The role of indigenous fruit trees in the rural livelihoods: A case of the Mwekera area, Copperbelt province, Zambia.

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DECLARATION

I, Felix Kanungwe Kalaba, hereby declare that the work contained in this thesis is my own original work and has not previously in its entirety or in part been submitted at any university for a degree.

Signature Date

ABSTRACT

The utilization and commercialization of indigenous fruit trees has in the past been overlooked by extension agencies due to the misconception that they do not play a major role in contributing to the rural livelihoods. There is new and increasing emphasis on the contribution of non-timber forest products (NTFPs) on improving the livelihoods and sustainable management of forest ecosystems of the *Miombo* woodlands. This study was conducted around Mwekera area in the Copperbelt province, Zambia to determine the role of indigenous fruit trees in the rural livelihoods. A total of 70 households were interviewed in the survey using semi-structured questionnaires, in-depth open ended interviews and focus group meetings to collect information on the use of indigenous fruits.

The study revealed that 99% of the households experience 'hunger' during the rainy season from November to April every year. Ninety seven percent (97%) of the households collect indigenous fruit, with the most collected fruits being *Uapaca kirkiana* (74%), *Anisophyllea boehmii* (71%) and *Parinari curatellifolia* (67%). Additionally, there is very little selling of indigenous fruit (31%) but that *Uapaca kirkiana* and *Anisophyllea boehmii* account for 95% of the fruits sold. Forty six percent (46%) of the households process fruits of *U. kirkiana*, *A. boehmii* and *P. curatellifolia* into juice and/or porridge. Furthermore IFTs are also used as traditional medicine. Sixty three percent (63%) of the households used IFTs for medicinal purposes with two-thirds of the respondents citing *Anisophyllea boehmii* as an important medicinal tree species.
The study also showed that 85% of the respondents have seen a change in the forest cover resulting into loss of biodiversity with 70% of the respondents indicating that the change is with respect to reduction in forest size and scarcity of some species; and that charcoal production and clearance of land for cultivation are the major causes of the scarcity of indigenous fruit trees.

It is concluded that the major contribution of IFTs in the study area is in filling the gap during times of hunger rather as being a source of income through selling. Charcoal production and clearance for agriculture are the main contributing agents for the loss of biodiversity and scarcity of IFTs. It is recommended that domestication of IFTs and sustainable forestry and agricultural management practices be employed to ensure that future generations continue to benefit from the forest resource.

OPSOMMING

Die gebruik en kommersialisering van inheemse vrugtebome is in die verlede geïgnoreer deur voorligtingsorganisasies as gevolg van die misopvatting dat hulle nie ’n noemenswaardige rol speel in die lewensonderhoud van landelike bevolkings nie. Daar word ’n nuwe en groeiende klem geplaas op die bydrae van nie-hout bosprodukte in die verbetering van lewens en die volhoubare bestuur van bosekosisteme in die *Miombo* bosland. Hierdie studie was onderneem in die Mwekera area in die Koperbelt provinsie, Zambië met die doel om die rol van inheemse vrugtebome in die lewensonderhoud van landelike bevolkings te bepaal. Onderhoude is gevoer met ’n totaal van 70 huishoudings deur middel van semi-gestruktureerde vraelyste, in-diepte ongestruktureerde onderhoude en fokusgroepvergaderings om informasie in te samel oor die gebruik van inheemse vrugtebome.

Die studie het gevind dat 99% van die huishoudings “honger” ervaar gedurende die reënseisoen van November tot April elke jaar. Sewe –en negentig persent (97%) van die huishoudings samel inheemse vrugte in, waarvan die meeste *Uapaca kirkiana* (74%), *Anisophyllea boehmii* (71%) en *Parinari curatellifolia* (67%) is. Verder word baie min inheemse vrugte verkoop (31%), maar *Uapaca kirkiana* en *Anisophyllea boehmii* maak 95% van die verkoopte vrugte uit. Ses –en veertig persent (46%) van die huishoudings verwerk die vrugte van *U. kirkiana, A. boehmii* en *P. curatellifolia* na sap en pap. Inheemse vrugtebome word ook gebruik as tradisionele medisyne. Drie –en sestig persent (63%) van die huishoudings gebruik inheemse vrugtebome vir medisinale doeleindes met twee derdes van die respondente wat *Anisophyllea boehmii* noem as ’n belangrike medisinale boomsoort.

Die studie het ook gewys dat 85% van die respondente ’n verandering in die bosdekking opgemerk het wat tot verlies in biodiversiteit gelei het en 70% ’n verandering wat tot vermindering in bosgroote en skaarsheid van spesies gelei het; en dat houtskool produksie en ontbossing vir kultivering die hoofsaaklike redes is vir die skaarsheid van inheemse vrugtebome.

Die gevolgtrekking word gemaak dat die vernaamste bydrae van inheemse vrugtebome tot die studiearea is om as ’n voedingsbron te dien gedurende honger tye eerder as ’n inkomstebron deur verkope. Houtskoolproduksie en ontbossing vir landbou is die hoof bydraende faktore tot die verlies van biodiversiteit en skaarsheid van inheemse vrugtebome. Daar word voorgestel dat die kultivering van inheemse vrugtebome en volhoubare bosbou -en lanboubestuurspraktyke gebruik word om te verseker dat toekomstige geslagte steeds sal kan baat van die boshulpbronne.

DEDICATION

This thesis is dedicated to the greatest women I have ever known; my late mother Evelyn Katebe Makasa, and to all mothers in Africa, who though living under harsh economic conditions, strive to give their children a better future.

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Finally to the only immortal God my Saviour be glory, majesty, power and authority, through Jesus Christ my Lord, before all ages, now and forevermore! Amen

ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
CIFOR	Centre for International Forestry Research
CSO	Central Statistics Office
DFID	Department For International Development
GRZ	Government of the Republic of Zambia
FAO	Food and Agriculture Organisation
HIV	Human Immune Virus
IFTS	Indigenous Fruit Trees
NTFPs	Non Timber Forest Products
PFAP	Provincial Forestry Action Plan
PRA	Participatory Rural Appraisal
SNR	School of Natural Resources (Copperbelt University)
UNDP	United Nations Development programme
ZFAP	Zambia Forestry Action Plan
ZAFFICO	Zambia Forestry and Forest Industries Corporation

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CHAPTER ONE

INTRODUCTION

This chapter contextualizes the study. It starts with problem statement and focus, which presents the problem at hand, its relevance and importance, and discusses the main theoretical, practical and empirical reasons for conducting this study. It then unfolds the research objectives and the main question that the present study endeavours to answer, before concluding with a brief overview of the thesis structure.

1.1 Problem statement and focus

Shortage of food and poor nutrition are seen as two major problems facing contemporary Africa (FAO 2000; Moore and Vaughan 1987), with acute malnutrition, food insecurity and low income levels found especially among the rural and peri-urban populations of southern African countries (Akinnifesi *et al.* 2004). This is particularly true for Zambia, which has had one of the highest negative rates of economic growth over the last forty years, and is currently ranked as one of the least developed countries in the world. According to the Ministry of Finance and National Planning (2002), there has been an increase in overall poverty during the 1990's, and currently approximately 73% of the Zambian population may be characterized as poor. Life expectancy at birth has declined, while HIV/AIDS prevalence is estimated to be about 20 percent of the adult population aged 15 to 49 years (FAO 2005).

Zambia remains one of the world's poorest countries, despite being endowed with many natural resources. For instance, it is one of the most highly forested countries in Southern Africa. About 55% of its 752 600 square kilometres surface area is covered by forest, most of which is administered traditionally under customary law. Most people living in rural communities rely on the natural resources for survival. The growing population numbers and large proportions of the rural population suffering from food insecurity mean that more and more people are falling back on forest resources in order to survive (Ros-Tonen *et al.* 2005). There is a strong correlation between dependence on non-timber forest products (NTFPs) and rural poverty (CIFOR 2003); NTFPs provide important livelihood contributions to people with limited or no alternatives. Some

serve subsistence needs, others have important gap filling or safety net functions and a few provide regular, important cash income (CIFOR 2003).

Zambia has a large pool of indigenous fruit resources (Kwesinga and Mwanza 1995, Storrs 1979, Hans *et al.* 1978). This is particularly true for the Copperbelt province: 90% of its vegetation is covered by *miombo* woodlands, which - despite the semi-arid conditions in which the *miombo* is found - have been reported to be rich (in terms of both diversity and quantity) in indigenous fruit trees, or IFTs (Maghembe *et al.* 1994; Campbell 1987). Their open and sparse woodlands also contain a wealth of other renewable resources, such as timber poles and fuel wood, as well as non-timber forest products (NTFP), such as beeswax, honey, mushroom, and edible caterpillars. Thus, it may be argued that the majority of the rural population in the Copperbelt province lives in the vicinity of apparently abundant indigenous forest resources.

In this province, the establishment of large-scale mining and metallurgical facilities in the 1930s resulted in a substantial and sustained influx of job seekers to the region, which previously had been sparsely populated. The decline of the copper industry, previously the major income generator in the area, has had serious social and economic repercussions for the local people. For example, between 1975 and 1995 Zambia's per capita income fell by 60 percent due to the crisis of the metal mining sector. It is therefore not surprising that the Copperbelt province currently represents the largest share of the poor (18%) and extremely poor (15%) in Zambia (Ministry of Finance and National Planning 2002). Due to an increase in the rate of unemployment, some people in this province have opted to move from the townships to rural areas in search of land for cultivation and natural resources with which to earn a living. These rural people's livelihood is therefore dependant on natural resources, which exacerbates pressures on these resources. As people try to escape the trap of poverty through use of forest resources, their unsustainable usage may lead to over-exploitation of the resources and forest degradation. This may culminate in deforestation, which eventually leads to loss of biodiversity of both flora and fauna.

In the past, the utility and commercial value of indigenous fruit has been overlooked by extension agencies at the expense of exotic species that are over-promoted (Kwesiga and Mwanza 1995). Research on the indigenous fruit trees (IFTs) of Zambia, aimed at conserving the genetic diversity of indigenous fruits, was initiated in 1976 through the Zambia National Institute for

Scientific and Industrial Research (NISIR). The emphasis was on conservation of genetic diversity of IFTs through genetic improvement of their reproductive biology, and to conduct laboratory studies aimed at quantifying the chemical composition of the fruits[1]. Research on IFTS has also been undertaken by other research organizations in southern Africa, such as the World Agroforestry Centre (Ambe and Malaisse 2001; Buwalda *et al.* 1997).

However, the role of IFTs in rural livelihoods has not been extensively researched. This may be because most research organizations view IFTs within a larger context of multipurpose trees within agroforestry systems, hence specific attention has been focused on their domestication interaction with other crops in agroforestry systems (Ambe and Malaisse 2001). Packham (1993) highlighted that, although there is growing understanding of the importance of wild fruits and other non–timber forest products in the diet of rural households, there is little knowledge about their importance in sustaining households through financial and nutritional stresses. Muok *et al.* (2001) echoed similar sentiments, as he noted that, although the potential role of IFTs in providing food security in arid and semi-arid areas has been identified, little information is available on communities' actual use, management and preferences in this regard. Information on the role of indigenous fruit in the livelihoods of the rural communities in Zambia, and in the Copperbelt province specifically, is scanty. The research reported in this thesis is aimed at addressing this gap in the literature, by seeking to explore the livelihoods of the rural communities, with the specific aim of documenting the role that IFTs play in their livelihoods.

1.2 Objectives and major research questions

The general objective of this study is to determine the role of IFTs in the livelihoods of the rural communities in Mwekera area, Copperbelt province of Zambia, in order to generate information on the use and management of IFTs by these communities. This is done with the aim of establishing the importance of IFTs to their livelihoods. The specific research questions the study seeks to answer are as follows:

1. What IFT species are available in the study area?

[1] Unfortunately, research at NISIR has been curtailed due to lack of funding and personnel (Kwesinga and Mwanza 1995).

2. What is the main role or significance of IFTs in the livelihood of the rural communities in the study area? Does the importance of IFTs in the livelihood of the rural communities in the study area vary seasonally and/or according to type of IFT species available?
3. How do the rural communities in the study area harvest and utilise IFTs?
    i. Harvesting methods currently practiced

    ii. Utilisation
        a) *What is the level and type (subsistence or commercial) of utilisation?*
        b) *What factors (e.g., age, gender and season) affect level and type of utilisation?*
        c) *What is the nature of existing markets for IFTs?*

4. Have the people in the study area observed woodland degradation? If so
    i. What are the causes of woodland loss?
    ii. How has it affected the availability of IFTs in the study area?

1.3 Thesis structure

This thesis is divided into five chapters: the introduction to the study is covered in chapter 1, while chapter 2 contains the literature review and theoretical framework that gave genesis to this study. The geography of the study area, research design and methodology are presented in chapter 3, while results presentations are dealt with in chapter 4. The findings are then discussed in chapter 5, while chapter 6 comprises the conclusions and recommendations that flow from the study.

CHAPTER TWO

LITERATURE REVIEW

This following chapter presents the literature that forms the first phase of this study. The chapter commences with an exposition of rural livelihoods and food security, so as to develop an understanding of the socio-economics of rural households. This is followed by a description of the Miombo woodland and the products and services that the woodland provides to the rural people. The focus of the chapter then narrows down to reviewing various studies on indigenous fruit trees (IFTs), which consider the importance of these fruit trees to livelihoods and the nutritional properties of the fruits. Existing literature on the trading, harvesting, and commercialisation and domestication of IFTs is then reviewed. The chapter concludes with a brief review of literature on deforestation and land tenure in Zambia.

2.1 Rural Livelihoods and food security

The concept of rural livelihoods development has attracted widespread attention from development agencies and analysts during recent years. Chambers and Conway (1992) define livelihood as the capabilities, assets and activities required for a means of living. The concept of livelihood is not one-dimensional: according to Campbell *et al.* (2002), households use a variety of inputs in their production processes as they attempt to meet and extend their livelihood needs. These can be classified as human, financial, physical, natural and social capital. 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 (DFID 1999). Sustainability is a function of how assets and capabilities are utilized, maintained and enhanced, so as to preserve livelihoods (DFID 1999).

Most of the rural people in southern and eastern Africa are food insecure and chronically malnourished (Tiisekwa *et al.* 2004), and households have been reported to experience food shortages. A rural household survey by Akinnifesi *et al.* (2004) reported that 60-85% of the rural households in Malawi, Zambia and Mozambique lacked access to food for three to four months per year, and 26-50% of these households had relied on indigenous fruit for sustenance during this period. In another study in selected rural communities in Zambia, Nkomeshya (1998) writes

that rural people experience low food reserves in their households between December and February. This period is thus referred to as the 'hunger period'. The households face food insecurity, and poverty is the major factor hampering development in rural areas (Mithöfer and Waibel, 2003). Rural people therefore use various products from their environment in order to sustain their livelihood. Scherr (1995) stressed that rural households' survival strategies encompass multiple objectives in maximization of utility, like provision of food and subsistence goods, cash for purchase of goods and services and saving for future needs. Households therefore depend on various activities to sustain their livelihoods. They choose a combination of activities that contribute most towards their multiple objectives and yields greatest utility (Mithöfer and Waibel, 2003).

2.2 The Miombo woodlands

The Miombo is a term used to describe woodlands that have floristic richness dominated by the genera *Brachystegia*, *Julbernadia* and *Isoberlinia,* forming the natural woodland habitat in central, southern and east Africa (Campbell *et al*. 1996). Miombo woodlands are the most extensive vegetation type in the Zambezian phytoregion (White 1983; Chidumayo 1997), covering an area of about 3.8 million km^2 on the central African plateau. It is estimated that the Miombo cover 270 million hectares (Mellington *et al.* 1986, cited in Chidumayo 1997). These woodlands extend through parts of Angola, the Democratic Republic of Congo (former Zaire), Malawi, Mozambique, Tanzania, Zimbabwe and Zambia. The natural range of the woodlands is 5^o to 25^o South of the equator (Figure 1).

The climate in the Miombo region is characterized by an alternation of dry and wet seasons, with an average annual rainfall of 600mm-1500mm distributed between November and March (Chidumayo 1997). The Miombo are classified into wet and dry Miombo, depending on the annual rainfall of more or less 1000mm, respectively (White 1983).

