UTILISATION OF INDIGENOUS FRUIT BY RURAL COMMUNITIES IN MWANZA DISTRICT, MALAWI

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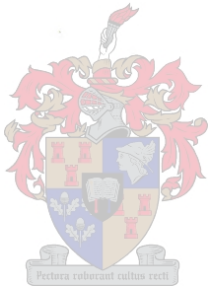
Thesis presented in partial fulfilment of the requirements for the degree of Master of Science in Forestry Sciences at the University of Stellenbosch



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March 2002

University of Stellenbosch

DECLARATION

I, the undersigned, 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.

ABSTRACT

Deforestation in Malawi is said to reach 2.3% per annum and negatively affects agricultural production, the backbone of the country's economy. High dependence on indigenous wood for sale as fuelwood or charcoal by rural communities due to poverty largely contributes to this deforestation. Women and children suffer most because they spend more time collecting firewood than men, affecting other activities like child-care and education.

The study, aimed at investigating ways to alleviate deforestation by increasing rural people's economic benefits from non-destructive indigenous fruit utilisation, was conducted in Mwanza District from February to June 2001. The district's customary forests which contain a wide variety of wild fruit species are currently deforested due mainly to charcoal production. Five out of 16 villages facing deforestation were randomly chosen by the lottery method. Group, individual and key informant interviews focused on the utilisation of preferred fruit species by communities while participatory resource assessment was used to determine availability and distribution of fruit trees. A market survey to assess fruit trade in the country was conducted in Balaka, Blantyre, Mangochi, Mwanza and Zomba Districts in early June 2001.

Twenty-six wild fruit species were found to be utilised by villagers in the study area but *Adansonia digitata* (Baobab) was the most commonly found near villages and the most preferred fruit by 90% of respondents. Other preferred species were *Tamarindus indica* (Tamarind), *Diospyros kirkii*, *Flacourtia indica* and *Vangueria infausta.* Most fruit trees except for baobab were found to be of small size classes because of being young stems regenerating while others were shrubs. The poor largely depended on fruit as a meal and for sale. Mainly children and women sold baobab and tamarind within the villages while only men sold fruit at distant markets for more income. Middlemen largely benefited from fruit sales compared to villagers who sold at low prices and lacked marketing information. Fruit rot affected retailers outside the study area. Tree climbing to harvest fruit was mainly done by boys and destructive harvesting methods were associated with commercial use. Large, sweet tasting fruit were mainly chosen by rural communities for subsistence use. Land clearance, mast fruiting, perishability and seasonality of fruit seemed to have affected harvest both for subsistence and for sale. However, 89% of households owned fruit trees in homesteads and agricultural fields, said to be more protected than in communal lands with open access. Preferred wild fruit trees were rarely cut by the communities. Local fruit processing, mainly by women, included porridge and juice making and fruit drying while careful storage enabled baobab fruit to be stored for up to a year.

Wild fruit plays an important role in the lives of rural communities mainly the poor. Communities attach value to the preferred fruit species but it is difficult to convince most of them to sell wild fruit unless value is added and price incentives are initiated. Regular marketing information could be provided to rural communities and policy makers should set fruit pricing guidelines to create price incentives. Domestication of the preferred fruit trees should be encouraged for continuous fruit supply. Simple fruit processing technologies for commercial purpose could be initiated for women mostly. Research is needed to determine sustainable harvesting levels of wild fruit and ways for participatory monitoring of the levels and harvesting methods used.

OPSOMMING

Ontbossing in Malawi beloop 2.3% per jaar, wat beteken dat landbouproduksie, die ruggraat van die land se ekonomie, negatief geaffekteer word. Wat grootliks bydra tot hierdie ontbossing is dat die plattelandse gemeenskappe as gevolg van armoede hoogs afhanklik is van inheemse hout wat as brandhout of as houtskool verkoop word. Vroue en kinders ly die meeste omdat hulle meer tyd as mans spandeer om vuurmaakhout bymekaar te maak. Dit affekteer ander aktiwiteite soos kindersorg en opvoeding.

