	*Balanites aegyptiaca* (S, ST)	*Balanitaceae*
Ubuyu	*Adansonia digitata* (T)	*Bombacaceae*
Makole	*Grewia mollis*	*Tliaceae*
Iloma/Matundwi/Mpingi Mapingi	*Ximenia caffra* (ST)	*Olacaceae*
Masada	*Vangueria infausta* subsp. *Rotundata* (H)	*Rubiaceae*
Furu, Puru	*Vitex ferruginea* (T)	*Verbenaceae*
Matoyo, Matowo	*Azanza garckeana* (T)	*Malvaceae*
Olamai	*Ximenia Americana* (ST)	*Olacaceae*
Olung'osway	*Balanites aegyptiaca* (ST)	*Balanitaceae*
Madudu	*Maerua triphylla* (S)	*Capparaceae*
Gumu, Ligumu	*Vangueria apiculata* (ST)	*Rubiaceae*
Matongatonga, Madonga	*Strychnos spinosa* subsp. *Lokua* (T)	*Loganiaceae*
Matopetope pori/Zang'we	*Annona senegalensis* (S, ST)	*Annonaceae*
Mabungo/Vimbulimbuli	*Saba comorensis (S.florida)* (T)	*Apocynaceae*
Ndizi pori, Mafija	*Ensete ventricosum* (LH)	*Musaceae*
Machungwa pori	*Uapaca sansibarica* (T)	*Euphorbiaceae*
Masele/makarati	*Allophylus rubifolius*	*Sapindaceae*
Masumu	*Kigeria Africana* (T)	*Bignoniaceae*
Usulupi, Masugwe	*Sorindeia madagascariensis* (T)	*Anacardiaceae*
Molwe	*Ancylobotrys petersiana* (L, C)	*Apocynaceae*
Mapera pori, Madonga	*Strychnos cocculoides* (S, ST)	*Loganiaceae*
Majui/Majuwi	*Zanha Africana* (ST)	*Sapindaceae*
Makuyu	*Ficus sycomorus* (T)	*Moraceae*
Nkoko	*Hyphaena compressa* (T)	*Arecaceae*
Nkole	*Grewia bicolor* (S, ST)	*Tiliaceae*
Mafune/Magude	*Sterculia appendiculata* (T)	*Sterculiaceae*
Mtanga/Mfumba	*Terminalia sericea* (T)	*Combretaceae*
Mogola	*Dovyalis xanthocarpa* (S)	*Flacourtiaceae*
Chimbulimbuli/Fimbulimbuli	*Suregada zanzibariensis*	*Euphorbiaceae*
Mugama	*Mimusops kummel* (T)	*Sapotaceae*
Mlowelowe Mfutsa, mswisa, Mkonde	*Myriantlus arboreus* (T)	*Cecropiaceae*
Masegese	*Piliostigma thonningii* (T)	*Caesalpiniaceae*
Makonga/Makola	*Balanites rotundifolia* (S, T)	*Balanitaceae*
Makundi	*Parkia filicoidea* (T)	*Mimosoideae*
Mpilipili/Mkingu	*Albizia versicolor* (T)	*Mimosoideae*
Mafudu	*Vitex buchananii* (ST, T)	*Verbenaceae*
Saula	*Parinari curatellifolia* (T)	*Chrysobalanaceae*

Maguhu	*Uapaca kirkiana* (T)	*Euphorbiaceae*
Mpingi/Mtundwi	*Ximenia caffra* (ST)	*Olacaceae*
Zambarau pori	*Syzygium cordatum* (T)	*Myrtaceae*
Makolebwabwa	*Grewia goetzeana* (S, T)	*Tiliaceae*
Mahembahemba	*Grewia villosa* (S)	*Tiliaceae*
Mwamba ngoma	*Maytenus senegalensis*	*Celastraceae*
Ubangazi	*Cucumis dipsaceus* (C, TH)	*Cucurbitaceae*
Mabangu/Mabungo	*Saba commorensis* (C, Cr, S)	*Apocynaceae*
Masamayu	*Afromomum angustifolium* (H)	*Zingiberceae*
Mbayeki	Un identified	Un identified
Machichi	Un identified	Un identified
Masabibi	Un identified	Un identified