The Miombo region is extremely rich in plant species: it has an estimated 8500 species of higher plants, of which more than 54% are endemic (Rodgers *et al.* 1996). Zambia has the highest diversity of trees, and is the centre of endemism for *Brachystegia*, with 17 species (Rodgers *et al*. 1996). The Miombo woodlands exhibit a number of features that distinguish them from other

tropical woodlands. According to Chidumayo (1997), the Miombo trees are frost sensitive and do not tolerate an absolute minimum temperature of less than -4^{o}C. This may be the significant factor that limits the northern and southern distribution of the Miombo. The soils in the Miombo are generally poor in nutrients (Storrs 1979; Chidumayo 1997) and differences exist in the nitrogen-fixing capacity of the canopy and under-storey species, with under-storey species possessing greater nitrogen-fixing ability (Frost 1996).

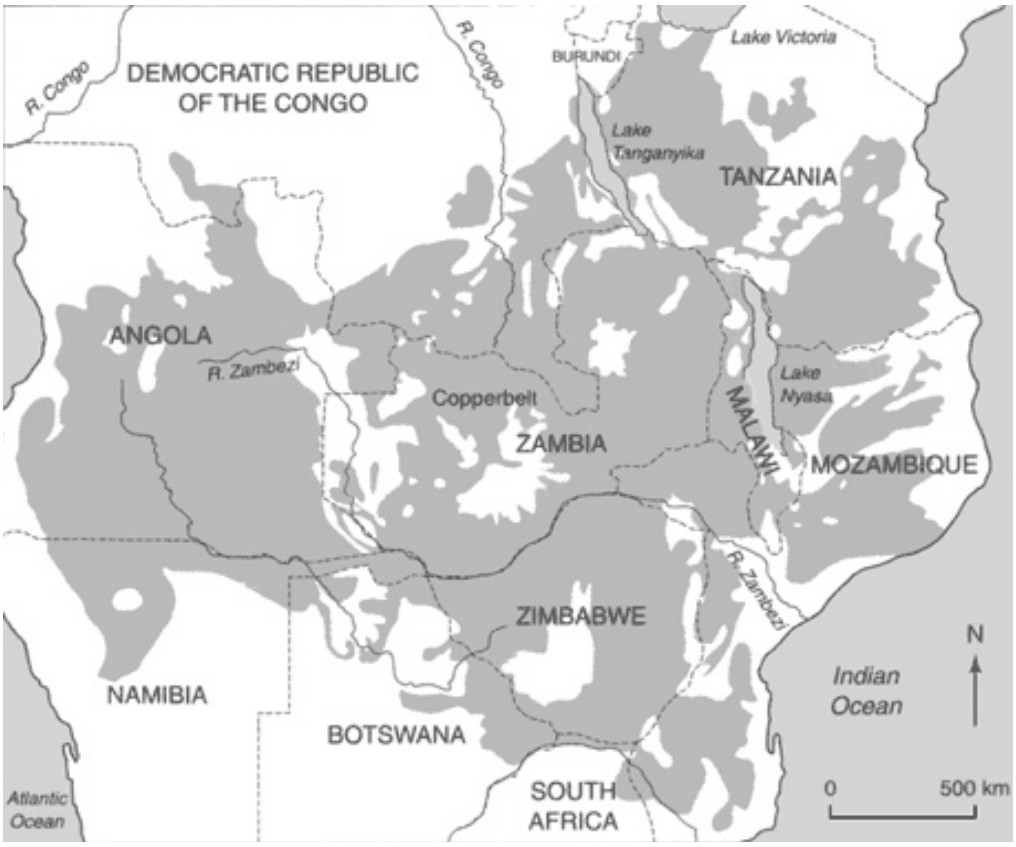

Figure 1: The distribution of the Miombo woodland

Source: Malmer (2007)

In Zambia, the Miombo is the most extensive woodland. It has a high degree of floral richness with richness in evergreen trees, and accounts for 58.3 % of the total forest area of Zambia (Njovu 2006). The other woodlands in the country are Kalahari, Mopane, and Munga woodlands. In the Copperbelt province, the Miombo accounts for about 90% of the woodland in the province (PFAP 1998; Njovu *et al.* 2004).

The Miombo woodlands are home to approximately 40 million people, and its products are very important in sustaining the livelihoods and fulfilling the basic needs of an additional 15 million urban Africans (Campbell *et al.* 1996). Throughout the Miombo region, the woodlands provide many products and services essential to the livelihoods of the rural communities (Clarke *et al.* 1996), with some products providing for basic needs, such as food, shelter and medicine. The products that are supplied by the Miombo include: energy in the form of firewood and charcoal (Dewees 1994; Clarke *et al.* 1996), poles and construction material (Mbwambo 2000), timber, mushrooms (Pegler and Pearce 1980), medicine, leaf litter, tannins, dyes, oils resins, and indigenous fruit (PFAP 1998). Forests form an integral part of essential subsistence and commercial goods for rural livelihoods. Leakey (1999) observed that forests play important roles in alleviating poverty in the tropics. The common products and services provided by the Miombo are as follows:

2.2.1 Poles and construction material

The supply of construction material is a vital role of the Miombo (Clarke *et al.* 1996). Poles of varying dimensions and durability are used in constructing houses and barns. Rope fibre, which is made by peeling strips from beneath the bark, is used to tie the poles together; the fibre must be strong, long and easily separated from the tree stem and the bark (Clarke *et al.* 1996). Grass is used for thatching, and must be replaced at frequent intervals (Grundy *et al.* 1993).

2.2.2 Firewood

Firewood is the main source of energy in the rural areas. Women are the principal collectors and consumers of firewood for domestic use, and are highly selective in the species utilised (Clarke *et al.* 1996). The characteristics of the favoured species include a hot flame, and burning with little smoke (Lowore *et al.* 1995). The smaller pieces of firewood that catch fire

easily are used for kindling, while larger logs are used for preparing food. The collection of dead wood reduces the amount of dead wood debris in the woodland (Chidumayo 1997)

2.2.3 Household implements and curios

Domestic implements, such as axes, handles and cooking sticks, are mainly made from wood. Curios fashioned from wood are an important source of foreign exchange (Mbwambo 2002; Clarke *et al.* 1996).The Miombo woodlands is a source of traditional household goods such as mats, baskets, and brooms (Lowore 2006).

2.2.4 Medicine

It has been reported by Mander and Le Breton (2006) that 80% of the world's population mostly from developing countries rely on traditional medical for primary health care. The roots, barks and leaves of many different species are used in such healthcare, both as medicine and for magic (Coote *et al.* 1993). Plants are used in combination for the self-treatment of diseases, such as coughs, headaches, sores and diarrhoea, and the local people are knowledgeable of the plants that can be used and how to prepare them (Clarke *et al.* 1996).

2.2.5 Spiritual and cultural value

The Miombo woodlands are important in sustaining the spiritual and cultural life of indigenous people. Religious beliefs that natural resources are guarded by the spirits of the ancestors are prevalent among the indigenous people in the Miombo woodland (Clarke *et al.* 1996). Therefore, a variety of rules and taboos exist that govern the use of resources. These rules must be obeyed, or misfortune and disaster are said to result (Clarke *et al.* 1996).

2.2.6 Fodder

Forests are excellent sources of animal feeds. Fodder from the trees provides the much needed carbohydrates to livestock even in the dry season, when very limited fodder is available. Farmers have knowledge on the various indigenous tree species that are used for fodder (Rootheart *et al.* 1997).

2.3 Importance of IFTs in rural livelihoods

Indigenous fruit are an important component of rural people's basket of natural resources. In the Southern Africa Development Community (SADC), the fruits are important, mostly among the marginalize groups in society (Akinnifessi *et al*. 2006). Indigenous fruit contribute on average 42% to the natural food basket that rural households rely on in southern Africa (Akinnifesi *et al*. 2006; Campbell *et al*. 1997). Various researchers have reported more than 50 species of IFTs from the Miombo woodland as important sources of food reserves for rural people in the SADC during periods of food shortages (Ramadhani *et al*. 1998; Kadzere *et al*. 2004; Saka *et al*. 2004)

Various studies in Africa have also stressed the importance of edible wild plants in the diet of rural people (Muok *et al.* 2001; Maghembe 1995; Leakey 1994). Research that has been conducted on the role of IFTs in rural livelihoods has found that indigenous fruits help to provide food security (Muok *et al.* 2001; Maghembe *et al*. 1994; FAO 1983; Fashawe 1972), as they are used as a food supplement. According to Fanshawe (1972), the local people in Zambia use IFTs as food supplements, fodder for livestock and medicine, and that these uses date back to pre-colonial times. In a study in East Africa, the Food and Agriculture Organisation (FAO 1983) reports that indigenous fruits help provide food security to the rural people.

According to Maghembe (1995), IFTs are receiving attention from researchers due to their value in this regard. Research by Mateke *et al.* (1995) showed that rural populations in the eastern province of Zambia use indigenous fruit to supplement their diets in many different ways depending on the fruit, the part of the fruit being utilised, and/or the ethnic group of the users. It was found that fruits of *Adansonia digitata, Anisophyllea boehmii, Uapaca kirkiana, Strychnos cocculoides* are eaten fresh. Fruits of *Parinari curatellifolia, Strychnos innocua, Trichilia emetica and Ochna pulchra* are also consumed fresh, while their seeds contains oil which, when extracted, is used for cooking, cosmetics and lubrication. The seeds of some of the fruits may be eaten raw, roasted and boiled as famine food (Mateke *et al.* 1995). In India, a study by Manomohandas (2001) on *Garcinia cambogia Desr*, which is indigenous to the country, revealed that the fruit is sought after by most people because it can be eaten, employed as a food flavouring, for curing fish, and to treat rheumatism, bowel problems and mouth disease in cattle. The fruit was also found to coagulate rubber Latex and polish gold and silver.

Indigenous fruits are important in areas remote from urban centres, especially during times of famine (Campbell 1987; Coote *et al*. 1993). They provide an alternative source of nutrition, particularly for communities in arid and semi-arid areas, where crop failures are a regular occurrence and often result in the poor nutrition of the local people, who are mainly subsistence farmers (Muok *et al.* 2001). According to Fanshawe (1972), indigenous fruits are also used as fodder for livestock and as medicine, and many rural households in the Southern Africa Development Community (SADC) rely on IFTs as sources of cash income, which is generated from sale of fresh fruits and products from the processing of IFTs (Akinnifessi *et al* 2006).

2.3.1 Nutritional properties of indigenous fruits

Many edible indigenous fruits that grow in indigenous woodlands are nutritionally rich, and play a central role as sources of nutrients for humans. For example, Saka *et al.* (1989), while investigating the nutritional attributes of IFTs reported the fruits to be rich in sugars, essential vitamins, minerals, oils and proteins.

Various studies have further affirmed that edible indigenous fruits are nutritionally rich and are sources of minerals and nutrients for humans (Muok *et al.* 2001; FAO 1983; Fashawe 1972). Wild fruit contribute greatly to diet quality, rather than quantity (Packham 1993). Saka (1995), who studied the chemical composition of edible fruits of wild plants in Malawi, discovered that *Adansonia digitata*, *Bauhimia thonningii* and *Vitex doniana* are excellent sources of calcium. Further, *Adansonia digitata*, *Bauhimia thonningii*, *Diospyros usambarensis* and *Vitex payos* were found to be excellent sources of vitamin D.

2.3.2 Trading of indigenous fruit as a source of income

Indigenous fruits are traded by households to earn income which is used for various purposes. According to Schomburg *et al*. (2002), indigenous fruits sold at local and urban markets yield substantial household incomes. Kaaria (1998) reported the trading of fresh fruit in Malawi and Ramadhani (2002) the same in Zimbabwe. According to Ramadhani (2002), there is no clearly defined or formal mechanism for the setting of indigenous fruit market prices. Producers assign prices based on information from people who have recently visited the market, from the previous season's prices, and from calculating harvesting costs. Retailers

and wholesalers reported that they determine fruit prices according to marketing costs and what their neighbours are charging.

2.4 Harvesting of indigenous fruit

Various methods of harvesting indigenous fruits have been reported, including picking fruits from the ground following abscission, climbing trees to pick fruits, throwing objects to dislodge fruits, hitting stems with heavy objects and shaking stems of branches to dislodge fruits (Kadzere *et al.* 2004). Shaking the trees to harvest ripe fruit may also dislodge immature and unripe fruits, and results in the cracking of fruit, as the fruit hits the ground hard (Kadzere *et al.* 2004). Methods such as throwing of objects to dislodge the fruit can also cause damage to trees and cause excessive bruising to the fruit, thereby reducing their shelf life and quality (Ham 2003).

According to Kadzere *et al* (2004), indigenous fruits are harvested both in their ripe and unripe states, depending on the demand for the fruit species. Fruits of *P. curatellifolia* were not harvested at an unripe stage, due to little competition and marketing of the fresh fruits. *U. kirkiana* fruits are often harvested at unripe stage for post-harvest ripening at home - a traditional technique called '*kupfimbika'* in the local Shona language.

Wild resources are subjected to over-harvesting and poor stewardship (Akinnifesi 2006). The harvesting of indigenous fruit using inappropriate methods causes fruit losses.
Wilson (2002, cited in Hughes and Haq 2003) estimated the post-harvest losses of fruits to be between 40-60%. In another study, Kordylas (1990) estimated post-harvest fruit loss to be between 5-25% in developed countries and 20-50% in developing countries.

2.5 Indigenous fruit processing

African people have practiced indigenous fruit processing for centuries (Ham 2003). To reduce fruit loss and maximize utility, fruits are processed into other products. According to Ngwira (1996), indigenous fruit grow and ripen within a very short period of the year, which leads to an overabundance of the fruit at the time when the supply usually exceeds the demand. Processing of fruit is therefore one way to utilize the excess fruit, but it may also be done to improve its palatability. Recently, Kadzere *et al.* (2004) identified a shortage of indigenous fruit associated with increased demand, and hence views fruit processing as a way of maximizing the utility of the available fruit.

In Zimbabwe, these researchers also reported that cleaning, grading, packaging, preserving, and processing were selectively used for maintaining the fruit quality of different species. Seventy-five percent of those utilizing *U. kirkiana* reported grading of fruits based on physical appearance and pest damage. In the Zambezi valley in Zimbabwe, 80% of the collectors of the indigenous fruit reported the processing of indigenous fruit, using processing techniques passed to them through generations (Kadzere *et al* 2004). Most IFTs are therefore important for both food security and as a source of income for rural communities. The fruits are processed into various products for both home consumption and for trade. In Malawi, Saka *et al* (2004) documents the different products that are processed from indigenous fruit (Table 1).

Table 1: Fruit utilization and processing fruit products in Malawi

Fruit product	Importance of fruit products	Fruit used
Sweet beer (‘*thobwa*’)	Food security	*Zizyphus mauritiana* *Parinari curatellifolia* *Anonna senegalensis*
Alcoholic beverages (‘*kachasu*’)	Income generation	*Uapaca kirkiana* *P.curatellifolia* *Strychnos cocculoides* *Z. mauritiana* *Strychnos spinosa*
Fresh	Food security	*P.curatellifolia* *Sclerocarya birrea* *S. cocculoides* *Z. mauritiana*
Juice	Food security	*P.curatellifolia* *Adansonia digitata* *Tamarndus indica* *U. kirkiana*
Yoghurt	Food security and income generation	*A. digitata*
Powder	Food security	*P.curatellifolia* *U. kirkiana*
Jam	Food security and income generation	*Fiscus indica* *P.curatellifolia* *U. kirkiana*
Porridge	Food security	*P.curatellifolia* *U. kirkiana*
Dried	Food security	*U. kirkiana* *Z. mauritiana* *P.curatellifolia*
Oil	Food security	*P.curatellifolia*
Nut extraction	Food security	*P.curatellifolia*

Source: Saka *et al* (2004)

Other authors (Nkanaunea *et al*. 2004; Ngwira 1996) have also reported the production of beverages and jams from *Uapaca kirkiana* and *Parinari curatellifolia*. Saka (1994) reported that in the lower shire valley in Malawi, the dominant fruit *Z. mauritiana* is sun-dried for three months and stored for future use. The dried product is brewed to produce a spirit known as *kachasu*. Seed kernels are roasted, pounded and added to cooking vegetables.