Hierdie studie het ten doel om maniere te ondersoek waarvolgens ontbossing verlig kan word deur mense op die platteland se ekonomiese voordele uit die benutting van inheemse vrugte te vermeerder sonder dat daar enige omgewingskade aangebring word. Die studie is uitgevoer in die Mwanza Distrik vanaf Februarie 2001 tot Junie 2001. Die distrik se inheemse bosse wat 'n wye verskeidenheid wilde vrugtespesies bevat, word tans ontbos – hoofsaaklik as gevolg van die produksie van houtskool. Vyf uit die 16 dorpies wat ontbossing in die gesig staar, is op 'n lukrake wyse met die loterymetode gekies. In die onderhoude met groepe, individue, en sleutelinformante is gefokus op die benutting van vrugtespesies wat deur die gemeenskappe verkies word. Hulpbronevaluering is gebruik om die beskikbaarheid en verspreiding van vrugtebome te bepaal. Die gemeenskap is by hierdie evaluering betrek. Marknavorsing om vrugtehandel in die land te evalueer, is vroeg in Junie 2001 in die Balaka, Blantyre, Mangochi, Mwanza en Zomba distrikte gedoen.

In die studie is bevind dat die inwoners van die area wat bestudeer is 26 wilde vrugtespesies benut. *Adansonia digitata* (Baobab/Kremetartboom) is egter die meeste naby die dorpies aangetref, en is deur 90% van die respondente as hulle gunsteling vrug aangedui. Ander gewilde spesies is *Tamarindus indica* (Tamarinde/Suurdadelboom), *Diospyros kirkii, Flacourtia indica* en *Vangueria infausta.* Die meeste vrugtebome, behalwe die baobab, val in die laer klasse wat grootte betref, omdat dit die jong lote is wat regenereer, terwyl ander struike is. Die arm mense is grootliks afhanklik van vrugte as 'n maaltyd en as verkoopsartikels. Hoofsaaklik kinders en vroue verkoop baobab- en tamarindevrugte in die dorpies, terwyl vrugte by verafgeleë markte slegs deur mans vir 'n groter inkomste verkoop word. Die middelman trek grootliks voordeel uit vrugteverkope, in vergelyking met die inwoners van die dorpies wat vrugte teen lae pryse verkoop as gevolg van 'n tekort aan bemarkingsinligting. Kleinhandelaars buite die studie-area is deur vrugteverrotting geaffekteer. Dit is hoofsaaklik seuns wat die bome klim om vrugte te oes, en destruktiewe oesmetodes is met kommersiële gebruik geassosieer. Plattelandse gemeenskappe verkies hoofsaaklik groot, soet vrugte vir bestaansgebruik. Dit wil voorkom of grondopruiming, die vrugvorming van byvoorbeeld akkers (*mast fruiting*), die bederfbaarheid en seisoensgebondenheid van vrugte, die oes affekteer vir bestaansgebruik sowel as vir verkope. Vrugtebome word egter deur 89% van die huishoudings besit en die bome by hierdie huise en in landbouvelde word beter beskerm as dié in gemeenskaplike lande met vrye toegang. Die gemeenskappe kap selde hulle gunsteling wilde vrugtebome uit. Plaaslike vrugteverwerking, hoofsaaklik deur vroue, sluit in die maak van pap en sap, asook die droog van vrugte, terwyl sorgvuldige bewaring daartoe kan lei dat baobabvrugte vir tot 'n jaar lank gebêre kan word.

Wilde vrugte speel 'n belangrike rol in die lewens van plattelandse gemeenskappe, veral vir die armes. Die gemeenskappe heg waarde aan hulle gunstelingvrugtespesies, maar dit is moeilik om die meeste te oortuig om wilde vrugte te verkoop – behalwe as waarde bygevoeg word en prysaansporings ingestel word. Gereelde bemarkingsinligting kan aan plattelandse gemeenskappe voorsien word, en beleidbepalers behoort riglyne vir vrugtepryse daar te stel om prysaansporings te skep. Die mense behoort aangemoedig te word om hulle gunstelingvrugtebome by hulle huise te plant om 'n voortdurende vrugtevoorraad te verseker. Eenvoudige vrugteverwerkingtegnologie kan vir kommersiële doeleindes vir hoofsaaklik vroue ingestel word. Navorsing is nodig om volhoubare oesvlakke van wilde vrugte te bepaal, sowel as maniere vir die deelnemende monitering van hierdie vlakke en die oesmetodes wat gebruik word.