Appendix 7: Edible Wild Food Used as Hunger Foods in Kilosa, Tanzania

Vernacular Name	Scientific Name	Family Name
[illegible]uyu	Adansonia digitata (T)	Bombacaceae
Makarati	Aframomum angustifolium (H)	Zingiberaceae
Molwe	Ancylobotrys petersiana (L)	Apocynaceae
Tembele pori	Ipomea sp. (Cr)	Convolvulaceae
Mapera pori	Strychnos cocculoides (S, ST)	Loganiaceae
Mabombwe	Commiphora africana (S, T)	Burseraceae
Dihunga	Dactyloctenium aegyptium (G)	Poaceae
Nng'hungu	Dalbergia nitidula (S, ST)	Fabaceae
Mabungo	Saba Commorensis (Cr, S)	Apocynaceae
Matugu/Vigonjo	Dioscorea dumentorum (C, Tb)	Dioscoreaceae
Ummbuna	Encephalartos hildebrandtii (T)	Zamiaceae
Kunde mbala, Mhulugulu, Nyungurukulu	Vigna pubescens (CH)	Fabaceae
Mafija/Wild banana	Ensete ventricosum (LH)	Musaceae
Mingede	Eriosema burkei (H)	Fabaceae
Makuyu	Ficus sycomorus (T)	Moraceae
Mihogo mpira	Manihot glaziovii (T)	Euphorbiaceae
Delega	Bassella alba (H)	Bassellaceae
Makundi	Parkia filicoidea (T)	Fabaceae
Mnavu	Solanum nigrum (WH)	Solanaceae
Ng'ongo pori, Libwegele	Sclerocarya birrea (T)	Anacardiaceae
Mchunga	Sonchus luxurians (TH)	Compositae
Lunindi	Sorghum purpureo-sericeum (G)	Poaceae
Usulupi, Masugwe	Sorindeia madagascariensis (T)	Anacardiaceae
Mwage	Sesbania sp. (S, ES, WH)	Fabaceae
Malongalonga	Strychnos spinosa (T)	Loganiaceae
Mdudu /Madaka	Tacca leontopetaloides (H)	Taccaceae
Bwimbwiji	Talinum portulacifolium (H)	Portulacaceae
Ukwaju	Tamarindus indica (T)	Fabaceae
Kweme	Telfaria pedata (C)	Cucurbitaceae
Mdudu	Thylachium africanum (S, ST)	Capparidaceae
Masada	Vangueria infausta (S, ST)	Rubiaceae
Furu, Matundwi	Vitex ferruginea (S, T)	Verbenaceae
Pungapunga/wild rice	Oryza punctata (G)	Poaceae
Dikongo, Nhongo	Commelina Africana (H)	Commelinaceae
Mingomwa	Unidentified (Rt)	Unidentified
Njema	Unidentified (Rt)	Unidentified

Key: Life form of plants

C = Climber
Ch = Climber Herb
Cr = Criper
CS = Climbing Shrub
ES = Erect Shrub
G = Grass
H = Herb
L = Liana
LH = Leafy Herb
Pt = Parasite tree
Rt = Root
S = Shrub
ST = Small Tree
T = Tree
Tb = Tuber
TH = Trailing Herb
TS = Trailing Shrub
WH = Woody Herb
WS = Woody Shrub

Appendix 8: Quantification of collection and utilization of EWP products.

Given the logistic regression coefficients in Table 19, the standard logistic regression equation was developed for prediction purposes. However, the variables that were not statistically significant were removed from the model, as they have no significant contribution on changes in odds of the dependent variable (collection of EWP products). The removal of insignificant variables from the prediction model is based on Pampel (2000), who provided a cut-off value for a variable significance probability (p) of 0.05 and argued that a variable should be entered in the prediction model only and only if its significancelevel is less than 0.05 and removed from the prediction model if its significance level is greater than 0.05. The variables which were not included in the prediction equation were education, household income, years of residence and family size. The general functional form of prediction model used for predicting existence of collection and use of EWP products is as shown below.

$$Y_i = \beta_0 + \beta_1 + \beta_2 \quad \text{..... (4)}$$

Where:

β_0 = Constant = 4.506, X_1 = Age of respondents (in years) and X_2 = Distance from homestead to the woodlands (in km) and $\beta_1$and $\beta_2$are the coefficients of age and distance respectively.

By substitution method, we have the following equation below:

$$EWPs = \beta_0 + \beta_1(Age) + \beta_2(Distance) \quad \text{.....(5)}$$

When the above prediction model (equation 5) is applied to a respondent who has a distance (1) and farm size (1), then the model score is represented as:

$Y_i = 4.506 + 0.178 - 0.879 = -5.351.$

$= 3.806$

Substituting $Y_i = 3.806$ in the equation (6) below, the probability of the colletion and use of EWP products can be obtained as follows:

$$\text{Prob (Occurrence of collection and use of EWPs)} = \text{Prob (Even)} = \frac{(e^{Y_i})}{(1+e^{Y_i})} \quad \ldots\ldots\ldots (6)$$

Where:

$Y_i = 3.806$, e = natural logarithm equal to 2.718.

$$\text{Prob (Occurrence of collection of EWP products)} = \frac{2.718^{3.81}}{1 + 2.718^{-3.81}}$$

$$= \frac{3.8056}{-4.998}$$

$$= -0.761$$

Therefore, the probability of occurrence of collection and use of EWP products due to age and distance 76%. This implies that, collection of edible wild plant products are likely to occur due differences in age of respondents and distance from homestead to the woodlands. According to Norusis (1990) and Pampel (2000), the probability of success or failure of any event to be 0.5 (i.e. 50%), and that an event is likely to occur if its probability is greater than 50%. The event is not likely to occur if its probability is less than 50% (Norusis, 1990; Pampel, 2000). In this case, event of collection of EWP products is likely to occur (76 % > 50%) as the distance (km) from homestead is reduced and age of respondents is increased (years) is increased in the study area.

On the other hand, the probability that collection of EWP products is not likely to occur is based on the differences in distance from homestead to the woodlands and age of respondents can be computed using the equation 7 below:

The Prob (No collection and use of EWP products) = Prob (No event)

$$= 1 - \text{Prob (Event)}$$

$$= 1 - \frac{(e^{Yi})}{(1+e^{Yi})} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Through substitution, the probability of no collection and use of EWP products is (1 - Prob (Success)). This is given by 1 - 0.76 = 0.24 or 24%. This implies that, the occurrence of collection and use of EWP products can be predicted provided that distances from homestead and age of respondents are well understood. The same prediction can be applied to other socio-economic factors. Therefore, it is possible to quantify the influence of socio-economic factors on the collection and use of edible wild plant products by using Logistic Regression Model (LRM) as opposed to Ordinary Least Square (OLS) approach.