2.6 Commercialisation and domestication of IFTs

There has been growing recognition of the importance of IFTs in the livelihoods of the people in southern Africa. This is evidenced by various studies, conferences and workshops undertaken by various organizations such as the World Agroforestry Centre (ICRAF)[2] and Commercial Products from the Wild Consortium[3] (CP Wild) on the use, processing and domestication of IFTs. Domestication of natural resources involves the deliberate cultivation of indigenous species on tenured farmland (Taylor *et al.* 1996).

Historically, local people in some regions in Africa have planted and retained IFTs in their farmland. For instance, in southern Cameroon, fruit trees of *Dacryodes edulis* have been planted on farmlands, while trees of *Irvingia gabonensis* are also planted by farmers in south-eastern Nigeria. It has been reported by Leakey *et al*. (2004) that farmers have selected and planted these IFTs based on their large fruit size, as well as other characteristics, such as taste and yield. This kind of selective planting has resulted in the fruits of *Dacryodes edulis* trees on farms being 66% larger than those in the forest. Farmers in south-eastern Nigeria have achieved similar successes with *Irvingia gabonensis* fruits, which are 44% larger on farm trees than on forest trees.

It has been widely accepted by researchers that prioritization is the first step towards domestication, therefore the preference of the indigenous people must be taken into consideration. In southern Africa, ethno-botanical surveys have been conducted by various researchers to ascertain the priority species in the region (Kwesiga and Chisumpa 1992; Minae *et al*. 1995; Franzel *et al.* 1996). The Current ICRAF domestication initiatives are focused on *Zizyphus mauritiana*, *Parinari curatellifolia*, *Strychnos cocculoides*, *Uapaca*

[2] http://www.icrafsa.org/
[3] http://www.cpwild.co.za/

kirkiana,Sclerocarya birrea, Adansonia digitata, Vangueria anfausta, Syzigium cordatum and *Vitex* Species (Maghembe *et al.* 1995; Akinnifesi *et al.* 2004; Akinnifesi *et al* 2006).

The global strategy developed by ICRAF and its partners views domestication as a farmer-led and market-driven process. The trees utilized are those that are important in meeting the needs of farmers, product markets and the environment (Saka *et al* 2004; Akinnifesi *et al* 2006). The top four priority trees that have been identified through the tree domestication programme of ICRAF in southern Africa are *U. kirkiana, S. cocculoides, P. curatellifolia* and *S. birrea.* In promoting the domestication of these IFTs, ICRAF has considered the forestry and the horticulture-based approaches (Akinnifesi *et al* 2006). The forestry approach depends on sexual propagation and the selection of breeding population and progenies, while on the other hand, the horticulture approach is dependent on vegetative or asexual propagation of the superior varieties of preferred species.

Domestication and on-farm cultivation IFTs is one way of ensuring reliable supplies of non-timber forest products, while at the same time reducing harvesting pressures in the wild (Leakey and Izac 1996), thereby reducing resource depletion. Tree inclusion in production systems also fulfils the function of reducing the risks inherent in monocultures of staple food crops, such as susceptibility to pests and diseases and soil nutrient depletion (Hughes and Haq 2003). Also, when trees are integrated with crops, radial growth of the tree roots can loosen the top soil and hence improve porosity in the subsoil (Sanchez and Leakey 1997).

According to Leakey and Simons (1998), the integration of various agroforestry practices into the landscape forms various niches in the ecosystem, thus making the system ecologically stable and biologically diverse. These niches, if filled with indigenous species that provide important environmental services or economically viable products traditionally obtained from the natural forests, can result in land-use that is both sustainable and productive. Increasing the quality, number and diversity of domesticated trees that provide a wide range of non-wood forest products to fill the niches should contribute to poverty alleviation and mitigate deforestation and land depletion (Leakey and Simons 1998).

2.7 Indigenous versus exotic fruit

The tropical climate conditions in Zambia provide opportunities for the cultivation of various exotic fruit species, such as mango, bananas, guava, loquat, avocado, apple, grapes, pineapple

and peach (Mingochi 1998). Mateke *et al* (1995) identified the introduction of exotic fruit trees, such as Mango (*Mangifera indica),* Guava *(Psidium guajava)* Paw paw (*Carica papaya)* and various citrus species as a hindrance to the improvement of IFTs in Zambia. This is because there more information has been documented on propagation methods, production packaging and major diseases and pests of exotic fruits as opposed to indigenous fruits. He observes that more focus is placed on research on exotic fruits than on indigenous fruits.

Akinnifesi *et al* (2006) attributes the lack of research on IFTs to the perception that people have of IFTs, i.e., that they are abundant, slow growing and inappropriate for cultivation. This perception has been aggravated by a limited understanding of the natural variability, reproductive biology and propagation of IFTs, as well as by a lack of techniques for cultivating and adding value to IFTs. Moreover, according to Opeke (1982), exotic fruit, like citrus, are water-based and therefore an adequate supply of moisture, especially during fruit development, is very important. Citrus fruit tend to be small under dry or semi-dry conditions. This is in agreement with Maghembe (1995), who explains that exotic fruits in rural areas are of inferior quality, due to poor management practices, such as lack of pest and disease control.

2.8 Deforestation in the Copperbelt province of Zambia

There is growing concern about deforestation in the tropics, with an annual global loss in forested land of 15.5million hectares (1980-1990) and 13.7 million hectares (1990-1995) in the developing countries (FAO, 1997). Future demand for timber, wood and other forest products is increasing as the world population increases. The high rates of deforestation in the Miombo poses a threat to the fruit trees in the wild. For example, Hyde and Seve (1993) reported the *U. kirkiana* tree to be under threat of extinction, because of high rates of deforestation in the Miombo.

The major forestry problems in the Copperbelt have been identified by the Provincial Forestry Action Plan (PFAP 1998) as deforestation and encroachment of forest by humans, with the main underlying causes of deforestation, being: land clearing for agriculture and for the settlement of migrants, and tree cutting to supply fuelwood for domestic and industrial use.
In Zambia, the Copperbelt woodlands are being depleted at a 5% rate annually, and much of this stems from the unsustainable harvesting of wood for charcoal production (PFAP, 1998).

For example, close to 50 000 hectares of forests that are well-stocked in trees are cleared for charcoal production in Kitwe alone (PFAP, 1998). It is estimates that close to 34.6% (772,100 ha) of open forests in the Copperbelt province is degraded (PFAP 1998). Chidumayo (1979) reported that during the late 1970s, the two major causes of woodland loss in Zambia were agriculture and fuel wood, and this is expected to still prevail today. In Zambia, it is estimated that charcoal production provides full time employment to 41 000 people in rural areas, while an addition of another 4500 are employed in charcoal transportation, marketing and distribution. (Ministry of Environment and Natural Resources 1997a) It has been estimated that, as a result of unsustainable harvesting, 30% of the Copperbelt province's population is experiencing fuel wood shortages (Zambia Forestry Action Plan 1995). Appendix 1 shows the status in terms of deforestation of indigenous forest in the Copperbelt.

2.9 The role of land and tree tenure

Tree and woodland utilisation is significantly affected by land tenure rights (Campbell *et al*. 1993). Land tenure influences sustainability of woodland resources (Dewees 1999), as people can only manage trees on land over which they have secure property rights (Bruce and Fortmann, 1992).

According to the Zambia Land Act of 1995, ownership of all land and natural resources in the country is vested in the Republican President, who administers it on behalf of the nationals. All trees are therefore in a sense "owned" by the Republican President on behalf of all Zambians (Forest Act Number 7, 1999). For administrative purposes, administrative powers relating to land and natural resources have been delegated to various institutions. Consequently, forests are administered on behalf of the President by either the traditional chiefs, or the Director of Forests.

Traditional land is administered by the chiefs who control its allocation to their subjects. Ownership is sustained through land utilization (cultivation) and may be inherited (Njovu 2006). Land, forest and wildlife resources in uncultivated areas are communally utilized (Ministry of Environment and Natural Resources 1997b). Forests on state land and in national parks are managed by government departments.

2.10 Chapter conclusions

This chapter has presented the importance of the Miombo woodland in providing various products to the rural people. It has been established that rural households are food insecure and rely on woodland products for basic needs in their livelihoods and also economic exploitation opportunities. Indigenous fruit trees are important in the livelihoods for household consumption. The fruits are nutritionally rich. The sale of indigenous fruit and their processed products such as alcoholic beverages, yoghurt and jams has also been highlighted. It is however unfortunate that there is very little information regarding IFTs use, processing and trade available for Zambia. In the next chapter, the general geography of Zambia will be discussed, which will then lead to explaining the methods that were used in this study.

CHAPTER THREE

STUDY AREA AND METHODOLOGY

This chapter is divided into two sections. The first section introduces the study area, while the second section explains the research design and methodology that was used in the study. In the first section, a country profile of Zambia's is presented, before discussing the Copperbelt province within in which the study was conducted. The first section concludes with a discussion of Mwekera, the study area itself. The second section explains the data collection methods that were used to investigate the research questions. Participatory rural appraisal and a household survey constituted the research designs that were used to collect empirical data. The section concludes with a discussion of the sampling strategy and the data collection and analysis instruments that were employed.

3.1 Overview of Zambia

Zambia is situated in southern Africa between latitudes 8° and 18° South and longitudes 22° and 34° East of the Greenwich meridian. It covers a total area of 752 614 km^2 and lies at an altitude of 1200 m above sea level. The country is landlocked and is surrounded by Angola, Botswana, the Democratic Republic of Congo, Malawi, Mozambique, Namibia, Tanzania and Zimbabwe (Figure 2).

Zambia experiences a typical sub-tropical climate comprising of three distinct seasons, namely the rain season from November to April, a dry cool season from May to July and a dry hot season from August to October. Temperatures range from 16 to 38°C, depending on the season, and night temperature can drop to as low as 4°C in some areas. The annual rainfall is higher in the northern parts (including the Copperbelt province) than in the southern parts of the country. The northern parts enjoy an average annual rainfall of 1 000 mm or more, while the southern parts have an average of 600 mm (Shitima 2005).

Figure 2: Geographical location of Zambia

Source: Shitima (2005)

3.1.1 Relief and drainage

Zambia lies at altitudes ranging from 900 to 1 500 m above sea level. The main river systems are the Zambezi, Luangwa, Chambeshi, Luapula and Kafue rivers. The Copperbelt province is the major watershed of the Kafue river, which drains southwards into the Zambezi. Therefore the province is a valuable ecosystem in terms of the regulation of the hydrological processes

of the country. Mweru, Mweru-wantipa and Bangweule are the three natural lakes in Zambia, while Kariba is the only man-made lake in the country (Shitima 2005).

3.1.2 Vegetation types of Zambia

Zambia's forest vegetation can be classified into three major categories: closed forests, open forests and grasslands (Njovu *et al.* 2004; Njovu 2006). The closed forests are comprised of *Cryptosepalum* evergreen, the decidous *Baikiaea* forests, *Marquesia, Parinari,* Riperian swamp and itigi, while the open forests (savannah woodlands) are dominated by the Miombo, followed by the Kalahari woodlands, Munga and Mopane woodlands. The last category comprises grasslands, which also encompasses wetlands and dambos

3.1.3 Forest resources

Zambia is a highly forested country in comparison to other countries in southern Africa. Its forest cover is estimated at 64 million hectares, covering about 55% of the total area of the country (PFAP 1998).

Forests have been disappearing drastically especially in the vicinity of large settlement areas. The Provincial Forestry Action Plan Work Plan identified over-dependence on wood fuel, which accounts for about 68% of Zambia's domestic energy consumption, as the main cause of forest degradation. Large tracts of forests are also cleared for agricultural purposes (PFAP, 1998). Natural forests have been neglected by the government, as evidenced by a lack of inventory. Large-scale forest inventories were last conducted in 1950s and 1960s.

3.2 The Copperbelt province

The Copperbelt province is situated in the northern part of Zambia, between latitudes 12^{o} 20' South and 13^{o} 50' South and longitudes 26^{o} 40' and 29^{o} 15' East. The province is bordered to the north by the Democratic Republic of Congo; to the west is the North-Western province, and to the south is the Central province of Zambia. The Copperbelt, as it is more commonly known, experiences high rainfall with high humidity during the rainy season, a cool dry season, and short hot season. Maximum daytime temperatures range from 15^{o}C in July to 37^{o}C in October. The average rainfall is estimated at 1 200 mm, usually ranging between 1 000 mm and 1 300 mm, but occasionally exceeding 1 500 mm (Njovu *et al.* 2004), thus making the province one of the areas with the highest level of precipitation in Zambia.

3.2.1 Population

According to the most recent Census (CSO 2000), the Copperbelt region has a population of 1 657 646, making it the highest populated province in Zambia. The average population density is 58.2 persons *per* square km. Table 2 shows the population distribution of the districts in the Copperbelt province, and compares the 1990 distribution (the last time a census was conducted before 2000) with that measured in 2000.

Table 2: Population distribution among districts in the Copperbelt province, 1990 & 2000

District	**Population**		**% share**
	1990	2000	
Chililabombwe	65 218	84 866	5.1
Chingola	168 999	177 445	10.7
Kalulushi	69 597	72 765	4.4
Mufulira	152 735	152 664	9.2
Kitwe	347 024	388 646	23.4
Luanshya	144 826	155 979	9.4
Lufwanyama	51 745	65 804	4.0
Masaiti	84 831	97 712	6.0
Mpongwe	38 718	67 972	4.1
Ndola	334 777	393 793	23.8
Total	1 458 459	1 657 646	100

Source: Central Statistics Office of Zambia, 2000

3.2.2 Forest estates in the Copperbelt province

The Copperbelt province covers approximately 31 014 km^2, representing 4.2% of the total land area of Zambia. The vegetation covering 90% of the Copperbelt's 518 111 ha forest area is single-storey, deciduous, closed-canopy woodland known as Miombo. This comprises a number of sub-types, depending on the dominant tree species. The major woodland regenerate freely from coppice and root suckers, and most of the woodland is comprised of re-growth (PFAP, 1998, Njovu *et al* 2004). The present forest estates, covering approximately 16.74% of the total area, are shown in Table 3, which also shows the forest area per district:

Table 3: The forest estates in the Copperbelt Province

District	Area (ha)	Total Forest (ha)	% of total area
Chililabombwe	100 900	30 104	29.84
Chingola	169 200	25 916	15.32
Kalulushi	96 000	68 668	71.53
Kitwe	82 600	11 858	14.35
Luanshya	92 700	20 512	22.13
Mufulira	133 400	34 402	26.54
Ndola Urban	94 100	49 088	52.17
Ndola Rural	2 332 500	276 563	11.87
TOTAL	3 101 400	518 111	16.74

Source: PFAP (1998)

There are 46 gazetted forests in the Copperbelt province (see appendix 1).

3.2.3 Livelihoods in the rural Copperbelt

The Provincial Forestry Action Programme (PFAP) has been operating in selected rural communities and districts within the Copperbelt province and has over the years documented various aspects of livelihoods in these areas. The predominant economic activity in the rural areas of the Copperbelt province is subsistence and semi-subsistence agriculture (PFAP 1998; Njovu *et al* 2004). Semi-subsistence agriculture implies that households are engaged in farming primarily for subsistence, but do sell some of their produce, depending on available surplus. Subsistence agriculture is a type of farming where all the produce is used to feed the household. A study on the rural livelihoods in the Copperbelt by Nkomeshya (1998) revealed that only 10% of the households practise semi-subsistence agriculture. The majority (60 %) of the households depend on subsistence agriculture for livelihood. The remainder exhibited

other livelihood systems, such as fishing, hunting, fruit trade and bee-keeping. The major constraints in the agriculture livelihood system are the lack of modern farming implements and loss of soil fertility.

Rural households in the Copperbelt tend to suffer from food insecurity, which is caused by limited harvests. According to Nkomeshya (1998), food shortages are experienced between November and February, on account of produce from previous harvests running out, due to limited production. To supplement their diets, the people consume wild foods, such as wild fruits, vegetables and roots, when in season. Collection of forest products is seasonal, except for fuelwood, medicine and charcoal. Forest products are important components of the rural livelihoods for both women and men (Nkomeshya 1998). Subsistence agriculture, the dominant livelihood in all the districts, is complimented by additional sources of livelihoods, these consist of, for example, casual labour and trading in forest products, such as grass, honey and wild fruits (see Table 4).