DEDICATION

This thesis is dedicated to my dear wife Mary and daughters Hazel, Pokelani and Carolyn.

ACKNOWLEDGEMENTS

I am sincerely grateful to the following:

- The German Technical Cooperation Agency (GTZ) and the German Academic Exchange Service (DAAD) whose financial support covered my studies at Stellenbosch University.
- Mr. M. Skottke and Dr. C. Fedlmeier (GTZ) for facilitating my sponsorship.
- The Ministry of Natural Resources for granting me permission to pursue my studies.
- My supervisor, Dr. I.M. Grundy (University of Stellenbosch) for her untiring guidance throughout my study period.
- Mr. J. Mwitwa, a Ph.D. student at Stellenbosch University for his great pieces of advice on my work.
- Mrs. A. Sadie for her assistance in statistical analysis of data.
- The Department of Forestry Headquarters Office, Mwanza District Forestry staff, Forestry Research Institute of Malawi (FRIM) staff, Mr. D. Jumbe and all forestry extension officers who assisted me in so many ways during my research work.
- The Wildlife Society of Malawi (WSM) staff, particularly D. Mauambeta, R. Mwamadi and S. Mkovole for providing me with useful information related to the study.
- The National Herbarium and Botanic Gardens for identifying samples from the field.
- My wife, children, father, brothers and sisters and all friends both at Stellenbosch University and in Malawi for their moral support throughout my study time.
- All people who in one way or another contributed to the success of the study.

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1 INTRODUCTION

1.1 Malawi

Malawi is a land locked country and is located between latitudes 09°22'S to 17°08'S and longitudes 33°40'E to 35°55'E. It covers an area of 118 000 km² of which 24 000 km² is comprised of Lakes Malawi, Chilwa and Malombe. The country is bordered by Tanzania, Mozambique and Zambia (Masamba, 1999) (Figure 1.1). In general, climate in Malawi varies, ranging from tropical, warm and semi-arid to sub-humid and humid. Rainfall occurs in a single season between November and April (Bunderson *et al.*, 1995; Masamba, 1999), annually ranging from 600 mm to 3 000 mm (GOM, 1996). Temperatures vary with season and altitude. October and November are the hottest months whereas June and July are the coolest (Bunderson *et al.*, 1995) with average annual temperatures of almost 20°C (Masamba, 1999).

1.1.1 Topographical areas: high, medium and lowland regions

Malawi is categorised into three distinct topographical areas. The high-altitude plateau ranges from 1 400 m to 2 300 m above sea level, with peaks reaching 3 000 m a.s.l. The highlands comprise Zomba and Mulanje Mountains in the South, Dedza Plateau in the Centre and Viphya and Nyika Plateaus in the North. The highest point in the country is Mulanje Mountain, which is 3 002 m a.s.l. The average annual temperature of this category is 13°C whereas average annual rainfall amounts range from 1 000 mm to 1 500 mm. Secondly, the medium-altitude plateau category falls between 800 m and 1 400 m a.s.l. It comprises more than 75% of the land surface. Average annual temperatures range from 19°C to 21°C whereas average rainfall amounts range from 800 mm to 1 000 mm annually. Finally, the Rift Valley Plains found along the lakes and the Shire River range from 50 m to 800 m a.s.l. Average annual temperature is 26°C but in the hottest months, the temperature reaches 38°C. Average annual rainfall is below 800 mm (Bunderson *et al.*, 1995; GOM, 1995; Masamba, 1999).

Figure 1.1. Malawi, showing its location in central Africa (CIA, 1985).

1.1.2 Silvicultural zones

There are 12 silvicultural zones in the country as given in Appendix 1.1. The zones are mainly based on climate.