Table 4: Rural livelihoods in selected districts of Copperbelt province

District	**Dominant livelihood**	*Additional sources of income and employment*
Chililabombwe	Subsistence agriculture, charcoal production	Beer brewing, honey, broom manufacture and trade
Chingola	Subsistence chitemene agriculture	Beer brewing, livestock sales
Kalulushi	Subsistence agriculture	Wild fruit and mushroom sales
Kitwe	Subsistence agriculture, charcoal production	Casual labor, wild fruit and mushroom sales, beer brewing
Luanshya	Subsistence agriculture	Casual labor, beer brewing, non-wood product sales
Mufulira	Subsistence agriculture	Casual labour, grass, wild fruit and mushroom sales

Source: Nkomeshya (1998)

3.3 Methodology of the empirical research

This section explains the methodology that was used to collect primary data necessary to achieve the objectives of this study. The purpose of the research involved both exploration and description. Exploration in social research provides a basic familiarity with the topic, as a new interest is being explored. According to Babbie and Mouton (2001), exploratory studies are useful in satisfying the researcher's curiosity and desire for better understanding. In this study, participatory rural appraisal constituted the explorative part of the research, which was complemented by descriptive research, in the form of individual, in-depth interviews, and a household survey. The purpose of *combining* PRA with other methods is triangulation. Triangulation is the combination of methodologies in the study of the same phenomenon or construct; a method of establishing the accuracy of information by comparing three or more types of independent points of view on data sources such as interviews, PRA, observation and documentation (BJA, 2006). The field work for this study was conducted from 27th November, 2006 to 11th January, 2007.

3.3.1 Participatory rural appraisal

Participatory Rural Appraisal (PRA) as a research tool serves the purpose of opening up discussion with participants, such as a rural community, on a particular point of interest (Slocum *et al.* 1995). PRA is a term used to describe a growing family of participatory approaches and methods that emphasise local knowledge and enable local people to develop their own appraisal, analysis and plans.

The community authorities were asked for guidance in arranging the participatory rural appraisal, as in Zambia, they are considered the custodians of all natural resources and of the welfare of the people in the communities, and because they are mandated to call for general meetings.

In this study, PRA primarily involved conducting focus group interviews in a selection of communities, in order to obtain data on the general views on IFTs held by the local people. Communities were also invited to complete certain exercises, which dealt with the availability of IFT species, their harvesting and utilisation.

3.3.1.1 Mapping

During focus group interviews, the participants were asked to create a map of their communities on sheets of paper, which provided a valuable visual reference for further discussions with them. This community mapping was also useful in identifying transects through the community that allowed for observation of different agro-ecological areas and natural resources, different groups within the community and different livelihood activities. According to Mukherjee (1993), maps are rich tools for knowing different aspects of a village such as location of dwellings, buildings and land-use patterns.

3.3.1.2 Observation / Transects walk

Once the general picture of the village from the mapping exercise was obtained, the researcher verified the information that was presented in the map by means of transect walks. The purpose of transect walks was to determine how the different land use categories are distributed in the landscape of the communities. They provided the researcher the opportunity to look at changes in vegetation, settlements, and economic activities. Transects also helped to generate knowledge of the micro-ecological zones found in each community. The importance of transect walks lies in the knowing the agro-ecological zones in rural areas and also getting an in-depth account from the participating villagers of such zones in the village such as uses, problems and opportunities (Mukherjee 1993).

The route of the walk in each community was chosen on the basis of the community maps, and in accordance with the advice of the group of participants taking part in the walks. In particular, routes that traversed the widest variety of micro-ecological zones (including forested areas, lowlands, deforested areas and fields) were chosen. Participants were asked questions about what was seen during the walk, and relevant information was recorded as the transect proceeded.

3.3.1.3 Seasonal calendar of activities

Participants were also asked to draw a seasonal calendar of livelihood activities, including the collection of indigenous fruit that they carry out throughout the year. Seasonal calendars are useful, as they provide clear, visual representations of seasonal variations .Different aspects of rural life can be reflected through seasonal diagramming ((Mukherjee 1993). Seasonal

calendars were used primarily to collect and analyse - together with respondents - data on the different seasonal livelihoods, the months in which different indigenous fruit ripen, and the vulnerability of people to hunger in the various seasons of the year.

3.3.1.4 Timelines

Timelines are used as a means to discuss the history of the community, by identifying key events that can provide essential reference points for the participants. According to Mukherjee (1993), timelines are important for gathering information on issues such as environmental degradation and food quality over a period of years as the elderly villagers narrate their life histories. In this research, the use of timelines involved analysis of events such as periods of droughts, natural disasters, such as fires, and changes in social, political or economic environments. Data was also collected on the way in which households dealt with, and how IFT use was affected by, such events.

3.3.1.5 In-depth interviews

In-depth interviews are one of the frequently used data collection methods within the qualitative approach. These interviews are open ended, which offers an opportunity for the object of study to speak for him or herself rather than providing the respondents with a battery of our own determined hypothesis-based questions (Babbie and Mouton 2001). In the present study, the interviewer had a general plan of inquiry, without any specific set of questions. The interviews were flexible and interactive, in order to allow the respondents to explain issues concerning IFTs use. According to Babbie and Mouton (2001), in-depth interviews are essentially a conversation in which the interviewer establishes a general direction for the conversation and pursues specific topics raised by the respondents. In-depth interviews were conducted with three informants who had vast knowledge on indigenous fruit trees uses in aspects such as fruit trading, processing of fruit and medicinal use. These informants were chosen based on prior knowledge about their using of IFTs, which was obtained during PRA group meetings.

3.3.1.6 Household survey

The majority of the primary data was collected by means of a survey of rural households.

A household is conceptualised as a domestic residential group whose members live together in intimate contact, rear children, share the proceeds of labour and other resources held in common, and in general co-operate on a day-to-day basis (Farah, 2006). The unit of observation, or respondent, was the household head. In this research, a household head was defined as an individual in one family setting, who provides actual support and maintenance to one or more individuals who are related to him/her through adoption, blood, or marriage. His/her authority to exercise family control and to support the dependent members is founded upon moral or legal obligation or duty. The unit of analysis was both individuals and households, as some questions in the questionnaire related to the household, while others related to the individual respondent.

The data that was collected at Individual-level was the respondents' age, sex and marital status. This information was recorded to obtain biographical background of the respondents.
On the household level, data were recorded on the number of individuals in the household, the major sources of income of the household and the harvesting and utilisation of the IFTs by the households. Harvesting is the process of gathering a crop, while crop in this sense has been defined as the yield from a plant in the growing season.
The respondents were also asked to report any changes in the availability of IFTs in the past10 years and if so, how this has affected their household

3.3.2 Sampling strategy

The study was conducted in the Kitwe district, which was purposively selected for a number of reasons. Both Nkomeshya (1998) and PFAP (1998) report the availability of indigenous fruit trees in this district. However, the contribution of IFTs to the livelihoods of the rural people in Kitwe has not been studied. In addition, IFTs in the district are subjected to very high rates of deforestation relative to other districts (PFAP 1998). Within the Kitwe district, the study was carried out specifically in the Mwekera area, which has a natural forest with a diversity of indigenous tree species. Three communities, Misaka, Chankalamu, and Kwishilya, were purposively selected for study, as they are situated around Mwekera National forest and therefore depend on the forest products for their livelihoods (Shitima, 2005).

A 20% sample of households within the selected communities was randomly selected from a sampling frame, which consisted of a list of the households in the selected communities.

Sampling intensity of 20% is representative of the population (Turyahabwe 2006; Hetherington 1975). The objective of the sampling procedure was to ensure that households in the sample were representative of the population of households in the study area. However, as the Kitwe district and communities were purposively (non-randomly) selected, the results cannot necessarily be generalised to all households in the Copperbelt province. The study will, however, provide information on the IFTs role in the livelihoods of the communities selected, and may be used as an indicator on IFTs use in other areas with similar conditions as the one studied.

3.3.3 Data collection instrument and analysis

Semi-structured questionnaire interviews were personally conducted with the heads of the sampled households (see appendix 2). This data collection method, the most commonly used in rural research (Chambers 1983), is probably the best method available to the social scientist interested in collecting primary data in order to describe a population that is too large to observe directly (Babbie 1995). Furthermore, the best way to learn from local people is to sit down, ask questions listen and record the answers, rather than asking respondents to complete a questionnaire. In some cases where inconsistencies in the data were identified after data entry, the researcher re-visited the respondents to validate the data.

Data was analysed using Statistica 7.1[4]statistical package. The household survey questionnaire consisted of both closed and open ended questions. Coding was engaged after data collection so as to transform the data into a computer readable format. Open ended questions resulted in non numerical responses which had to be coded before analysis. The purpose of coding is to reduce a wide variety of idiosyncratic items of information to a more limited set of attributes composing a variable (Babbie and Mouton 2001). The numeric codes of the data were then entered into the statistical software for analysis.

3.4 Chapter conclusions

This chapter presented a background to the study in terms of the area investigated, and discussed the research methods used to collect data. The next chapter consist of the presentation of the results that were obtained by analysing the collected data.

[4] StatSoft, Inc. (2006). STATISTICA (data analysis software system), version 7.1. www.statsoft.com.

CHAPTER FOUR

RESULTS

The following chapter presents the findings primarily of the household survey, and secondary of data collected during the participatory rural appraisal, personal observations and interviews with informants, on the role of indigenous fruit trees in the rural livelihoods. The results are presented according to various topics. The chapter commences with a description of the households surveyed, including their livelihood strategies and food security. Thereafter, findings from the PRA on woodland use are presented. The focus of the chapter then narrows to indigenous fruit in particular, including the types of fruit that are available, their value (ranking) and uses (including medicinal uses). This section further includes the presentation of data on fruit collection, trade, and processing. The chapter concludes with the findings regarding respondents' perceptions of woodland degradation and its impacts on households.

4.1 Description of households surveyed

A total of 70 households were interviewed in the household survey. In the study area, 64% of the heads of households were men, while 36% were women. The age of the majority of respondents (89%) ranged between 20 and 60 years (see Figure 3). The average number of individuals in a household was six.

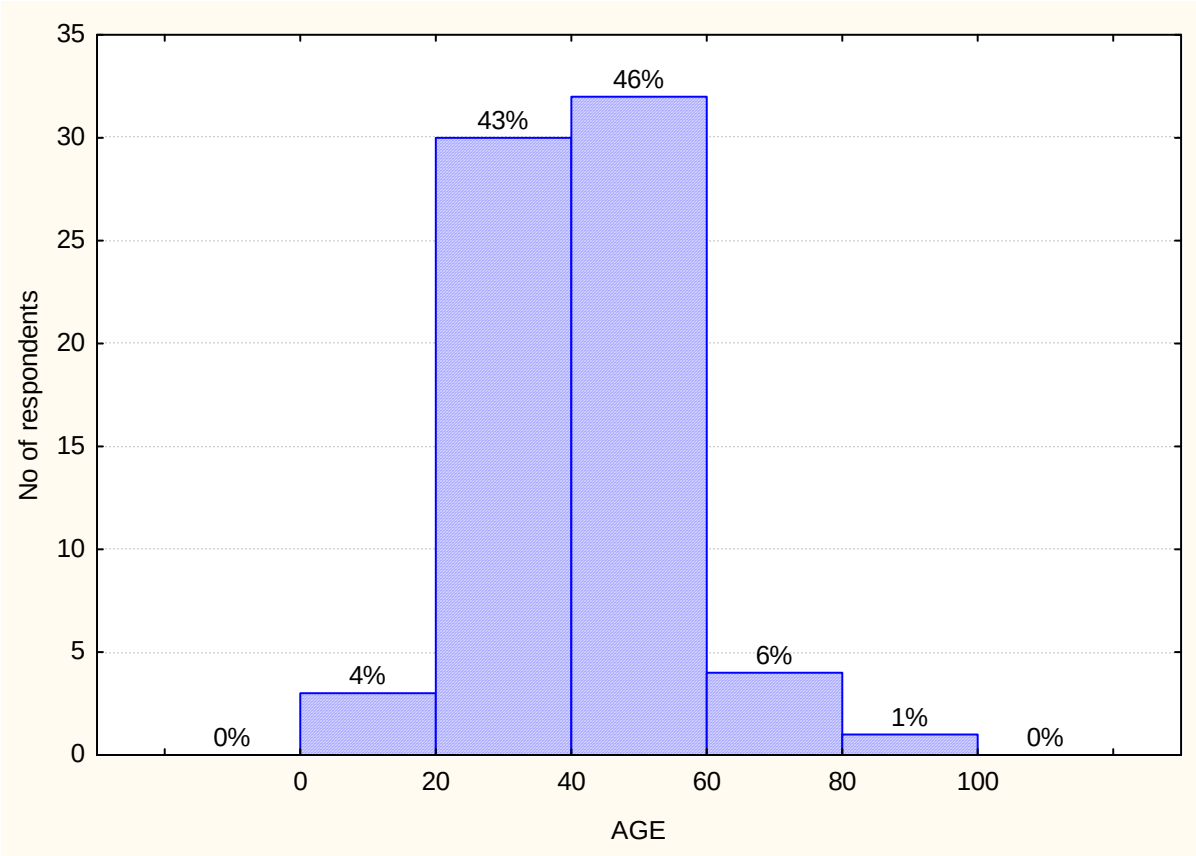

Figure 3: Age distribution of respondents (n=70)

4.2 Woodland use

From the participatory rural appraisal it became clear that the woodlands in the study area are important to the rural households. They are a source of energy, i.e. as fuel wood, as well as a source of medicine, building poles, thatching grass, fibre, wild vegetables, grazing grass, mushrooms and wild fruits (see Table 5).

4.2.1 Seasonality of forest products

These woodland products can be classified as either seasonal or perennial. Products are classified as seasonal if they are gathered from the woodlands only during some months of the year, while perennial products are those that are gathered throughout the year. Among the seasonal products are wild fruits, wild vegetables, mushrooms and thatching grass. Wild fruits are available only between September and February, mushrooms are in season between December and February, while wild vegetables are available between September and February. The collection of thatching grass is done between April and August. The other

products from the woodlands, i.e. fuel wood, medicines, fodder, building poles and fibre, are perennial (see Table 5).

Table 5: The seasonality of forest product use

Forest Products	***Jan***	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	**Dec**
Fuel wood												
Charcoal												
Building poles												
Fibre												
Wild fruits												
Medicines												
Thatching grass												
Fodder												
Mushroom												
Wild roots												
Wild vegetables												

Apart from household use, the forest products are important in generating cash income to the households. The products traded include Charcoal, building poles, mushrooms, wild fruits and wild roots

4.2.2 Gender differences in woodland use

The PRA group interviews revealed that among the activities that are identified in woodland use, there are some activities that can be identified as being the exclusive domain of women, and those that are the exclusive domain of men. The activities that are dominated by women (and children) are those that provide food to the household, such as collection and selling of mushrooms, indigenous fruit and other forest products. Men dominated in charcoal production and cutting of building poles. Other activities, such as firewood collection, are carried out by both men and women. According to the group interviews, men collect larger logs, while women and children collected medium-sized firewood. It was, however, pointed out that women and children collect firewood more often than men.

4.3 Livelihood strategies and food security of households

4.3.1 Livelihood strategies

The means by which the households earn an income are diverse. Almost three-quarter (74%) of the households surveyed indicate that they apply more than one strategy to sustain their households. The major economic activities carried out by households in the study area include agriculture (87%), charcoal production (33%), and selling of mushrooms (27%) and indigenous fruit (26%). Rural people are also involved in other activities, as 34% of households mentioned bee keeping, beer brewing, and piece work (Figure 4). Piece work is an informal term that is used to describe jobs that rural people are hired to do on other people's farms, or when they are hired to work temporary on a project in a village. Figure 4 shows the percentage of the households who identified various livelihood sources as important for the livelihood of their households:

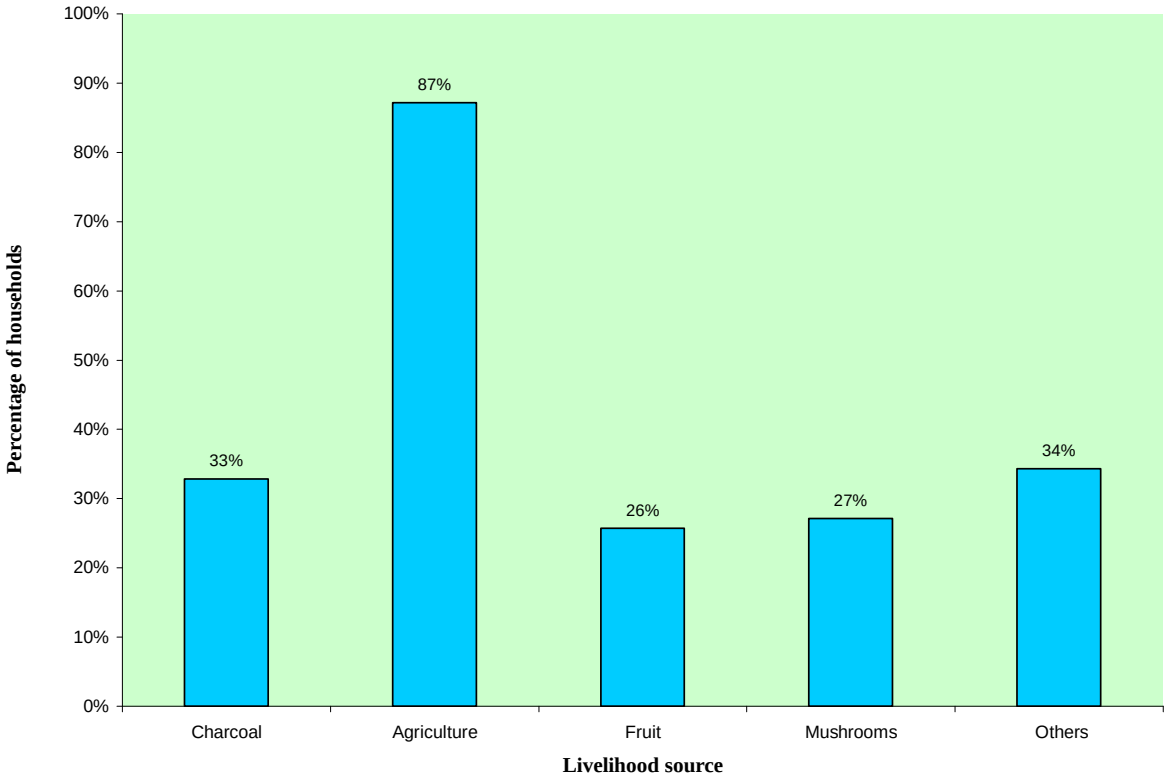

Figure 4: Livelihood strategies of the households (n=70).

Farming is done to grow food to meet the needs of the household and the 'perceived' surplus is sold to provide income for the household. The various agricultural products that are

cultivated include maize, groundnuts, pumpkins, beans. The local people practice shifting cultivation.

4.3.2 Food security of households

The survey results revealed that 99% (Figure 5) of the households interviewed experience food insecurity and constantly experience a 'hunger period'. The critical 'hunger period' is between November and April. Food shortages were ascribed to poor harvests that were only sufficient to last a few months. The increase in prevalence of poor harvests is caused by erratic rainfall.

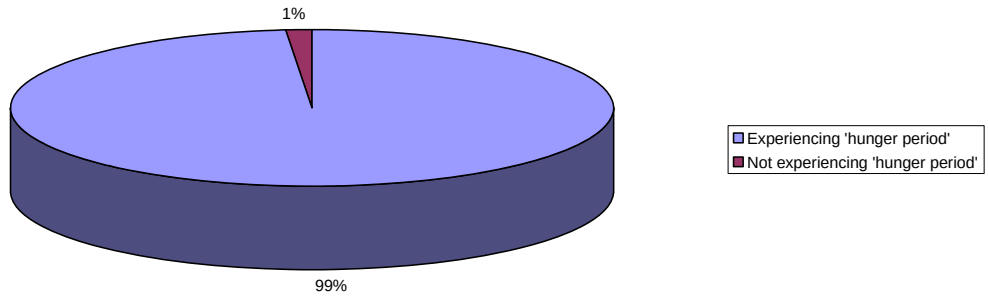

Figure 5: Food security status of the households (n=70).

4.4 Indigenous fruit trees

4.4.1 Access to IFTs

The people in the study area have access to various indigenous fruit trees. The IFTs were not only found in the woodland, but some households retained fruit trees on their fields, by leaving trees standing in agricultural land (Figure 6). The trees are therefore not planted by the land owners, but were retained when the land was being cleared for cultivation.

Figure 6: *A. boehmii* tree retained on agricultural land.

4.4.2 Types of IFTs and their uses

4.4.2.1 Preference ranking

During the household survey, the ranking of preferred species revealed that the two main prioritisation criteria for the ranking of preferred species by the respondents were: (i) the food contribution of fruit to a household; and (ii) the marketability of the fruit. The respondents in the household survey ranked the fruit in the following descending order: *U. kirkiana*, *A. boehmii* and *S. cocculoides* (Figure 7).

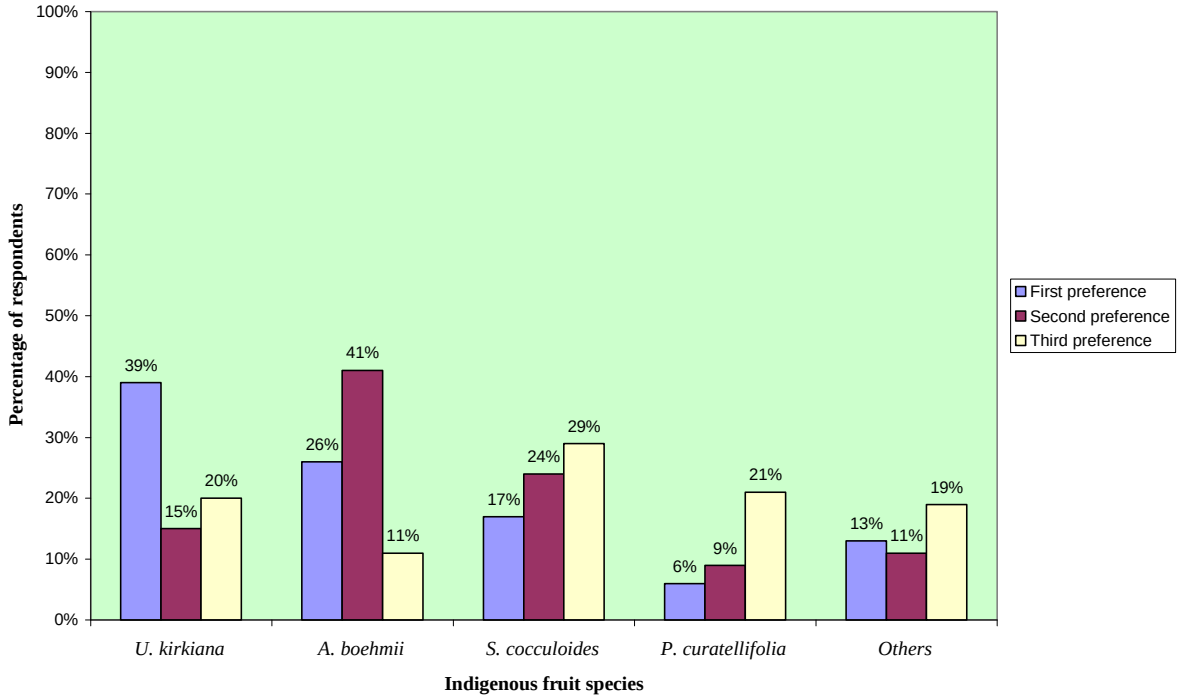

Figure 7: Preference ranking of IFTs

4.4.2.2 General uses of IFTs

During the PRA group interviews it became clear that the use of fruit types differs from household to household. Table 6 shows the scientific and local names of each of the available fruit types, as well as their reported uses:

Table 6: Types of indigenous fruit and their use(s)

Scientific names	**Local name**	*Use of fruit*
Uapaca kirkiana	Masuku	Eaten fresh, Juice and Porridge
Anisophyllea boehmii	Mufungo	Eaten fresh, Juice and Porridge
Parinari curatellifolia	Mupundu	Eaten fresh, Juice and Porridge
Strychnos cocculoides	Kasongole	Fruit pulp
Strychnos pungens	Tugome	Fruit pulp
Garcinia huillensis	Musongwa	Eaten fresh
Landolphia kirki	Mabungo	Fruit pulp
Diospyros mespiliformis	Muchenja	Eaten fresh
Syzygium guineense	Mufinsa	Eaten raw

4.4.2.3 Medicinal value of IFTs

The survey on the value of IFTs specifically for medicine showed that 63% of the households use IFTs for medicinal purposes. Trees that are commonly used by households included *A. boehmii*, *U. kirkiana*, *P. curatellifolia* and *S. cocculoides.* *A. boehmii* was the most used IFT (67%) followed by *U. kirkiana* (44%) and *P. curatellifolia* (36%) (Figure 8). The tree parts that are used are usually the roots, leaves and barks. Extraction of the active drugs from barks and roots is usually done by means of the processes of infusion[5] and decoction.[6]

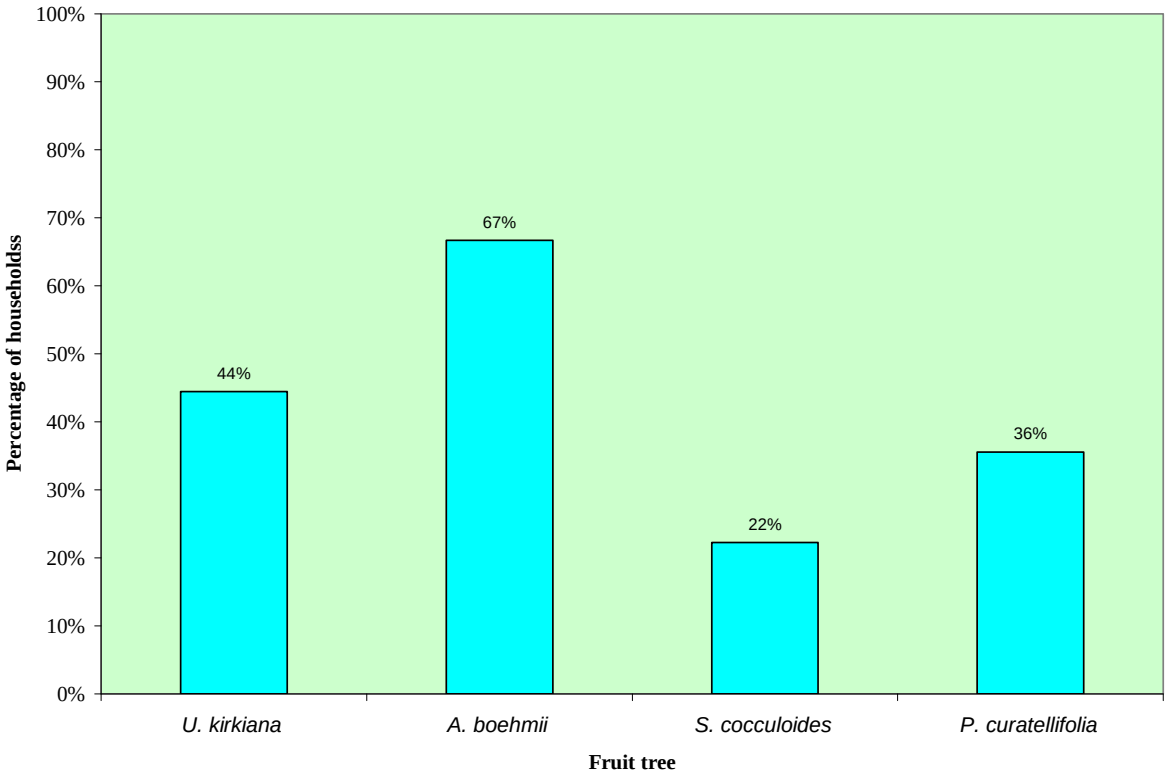

Figure 8: Percentage of households that use of IFTs for medicinal purposes (n=44)

The diseases cured and/or treated using the above medicinal fruit trees and the parts of the trees used are summarized in Table: 7

[5] Infusion is the process of extracting active drugs from a plant by soaking the plant material in water
[6] Decoction involves boiling plant material in water to produce a concentrated extract

Table 7: Indigenous fruit trees and their medicinal use

IFT species	Part uses	Medicinal uses and process
A. boehmii	Roots Bark	Infusion of roots is used to cure dysentery and diarrhoea. Decoction of bark is used to treat stomache–ache and syphilis. It is also used as a mouthwash to cure tooth-ache and bleeding gums.
U. Kirkiana	Roots Leaves	Infusion of the roots is used for treating coughs. In treating infants for diarrhoea and cough, tender leaves and the apical buds are crushed and then mixed with water. This is given to infants at regular intervals.
P. curatellifolia	Bark and roots	Infusion of the bark and the roots is used to treat diarrhoea and stomach-aches.
S. cocculoides	Roots and fruit	Decoction of roots administered by half a cup at a time is used to treat syphilis. Water in which the fruit has been soaking for 30minutes is used as eardrops to treat ear-ache.

Harvesting of plant parts is done by using tools such as axes for barks and hand hoes for roots. During the field study (transects walk), a *Parinari curatellifolia* tree was observed as having had its bark harvested, penetrating even the woody part of the tree (see Figure 9)

Figure 9: Picture of *Parinari curatellifolia* debarked for medicinal use.

4.4.3 Fruit collection

Almost all of the respondents (97%) in the household survey indicated that their households collect fruit, and all of them reported that their household collects more than one type of fruit. Thus, people collect a variation of indigenous fruit. The fruits are collected from a nearby state forest in Mwekera, from private farms, as well as from open access areas

4.4.3.1 Types of fruit collected

A breakdown of the kinds of fruit collected showed that 74 % of the households collect *U. kirkiana*, 71% collect *A. boehmii*, 50% collected *S. cocculoides*, while 33 % collect *P. curatellifolia* (Figure 10). In addition to these fruit that are collected by a large proportion of the households, 11% of them also reported collection of *L. kirki*, *S. pungens*, *S. guineense*, *G. huillensis* and *D. mespiliformis.*

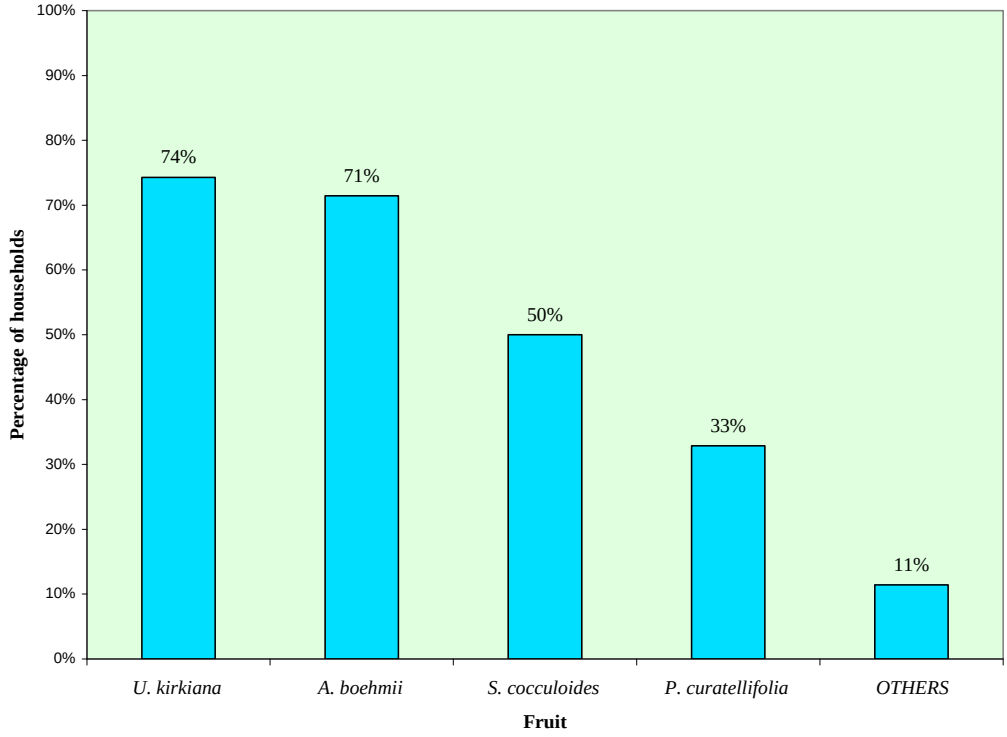

Figure 10: Fruit collected by households in the study area (n=70)

4.4.3.2 Methods for harvesting and collection of fruit

Harvesting of fruit is done using traditional methods, such as picking fruit up from the ground, shaking the stems or tree branches, so as to cause the ripe fruit to fall, and using sticks to knock the fruits down. The household survey revealed that there are no rules regarding the harvesting of IFTs. During harvesting, some fruit sustain cracks and bruises. The fruits that are mostly affected are *U. kirkiana* and *A. boehmii* which have a delicate pericarp when they are fully ripe, thus causing to fruit losses

During fruit collection, local people use buckets, baskets, sacks and other containers of various shapes and sizes. At the time of fruit collection, both ripe and unripe fruit are collected. Unripe fruit are harvested by cutting the branches bearing the fruit. The unripe fruit is then stored for post harvest ripening (locally known as *Kufundika*)

One of the constraints to the collection of fruit that was cited both during group interviews and the household survey was the distance that people have to cover to collect fruit. This distance was said to have increased over time.

4.4.3.3 Fruit collection responsibilities

Data on fruit collecting responsibilities indicated that women and, to a lesser extent, children are the primary collectors of the fruit. Women and children account for 55% and 28% of the collectors, respectively (Figure 11). The women combine fruit collection with other activities such as fuelwood and wild vegetables collection.

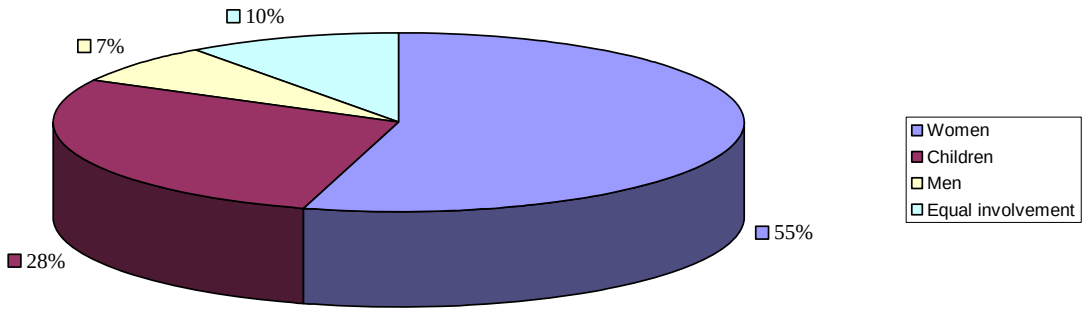

Figure 11: Percentage distribution of fruit collectors in the study area (n=68)

4.4.4 Fruit trade

4.4.4.1 Extent of fruit trade.

The household survey results indicate that 31% of the respondents sell fruit. As with fruit collection, marketing of fruit is also the domain of women (See Figure 12 showing girls selling the fruit along the Kitwe-Ndola highway). The fruits are sold at the local, roadside and urban markets. People use different containers to sell the fruits from, depending on what is available, such as cups, heaps, bowls, and plates.

Figure 12: Fruit selling at the roadside along Kitwe- Ndola highway.

4.4.4.2 Transportation of fruit to be traded

For short distances, fruit are carried in different containers ranging from sacks to tins and buckets. It was discovered during the survey that long-distance transportation of fruit was dependent on the nature of the fruit. For example, fruit such as *U. kirkiana* and *A. boehmii,* which gets easily damaged by breaking and bruising during transportation, are carried in local baskets called *museke*(Figure 13 showing two *museke*: one containing mango and the other *U. kirkiana*).

Figure 13: Baskets (*Museke*) for carrying fruit products in the photo are Mangoes and *U. kirkiana* (Masuku)

4.4.4.3 Types of fruit traded

The fruits with high market value are *U. kirkiana* and *A. boehmii*. Therefore, it is not surprising that 96% of the households that sell fruit report selling these two fruit species. On average, a household sold four *Miseke* of *U. kirkiana* per week and two miseke of *A. boehmii* depending on the availability of the fruit in a season. The other fruits sold, albeit in smaller proportions, are *S. cocculoides* (local name (Kasongole) and *P. curatellifolia* (Mupundu) (Figure 14).

4.4.4.4 Commercial value of IFTs

Wholesale prices for the fruits ranged from ZMK50,000- ZMK80,000[7] per basket (*museke*) for *U. kirkiana* and K40,000 - K 60,000 per basket for *A boehmii.* At the roadside, the fruits were sold at retail prices, although this was dependent on the size of the heaps in/plates on which the fruit is sold. The prices per plate ranged from ZMK500 – ZMK2000 for the two

[7]Exchange rate ZAR 1=ZMK550

fruits. It was also revealed during the PRA group interviews and household survey interviews that fruit rot was the major problem identified with fruit selling, which forced the local people to sell fruit at low prices.

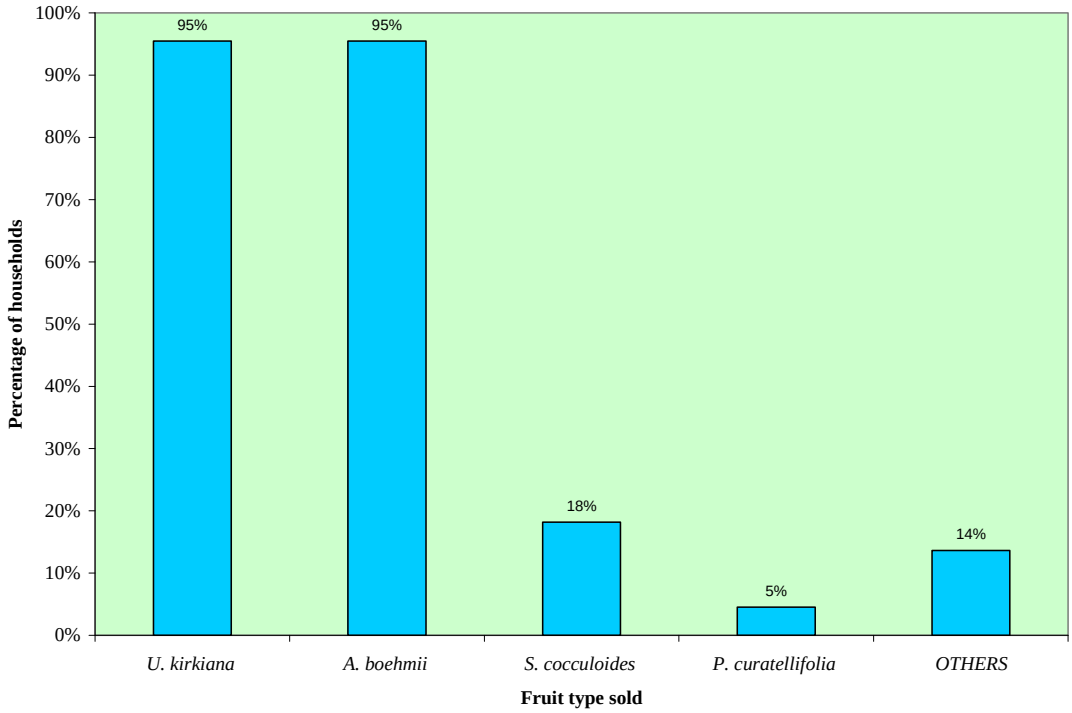

Figure 14: Percentage of households selling various types of fruit

4.4.5 Fruit processing

4.4.5.1 Extent and scale of processing

Less than half (46%) of the households report processing fruit, and processing of fruit is limited to a few fruit tree species such as *U. kirkiana, A. boehmii* and *P. curatellifolia* (Figure 15). The proportions of households that process each of these species in descending order are: *A. boehmii* (36%), *P. curatellifolia* (33%), and *U. kirkiana* (31%)

Fruit processing is done on a minor scale. There was no evidence of commercial processing of any fruit. The household survey results reveal that all the households in the study area that process fruit do so for home consumption. The essence of processing is to add value to, and increase the palatability of the fruit. Processing of fresh fruits is necessary, as the fruits' perishability rate is very high, due to lack of cold storage facilities in the rural areas.

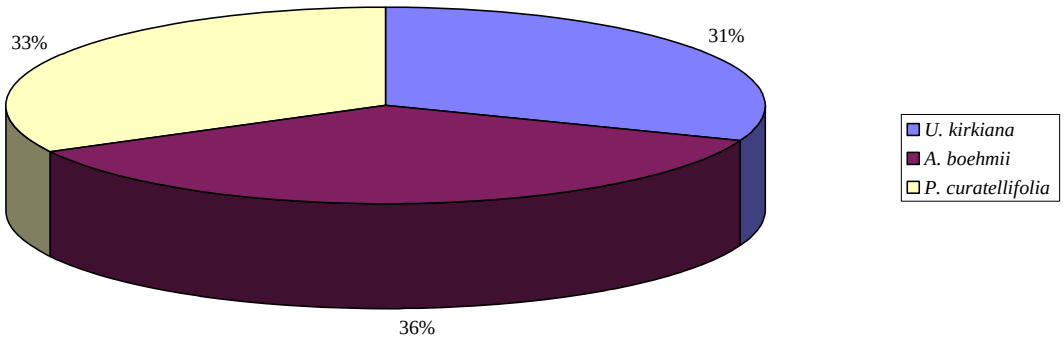

Figure 15: Distribution of fruit that are processed by households (n=32)

4.4.5.2 Processing methods

The main processing involves the making of porridge and juices. According to the group interviews, to process *U. kirkiana* into juice, the fruit pericarp is removed, and the pulp and seed is soaked in water and stirred until the seed detaches from the seed. The liquid is then sieved to remove the seeds and any other particles that might be in the liquid. In some instances, the pulp can be squeezed from the fruit and then mixed with water. The liquid pulp is then boiled for a few minutes, while stirring until completely blended, after which it is cooled and ready for consumption. These methods are also used for processing *A. boehmii* and *P. curatellifolia.*

Porridge is made by removing the pericarp of the fruit, soaking the pulp and seeds for some time, and then removing the seeds from the liquid pulp. Thereafter, the liquid is boiled and maize flour or bran is added to the boiling liquid while stirring. This mixture is left to boil until it thickens to porridge.

4.5 State of the forest

It was found that 85% of the respondents have seen a change in the forest cover in the past 10 years. According to the respondents, the forest cover is diminishing, and it is becoming difficult to find certain species of trees in the forest.

4.5.1 Causes of forest cover loss

The loss of forests cover is attributed to charcoal production and expansion of land for agriculture. Seventy-four per cent (74%) of the respondents cited charcoal production and clearing of forest for agriculture as the main causes of forest loss. Men are the major role players in both the production and selling of charcoal. Charcoal is transported to major markets in Kitwe on bicycles (Figure 16), while for long distance markets the charcoal is transported by trucks (Figure 17)

Figure 16: Charcoal producers transporting their products to the market

Figure 17: Truck loading charcoal

4.5.2 Impact of forest loss in livelihoods

The loss of forest cover also entails a reduction in the forest tree species distribution. By far the majority (93%) of the respondents in the household survey indicated that indigenous fruit trees are under threat, as they report a reduction in their availability. Respondents also mentioned that the distance that people have to cover to collect fruit has increased over time (see section 4.4.3.2 above). Figure 18 shows the percentage of respondents that have observed a reduction in the availability of at least some fruit trees:

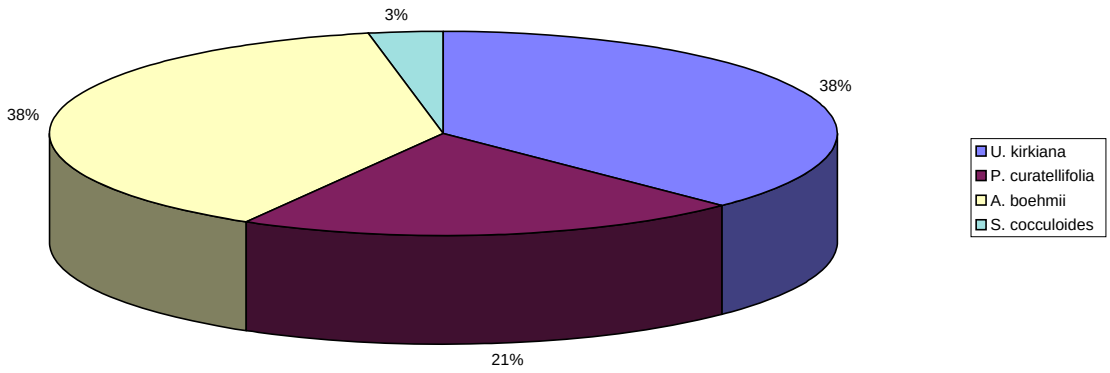

Figure 18: Percentage of respondents reporting an increase in the scarcity of different types of IFTs (n=65)

The largest proportion of respondents report two species as particularly threatened. These are *U.kirkiana* (38%) and *A.boehmii* (38%). Twenty-one percent reported *P.curatellifolia* as threatened, while only a small proportion of respondents (3%) reported *S. cocculoides* as being threatened.

4.6 Chapter conclusions

This chapter has presented the results pertaining to the use of IFTs in the study area. It has provided various tables and figures as regards to the various aspects of IFTs that were under scrutiny in this study. The next chapter will present the possible explanation of some of these results and relate to it the findings of similar studies conducted elsewhere.

CHAPTER FIVE

DISCUSSION

This chapter discusses the results presented in the previous chapter, and seeks to explain the role of IFTs in rural livelihoods and compare the findings to other similar studies. It commences with a discussion of the socio-economic status of the rural people studied. The livelihoods activities in the area studied and the use of biodiversity is discussed. The different uses of IFTs are then discussed including the analysis of local fruit processing knowledge, where after the focus shifts to the IFTs that are perceived to be under threat. The chapter concludes with a discussion domestication of IFTs.

5.1 Socio-economic status

The research results indicate that almost all of the households experience regular hunger periods during the rainy season (i.e. between November and April). This implies that most households suffer from food insecurity, offering enough evidence of the high prevalence of rural poverty in the study area. Households are characterized with low literacy and lack inadequate skills and training, such as production and marketing skills. The major cause of food insecurity that was identified was cited as poor harvests, which have become very prevalent in recent years, due to erratic rainfall, thus making the quantity of food harvested only sufficient enough to last for a few months. The results from this study coincide with the findings of Akinnifesi *et al.* (2004) study of household food security in Malawi, Zambia and Mozambique. They reported that 60-85% of rural households lacked access to food for three to four months per year, and 26-50% of the respondents had relied on indigenous fruit for sustenance during this period. It is worth noting that, as the present study shows most of the indigenous fruits are in season during the 'hunger period" (rain season), which means that fruit are available to the rural people during this period of high vulnerability to hunger, and hence that the indigenous fruits are relied upon as 'safety nets'.

5.1.1 Livelihood activities

The main livelihood activity among the rural households studied is farming. The main type of farming is shifting cultivation, which depends on shifting from one plot to another. This agriculture system involves clearing of a piece of land followed by years of farming until the

soil losses its fertility. Once the land becomes unsuitable for crop production, it is left to regenerate naturally during the fallow period. This is due to the fact that soils in the miombo woodlands are generally poor (Chidumayo 1997). Farming is done to grow food to meet the needs of the household and the surplus is sold to provide income for the household. Charcoal production is the second most important livelihood activity after farming. Charcoal production has a low capital outlay and provides immediate cash. The number of households that produce charcoal is likely to be higher than one in every three, as most of the charcoal is produced and traded illegally. For example Shitima (2005) in his study in the Mwekera area, reported a couple that stated that they had never been involved in charcoal manufacturing but their backyard 'store-room' was filled with bags of charcoal as well as wheel barrows used in transportation which were quite visible from where the interview was being conducted. Mushrooms, fruit, and 'piece work' make a significant contribution to rural livelihoods in the area studied.

The results of this study clearly show that, in the area studied, rural livelihoods are not dependent on one sole activity. Rural households choose a combination of activities that contribute most towards their multiple objectives and yields greatest utility (Mithöfer and Waibel 2003). A study by Scherr (1995) similarly stressed that rural households' survival strategies encompass multiple objectives in maximization of utility, like provision of food and subsistence goods, cash for purchase of goods and services and saving for future needs.

5.1.2 Biodiversity utilisation

The results from this study confirm the dependence of the rural community on biodiversity for sustenance. It is clearly indicated that people use various components of biodiversity, both food and other non-food products, in their livelihoods. The various components of biodiversity used include fuel wood, medicines, and construction material, such as building poles, thatching grass and fibres. In the area studied, the foods that are gathered from the woodlands are wild fruits, wild vegetables and mushrooms. These make an important contribution to the food basket of the households. The dependence of rural communities on biodiversity for food sources is well documented (PFAP 1998; Nkomeshya 1998; Clarke *et al.* 1996; Campbell *et al.* 1996). According to Campbell *et al.* (1996), Miombo woodland products contribute to rural household welfare, providing food and non-food consumption products. Similarly Clarke *et al.* (1996) reported wild foods, such as edible insects, wild plant

leaves and wild fruits as being important to the rural households in the Miombo woodlands. This study established that the dependence of rural households on wilds foods is seasonal, owing to the seasonality of these food crops.

Trading of biodiversity products is an important source of income for rural communities. Whilst subsistence agriculture is the mainstay of the livelihood of many people, cash income gained from the marketing of biodiversity products is a vital component in the livelihood of rural people, The value of natural resources in the lives of rural people is mainly as a gap-filler, in the sense of it complementing other meagre sources of subsistence income at the domestic level. The study revealed that women are mainly involved in the selling of wild foods, such as mushrooms and fruit, while men are actively involved in charcoal production and selling.

5.2 Indigenous fruit tree harvesting, utilization and trade

Households use IFTs in various ways, such as food supplement, source of income when traded and for medicinal purposes.

5.2.1 Access of IFTs by households

The rural households studied have access to IFTs. These trees are mostly accessed from the forest. Some households retained fruit trees on their fields, by leaving trees standing in agricultural land. The trees are therefore not planted by the land owners, but were retained when the land was being cleared for cultivation and some of them regenerated through natural means. In Malawi, Ngulube *et al.* (2006) highlighted the appreciation communities have for fruit trees by reflecting on the prevalence of cultural-religious restrictions governing their use and exploitation. Ngulube *et al.* (2006) also reported that during woodland clearing prior to cultivation or settlement, important fruit trees such as *Parinari curatellifolia*, *Strychnos cocculoides* and *Uapaca kirkiana*, are customarily left uncut and scattered around homesteads or crop fields. Packham (1993) has reported similar cases for Tanzania, Zambia and Zimbabwe where *Parinari curatellifolia* and *Uapaca kirkiana* are left deliberately in cultivated fields. The integration of IFTs in agricultural production systems has also been reported to reduce the risks inherent to monocultures of staple food crops, such as susceptibility to pests and diseases, soil nutrient depletion (Hughes and Haq 2003). In soil amelioration terms, Sanchez and Leakey (1997) pointed out that radial growth of the tree roots can loosen the top soil and hence improve porosity in the subsoil. The trees also

generate leaf litter, which acts as a ground cover which decreases the runoff from the soil surface hence improving the physical properties of the soil.

Notwithstanding these advantages, the farmers only retain a few trees, because of the fear that the trees may keep sunlight from reaching their crops. These trees are generally well-managed and protected by the owner, compared to the complete lack of management of the trees found in communal areas. Access by other community members to household owned trees is, however, limited when compared to communal trees. For example, on communal land, even fruits that are unripe are collected, for fear that once they are left to ripen, other people will have access to them. The unripe fruits are placed in a sack that limits circulation of air, in order to induce ripening (locally known as *Kufundika*). On farmlands or homesteads, on the other hand, the fruits can be left to fully ripe on the trees due to limited access to the trees by other people. Post-harvest ripening has also been reported in Zimbabwe, where due to competition, fruits are harvested at unripe stage for local post-harvest ripening at home - a traditional technique called '*kupfimbika'* in the local Shona language (Kadzere *et al* (2004)

5.2.2 Preference ranking.

In this study, priority setting was done at household level, as it requires understanding of user needs and preferences. The top three priorities are *U. kirkiana, A. boehmii* and *S. cocculoides*. The trees are highly regarded due to their food contribution to the households and their marketability. These trees are also used by households for medicinal purposes. It should be noted that *A. boehmii* has not featured in most in previous regional prioritisation programmes. The Current ICRAF domestication initiatives are focused on *Zizyphus mauritiana, Parinari curatellifolia, Strychnos cocculoides, Uapaca kirkiana,Sclerocarya birrea, Adansonia digitata, Vangueria anfausta*, *Syzigium cordatum* and *Vitex* Species (Maghembe *et al.* 1998), while the top four priority trees that have been identified through the tree domestication programme of ICRAF in southern Africa are *U. kirkiana*, *S. cocculoides, P. curatellifolia* and *S. birrea.* (Akinnifesi *et al* 2006). Further research on why *A. boehmii* has not been identified as a priority species in the regional domestication programmes must be investigated. There is therefore need to study the distribution of this species in the Miombo woodland, and also its propagation.

5.2.3 Contribution of IFTs to food security

The study revealed that the large majority of households in the study area consume indigenous fruits. It was also well-established that all the households interviewed collected more than one type of fruit. *U .kirkiana* and *A .boehmii* were the fruits collected the most by households. The other fruits collected are *Strychnos cocculoides* and *P. curatellifolia,* while *S. pungens, L. kirki S. guineense* are collected by fewer households. In the study area, it's evident that indigenous fruits are an important source of food to the households. Indigenous fruit therefore help to provide food security to rural households. The findings of this study are in agreement with various studies (Muok *et al.* 2001; Maghembe *et al* 1994; FAO 1983; Fashawe 1972) that have reported the importance of indigenous fruit as a dietary supplement. Akinnifesi *et al* (2006) reported that indigenous fruits are important in the Southern Africa Development Community (SADC) especially for marginalised groups in society. It has further been reported that indigenous fruits contribute on average about 42% of the natural food basket that rural households rely on in southern Africa (Akinnifesi *et al* 2006; Campbell *et al* 1997).

5.2.4 Harvesting methods of Indigenous fruit.

The study showed that rural people use various fruit harvesting methods. Fruit harvesting is done by knocking the fruit down with sticks, throwing objects to dislodge fruit, shaking the stem or branches, climbing the trees, and picking fruit up from the ground following abscission. Poor harvesting methods cause some fruits to sustain bruises, thereby reducing the fruit's shelf life. These results are similar to those of an earlier study by Kadzere *et al*. (2004), who reported that some harvesting methods can cause damage to the fruit trees and excessive bruising of the fruit.

It was observed that, after harvesting, there were losses of fruit due to poor harvesting and rough handling of the fruit, which caused the fruit to sustain cracks and bruises. The fruit that falls to the ground after abscission sometimes sustain bruises and cracks. The shacking of the tree stems and branches also causes some damage to fruits depending on the height to which the fruit fall and the ground surface. The group interviews revealed that the indigenous fruits that are affected are *U. kirkiana* and *A. boehmii,* due to their delicate outer covering when the fruit is fully ripe. Other fruits such as *S. cocculoides* and *S. pungens* have a hard outer covering, hence they do not easily get damaged. In an attempt to reduce post-harvest losses

of fruit, the local people use baskets called *museke* to transport *U. kirkiana* and *A. boehmii*. The *museke* allows the air to circulate through thereby avoiding fruit rot. The fruit that are very ripe are more susceptible to damage than those that are less ripe. To avoid these damages, some rural people prefer harvesting fruit that are not yet fully ripe.

In the study area, it's evident that the harvesting methods currently practiced cause some fruit losses. These considerable losses of fruits reduce the quantity and quality of fruit available for consumption and sale. These findings correspond to that by Saka *et al.* (2004) who reported that fresh fruit incur direct or indirect nutrient and general quality loss from the field to the consumer. In quantifying the amount of fruits lost, Wilson (2002 cited in Hughes and Haq 2003) reported post-harvest losses of fruit to be between 40 and 60%. Kordylas (1990) estimated post-harvest fruit loss to be 5-25% in developed countries compared to as much as 20-50% in developing countries. These losses are attributed to a lack of knowledge in fruit handling and marketing.

5.2.4.1 Constraints to sustainable harvesting

The absence of rules regarding the harvesting of IFTs is a constraint to sustainable usage. This study has revealed that there are no norms, either community-based or traditional, on harvesting of IFTs in the study area.

In open areas, there are no property rights, therefore, the forest resource is viewed as a common property. The free access and consequent exploitation of common resources has been termed by Hardin (1968) as the 'tragedy of common'. This is because unrestricted demand for a finite resources causes exploitation of the resources (Bromley and Cernea, 1989) as each individual's aim is to maximise his/her own benefits. This might be attributed to the fact that there are no incentives to act in a socially altruistic way (Hardin, 1968). It is therefore necessary to come up with IFTs policies that will empower community groups to manage the IFTs in open areas.

5.2.4.2 Fruit collection responsibilities

Collection of fruit is predominantly conducted by women and children. Women combine fruit collection with other daily activities such as collecting fuelwood, cooking and daily chores. This study confirms what other studies have reported on women as being the primary fruit

collectors (Schreckenberg 2004; Ruiz-Pérez *et al*. 1997). In Benin, the shea tree (*Vitellaria paradoxa*) is considered 'a gift from God to enable women to survive' (Schreckenberg 2004) because of its importance with respect to providing income to women through trading. Similarly, Ruiz-Pérez *et al*. (1997) reported that women were the major collectors and decision-makers with regard to the selling of indigenous fruits.

5.2.5 Fruit trade

In this study, almost a third of the households were involved in the fruit trade. Trading of the fruit is done by women, who sometimes delegate the task to the children. The income realised from this activity is usually administered by women. The trade of fruit depends on the market value of the species, which is determined by the demand of the fruit on the market. The major fruit that have market value are *U. kirkiana* and *A. boehmii*. Other fruit that are sold to a lesser extent are *S. cocculoides* and *P. curatellifolia.*

5.2.5.1 Factors influencing fruit trading

The major factors influencing the tendency to trade fruit are the cash needs of the households, and their access to other forms of income-generating activities. The tendency to sell fruit is more prevalent in households who use it to compensate for their limited access to other forms of income-generating activities. Other studies have also reported that fruit trading helps households to bridge cash flow problems (Mithöfer and Waibel, 2003)

It was well established in this study that gender affected the profile of traders of indigenous fruit. Women were the main traders of the fruit. This may be because through generations, the selling of indigenous fruit has been considered as a domain for women and has therefore traditionally been shunned by men. The findings of this study are similar to results obtained in a study in West Africa: Ndoye *et al.* (1995) estimated that trade of four indigenous fruit products (*Dacryodes edulis*, *Irvingia gabonensis*, *Cola acuminata* and *Ricinodendron heudelotii*) within Cameroon and the neighbouring countries involved mainly women as traders. According to Alderman *et al* (1995), Additional income from women's activities has proved to be beneficial for children's well-being, whereas men tend to spend a higher proportional of their income on personal use.

5.2.5.2 Constraints to trading of indigenous fruit

The study showed that only about one-third of the households that collect fruit sell the fruit. This indicates that, for the majority of the people, the fruits are mainly collected for individual consumption implying that indigenous fruits are important as a 'safety net'; as they supplement rural diets during times when households have very low food reserves (Kaaria, 1998). It was however, discovered that some people did not sell fruit in the rural market, due to fear of a possible oligopsony, which is a condition where the market is dominated by many sellers and few buyers. There are also no guidelines for setting fruit prices per unit, and the people lack market infrastructure and adequate storage facilities. Ham (2003) also identified lack of market infrastructure as a big problem associated with fruit trading. It was also reported by Akinnifessi *et al.* (2006) that indigenous fruit markets in southern Africa are largely informal, small and volatile. In order to improve trading of fruit, it is important to create infrastructure, and guideline concerning the pricing of the fruits.

5.2.6 Extent and scale of fruit processing

Fruit processing is undertaken to add value to the fruit. The study revealed that almost half of the households process fruit into juices and porridge, using traditional processing methods for household consumption. The fruit that are processed are *U. kirkiana, A. boehmii and P. curatellifolia.* In the area studied, there is no evidence of trade in processed fruit products. It was also reported that porridges are consumed mostly by children. Fruit processing increases the shelf life of the fruits. In this study, *A. boehmii* and *U. kirkiana* were reported to have a shelf life of between two to four days, which is in line with what other authors, such as Schomburg *et al*. (2002) have reported that the shelf life of *U. kirkiana* is two to three days. However, the shelf life of the fruit depends on the degree to which the fruit is ripened during harvesting as the fruits that are collected when fully ripe tended to have a shorter shelf life as compared to those that are partially ripe. Fruit processing can therefore be viewed as a way of reducing fruit wastage.

5.2.6.1 Current processed products

This study only revealed that the fruit were processed into either juice or porridge. Some studies have highlighted the processing of fruit into more products than what have been identified in this study. For example, Packham (1993) reported the brewing of 'musuku wine' from *U. kirkiana*. Similarly a study in Malawi by Kwesiga and Mwanza (1995) reported a brand of wine called *Mulunguzi*, a product of *U .kirkiana*. In another study in Tanzania,

Tiisekwa *et al* (2004) reported that *U. kirkiana* fruits have the required functional characteristics for juice and jam making. The fruits produced high quality juices and jams acceptable to consumers. The fruits of *Sclerocarya birrea* are used to make a liqueur (Amarula), which is traded worldwide (Akinnifesi *et al* 2006). In this regard, it would seem the processing of the fruits in the study area was limited to the knowledge that the local people have on the processing of different fruit species.

5.2.6.2 Analysis of local knowledge on fruit processing

There seems to be a lack of information with regard to production and processing of IFTs among the people studied. According to Sambo (1991, cited in Minae *et al.* 1995), people lack information on the propagation of IFTs, and therefore have to rely on natural regeneration. In this study, it may be argued that the local people are also unaware of the processing technologies that may be appropriate to their needs, despite the fact that technologies are being used elsewhere in Zambia and southern Africa. Several studies (Leakey, 1999; Packham, 1993; Kwesiga and Mwanza 1995; Mateke *et al*, 1995; Akinnifesi *et al*, 2006; Saka *et al.*, 2004) have highlighted the processing of IFTs into wine and jams by various groups, communities and small-scale enterprises, yet the information regarding this processing, which is very valuable to communities that utilise IFTs, is lacking in many communities. For example, Leakey (1999) reported that in Zambia, *U. kirkiana* was processed into local potent spirit *kachasu,* jams and cakes. Similarly, Akinnefisi *et al* (2006) highlighted the processing of *U. kirkiana* into *masuku* wine and jam in Zambia while Parinari nuts were processed into oil in Zimbabwe and Strychnos fruits into juice in Tanzania.

These fruits that are processed are available in the study area. This provides some evidence that in the area studied, the people probably have limited knowledge on the processing of indigenous fruit. Ham (2003) argued that the development of improved indigenous fruit processing technologies owed its effectiveness to the information being disseminated to communities who can use it in their everyday lives. In the current study, local people, however, expressed a need to access information on the processing of IFTs. Similarly Hughes and Haq (2003) also reported a willingness among farmers in Asia to receive information on production and consumption of IFTs. Tiisekwa *et al* (2004) stressed that if farmers in areas of fruit tree availability are trained, they can easily process the fruit during the fruiting season for

home consumption during the off-season and for sale to earn cash. Thus the IFTs can contribute to improving the food and nutritional security of rural people.

5.3 Medicinal value of indigenous fruit trees

Many wild plants are used as traditional medicines. Indigenous fruit trees are important sources of medicine for the rural people in the study area. The study revealed that almost two-thirds of the households use IFTs for medicinal purposes. In this study, fruit trees that were identified as important for medicine included *Anisophyllea boehmii*, *Uapaca kirkiana*, *Parinari curatellifolia* and *Strychnos cocculoides*. The use of indigenous trees for medicine is widespread probably due to poor health services which are often not stocked with drugs. Traditional medicine is preferred as the local people consider it to be effective. The knowledge about the medicinal use is passed through generations. The plant parts that are used are leaves, barks and roots. Tree barks are harvested using axes, while roots are harvested using hand hoes.

It's evident from the findings of study this that IFTs are important sources of medicine to the households. It has been reported by Mander and Le Breton (2006) that up to 80% of the world's population (mostly in developing countries) rely on traditional medicine for primary health care. The households interviewed were aware of the tree species and parts that are used to self-medicate a range of minor ailments. The healing properties of the medicine are closely tied to cultural beliefs (Mander and Le Breton, 2006).

The excessive harvesting of the bark, as observed in this study can have negative effects on the physiology of trees. Geldenhuys and Mitchell (2006) reported that intense and frequent harvesting of the bark can cause the trees to die. Unsustainable harvesting methods for medicinal plants have placed some tree species under immense pressure, resulting in some becoming rare or even extinct. For example, SNR (2005) in a study in Luapula province in Zambia, identified *Strychnos cocculoides*, *Strychnos spinosa* and *Garcinia huillensis*, as becoming rare. The disappearance of these plant species has been attributed to bad harvesting practices, which leave the plant unable to recover from harvesting shocks.

5.4 Threats to Indigenous fruit trees

The significant change in the forest cover reported by respondents as reflected in the perceived loss of biodiversity, reduction in forest size and scarcity of some species was attributed to land clearing for agriculture and charcoal production. Hence these factors are also seen as affecting availability of IFTs. These finding are supported by Hyde and Seve (1993), who reported that *U. kirkiana* is under threat of extinction in the Miombo due to high rates of deforestation, which has been compounded by little domestication (Ngulube *et al* 1995).

As mentioned in section 5.1.1 above, farmers in the study area practices a form of shifting cultivation. Agricultural expansion or the practice of shifting cultivation is known to contribute to huge annual losses of forest cover (Chidumayo, 1997; PFAP, 1998). The forests are opened up by cutting down trees, and then burning the clearfelled site. People clear the forest to make way for agriculturally based land use systems, which rely on the forest as a source of nutrients. The practice of slash-and-burn agriculture helps to release nutrients that are held in the plant components of the ecosystem. The released nutrients improve the soil for a short while. Once the nutrients are exhausted, people shift their clearing practices to a new forest area, in search of fertile soil. The increase in human population poses a challenge to this form of cultivation. This is because, due to population pressures, the fallowing period is becoming shorter, which has a negative impact on the fertility of the soil as is the case in this system. The forest biomass is the source of the nutrients; therefore, a reduced fallowing period causes a decrease on the biomass available to release nutrients.

Charcoal production also contributes to loss of biodiversity. The problem of charcoal production is prevalent in areas closer to urban centres (SNR, 2005). The high deforestation in the vicinity of urban areas is attributable to the high energy demand in these areas. Rural areas in the vicinity of urban areas meet this high demand by supplying charcoal. Due to the high electricity tariffs, most urban households use charcoal to meet part or all of their domestic energy demands, making charcoal a major household fuel in urban Zambia (Chidumayo 1997). With regard to the study area, the demand for charcoal in Kitwe is also high, providing a ready market for charcoal.

Over-exploitation of forest resources alters the structure and distribution of species. This change may result in an increasing loss of biodiversity. The reduction in forest size has a

negative impact on the household incomes, because a reduction in biodiversity results in a corresponding reduction on domestic income earnings for those who trade in forest products.

The findings of this research indicate that the highly threatened IFTs are *U. kirkiana and A. boehmii*, as the respondents indicated that with the passage of time, the fruits have become scarce, particularly in the nearby forest and open areas, and they have to walk increasingly long distances to collect the fruits. It is important to note that the IFTs that are highly preferred by the households are the ones that were identified as being under threat of extinction.

5.5 Domestication of IFTs.

In order to improve the contribution of the IFTs to the rural household livelihoods, it is vital to domesticate IFTs. Local planting, product development and market expansion are the first steps in domesticating wild fruits in fields, homesteads and communal areas (Maghembe *et al* 1998; Leakey *et al.*1994; Akinnifesi *et al.* 2006). The choice of which trees to domesticate follows a priority setting which identifies the most highly valued species. Domestication is likely to be effective when local people are involved in the process of priority setting of the tree species (Franzel *et al.* 1996). The top three priority IFTs are *U. kirkiana, A. boehmii* and *S. cocculoides*. There is therefore need to promote domestication of IFTs in the study area, and the trees that should take preference are those that are highly ranked by households, and were reported to be under threat. It is cardinal to consider domesticating the IFTs that are scarce, so as to maintain and broaden biodiversity. It is worth observing that the trees that are under threat are actually the same fruit trees that are ranked highly, i.e., *U. kirkiana* and *A. boehmii*. Domestication of IFTs is important as the indigenous fruit trees are vital for the survival of rural households as they provide food, medicines and are source of income.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

The objective of this study was to investigate the role of IFTs in the rural livelihoods, with the aim of establishing the use and management of the IFTs in the study area. The purpose of this study was both exploratory and descriptive; hence, the data collection methods that were used are the participatory rural appraisal and a household survey.

6.1 Conclusion

Rural households in the Mwekera area are faced with food insecurity and experience regular hunger periods lasting on average four months every year, indicating substantial rural poverty. This rural poverty was evident through the activities that rural households ventured into such as farming, charcoal production and the selling of biodiversity products to sustain their livelihoods.

The local people in Mwekera have access to various species of IFTs. This study has revealed that indigenous fruit trees play a significant role in people's livelihoods. Indigenous fruits are a source of food and means of generating cash that is essential for sustaining rural communities. The fruits are used as a safety net in times of hardships which concurs with the findings of studies conducted elsewhere in southern Africa (Maghembe 1995; Akinnifesi *et al*. 2006). However, it was established that fewer households are involved in fruit trading which was predominantly informal and strongly influenced by seasonality of the indigenous fruits.

The study also revealed that fruit collection was a traditionally female dominated activity and that *U. kirkiana, A. boehmii and P. curatellifolia* are the most preferred species due to their contribution as a food supplement to the households and their marketability. In addition, *Uapaca kirkiana* and *Anisophyllea boehmii* were more valued because of their commercialization potential while *Parinari curatellifolia* compliments the food requirement during the lean periods.

While the households exhibited useful knowledge on the processing of some indigenous fruit, there was no evidence of trade in processed products. The main products after processing

were only local juices and porridges for household consumption. There was an obvious lack of information on processing of fruits into other products such as wines, oils and jams.

Apart from the fruits collected, the study revealed that tree parts such as leaves, roots and barks are important for traditional medicine with *A. boehmii, S. cocculoides, U. kirkiana* and *P. curatellifolia* as being very useful medicinal tree species. However, the significant change in the forest cover has also resulted in increased scarcity of some tree species; most notably *A. boehmii and U. kirkiana*. The degradation of forests has resulted in an increase in the level poverty in the study area due to reduction of domestic income that depends on forest utilization, while there is also a reduction in the fruits available to the household for consumption.

6.2 Recommendations

In order to promote sustainable utilization and management of indigenous fruit, the following recommendations are suggested:

- In order to improve the processing and marketing of IFTs, the rural community must be provided with information on harvesting, use and processing as well as regular marketing information on the potential fruit markets. The government and stakeholders must link the rural fruit producers with possible markets including international markets.

- There is also need for organizations promoting indigenous fruit use to organize workshops in rural areas so as to enlighten people on various aspects of IFT. There is need for training programmes for the communities in relevant aspects of IFTs including the use of appropriate machinery/equipment.

- There is need to strengthen/promote deliberate growing of the trees to increase future raw material supplies. The existing forest policy must be reviewed, modified and enforced to ensure they adequately address indigenous resource conservation and loss of biodiversity.

- In order to reduce deforestation that is caused by expansion of agriculture land, sustainable farming systems such as crop rotation and agroforestry must be introduced

in the area so as to maintain and possibly improve soil fertility. In addition, the government and stakeholders should consider identifying alternative income generating activities for the rural communities particularly those involved in charcoal production as a way of curbing deforestation.

- Finally, there is a need to support domestication of the preferred indigenous fruit species by the households. Thus, the reproductive biology and ecology of particularly species such as A. *boehmii*, which has been poorly researched, must be investigated as a way of improving the quality of the IFTS, through participatory selection for desired traits; followed by vegetative propagation in order to shorten the time taken to produce fruits.

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APPENDICES

Appendix 1: Status of forest reserves in the Copperbelt province

Name of forest	Area (Ha)	Status
Kasaria Forest Reserve	6 273	Encroached
Njiri Forest Reserve	6 698	Heavily encroached
Lumina Forest Reserve	4 530	encroached
Ngala Forest Reserve	2 752	Intact
Mufulira Forest Reserve	6 568	Heavily Encroached
Nsato Forest Reserve	15 000	Encroached
Mwekera National Forest	17 887	Under pressure
Misaka National Forest	28 321	Depleted
Maposa Local Forest	10 021	Depleted
Ichimpe National Forest	10 141	Depleted
Karibu Local Forest	174	Depleted
Nkana North		Depleted
T Chisenga National Forest	4 706	Depleted
Muva Local Forest	3 216	Partially degazetted
Masansa National Forest	1 149	
Lufubu Botanical Reserve	63	
Roan Local Forest	3 853	Degraded
Lushishi National Forest	6 393	Encroached
Luano National Forest	13 944	Settled in
Ndola	2 910	Under ZAFFICO plantations
Ndola West	2 140	Under ZAFFICO plantations
Chichele	2 560	Under ZAFFICO plantations
Misaka	28 400	Under ZAFFICO plantations
Kasafwe	2 270	Almost depleted
Miengwe	8 094	Intact
Bwana Mkubwa	1 704	Depleted
Katanino	4 532	4 131 ha marked for degazation
Songwe Welala	5 698	4 131 ha marked for degazation
Chondwe	3 223	partially degraded
Hippo pool	5 500	Degraded
Nsato	15 216	Intact
Border	6 900	partially degraded
Dome	3 622	Intact
Kafwila National Forest	12 800	Intact
Kirila	2 066	Depleted
Kameza	7 228	Half still intact
Konkola National Forest	3 845	Intact
Lamba protested Forest Area	154 500	Settled in
Chati	40 165	Encroached & Depleted
Chibuluma No.975	1 437	
Chibuluma No.972	720	
Chisenga	4 706	Encroached & Depleted
Chisangwa	9 793	Encroached & Depleted
Lamba Headwaters)	154 500	Encroached

Source: PFAP 1998

Appendix 2: Questionnaire for household interviews

Respondent Ref No ☐☐

Date of interview ☐☐ December, 2006

INSTRUCTION: CIRCLE ROUND THE NUMBER WITH THE CORRESPONDING ANSWER

A. Interviewee's profile data

Respondents name :					
Sex (Circle)	1. Male			2. Female	
Age ☐☐					
Marital status	1. Never Married	2. Married	3. Widow	4. Divorced	
Number of individuals in household ☐☐					

B. Livelihood

1. Do the means in which you earn a living vary throughout the year
   1. Yes
   2. No

2. [ACTIVITIES THAT THE HOUSEHOLD DOES TO EARN A LIVING]
   1. Charcoal (selling)
   2. Agriculture
   3. Selling of indigenous fruit
   4. Mushrooms
   5. Piece work

   Other (please specify) _____

   _____

3. Does your household often experience a 'hunger period'
   1. Yes [Go to next question]
   2. No [Go to table on next page]

4. Which period of the year is the 'hunger period?
   1. Rain season
   2. Cold season
   3. Hot season

C. Collection of fruit

1. [COMPLETE THE TABLE]

Product code	Indigenous fruit species	1.Did any member of the household collect any fruit from the forest during the last 12 months [ASK Q1 FOR ALL FRUITS FIRST] 1. Yes 2. No	2. Which of the fruits did you sell? 1. Yes(Sold) 2. No (Not sold)	3. How much [FRUIT] does your household sell in a week?	4. What price did you get for the [FRUIT NAME] that you sold? [IF MORE THAN ONE PRICE, GET THE AVERAGE]
1	Masuku				
2	Imfungo				
3	Intungulu				
4	Tusongole				
5	Mpundu				
6	Others (Specify)				

1. Who are the main collectors of indigenous fruit in your household?
   1. Men
   2. Women
   3. Children
   4. All of the above equally

2. Are there any factors that prevent your household from collecting fruits?
   1. Yes
   2. No [Go to question 4]

3. Please describe the factors.

_____

_____

_____

4. [PROBE THE UTILIZATION OF INDIGENOUS FRUIT USING THE A SCALE OF 1 TO 4, WITH 1 BEING THE GENDER OR AGE THAT IS VERY HIGHLY INVOLVED IN AN ACTIVITY, 2 MODERATELY INVOLVED, 3 SLIGHTLY INVOLVED, 4 NOT AT ALL]

	Boys ≤ 16	Girls ≤16	Women ≥17	Men ≥ 17
Collection				
Eating				
Selling				

5. [RECORD THE PLACE OF HARVEST, HARVESTING METHODS AND MONTH OF HARVEST FOR ANY OF THE FOLLOWING FRUIT TREE(S) USED IN THE HOUSEHOLD.]

Fruit species	Place of harvest	Harvesting method	Month
Masuku			
Imfungo			
Intungulu			
Tusongole			
Mpundu			
Others (Specify)_____			
_____			
_____			

6. Are there any rules for harvesting indigenous fruits in the area or community?
   1. Yes
   2. No [Go to question 8]

7. Does the household process fruit in any way?
   1. Yes
   2. No [Go to question 9]

8 .If yes, what processes do you carry out for home consumption and for commercial use?

Fruit	Processing for home consumption 1. Wine 2. Jam. 3. Juice 4. Porridge. Others please specify	Processing for commercial use 1. Wine 2.Jam 3. Juice Others please specify
Masuku		
Imfungo		
Intungulu		
Tusongole		
Mpundu		
Others (Specify)		

9 Are there any indigenous fruit trees that your household uses for medicinal purposes?
   1. Yes
   2. No [Go to question 11]

10 If yes, complete the following table

Species	Part of the tree used 1. Leaves. 2. Barks. 3. Roots Others please specify	Disease treated
Masuku		
Imfungo		
Intungulu		
Tusongole		
Mpundu		
Others (Specify)		

11. Rank the 3 most important indigenous fruit trees in terms of their importance to your household

Rank	Indigenous fruit tree
1	
2	
3	

12. What was your ranking based on?
1. Selling of the fruit
2. Using of the fruit at home
Other (please specify) _____

_____

13. Does your household privately own any indigenous fruit trees?
1. Yes
2. No

14. Does your household have access to money lending facilities?
1. Yes
2. No

15. Does access to loans vary between women and men?
1. Yes
2. No [Go to part D]

16. In what ways does access of loans defer between women and men?

_____

_____

_____

D. PERCEPTION OF WOODLAND DEGRADATION

1. Have you witnessed a change in the forest over the last 10 years?
   1. Yes
   2. No [Go to question 4]
   3. Unsure/Don't know [Go to question 4]

2. How has the forest changed?

   1. It's harder to get products from the forest
   2. The forest is smaller, there are fewer trees
   3. It's harder to get certain species of trees
   Other (please specify) _____

   _____

   _____

3. How has the change of the forest affected your household?

   1. Does not affect me
   2. Need more time to collect products
   Other (please specify) _____

_____

_____

4. Among the indigenous fruits that exist in your area, are there any trees that you would say have become scarce?

   1. Yes
   2. No [Go to question 10]

5. If your answer is yes, which indigenous fruit trees in your village have become scarce?
   1. Masuku
   2. Mpundu
   3. Mfungo
   4. Intungulu
   5. Tusongole

   Others (please specify) _____
   _____
   _____

6. For the indigenous fruits that are scarce, what in your view is the major cause of their scarcity?

1. Charcoal making
2. Timber extraction
3. Clearance for farming

Other (please specify)_____
_____
_____

7. Are there any organizations you know that are working in your area that are assisting with management of indigenous fruit trees?

   1. Yes
   2. No [Go to question 13]
   3. Unsure/Don't know [Go to question 13]

8. Do these organizations involve the local people in management of the IFTs?
   1. To a great extent
   2. To a moderate extent
   3. To a slight extent
   4. Not at all [Go to question 13]

9. If your answer is 1,2or 3, how are the local people involved?

_____

_____

_____

_____

10. Does the community have rules or regulations for protecting indigenous fruit trees?
    1. Yes
    2. No [Go to question 15]

11. If the answer is yes, are the rules being adhered to?
    1. Always
    2. Seldom
    3. Never

12. If the answer to question 15 is never or seldom, why are the rules not adhered to?

_____

_____

_____

Thank the respondent for according you time for the interview.