1.1.3 The *miombo* woodlands

The *miombo* woodland region stretches from Tanzania and the Democratic Republic of Congo in the North to Zimbabwe in the South and from Angola to Mozambique through Zambia and Malawi. A number of rivers including the Zambezi, Ruvuma, Rufiji, Zaire and Cuanza originate from the region (Campbell *et al.*, 1996) (Figure 1.2).

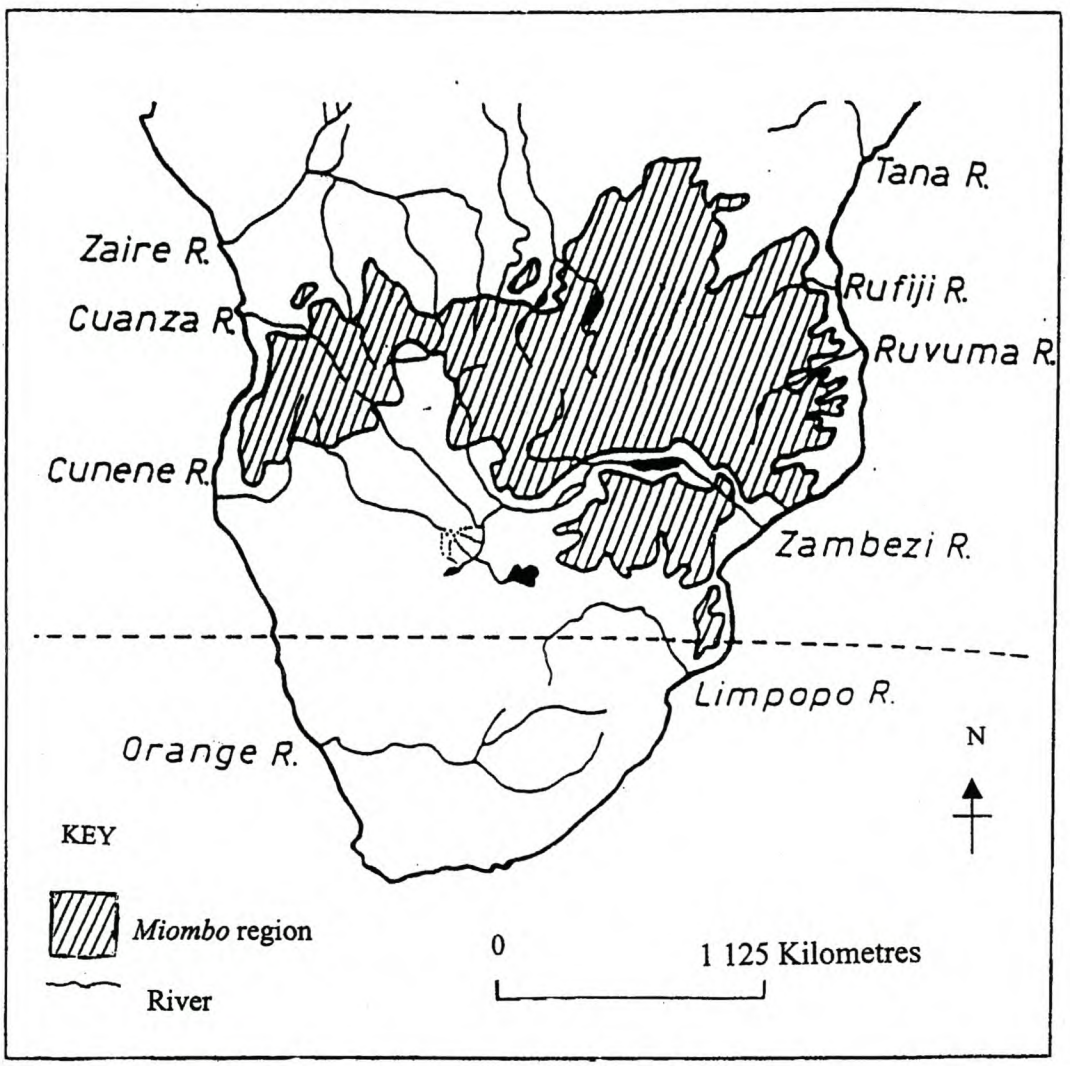

Figure 1.2. The *miombo* woodland region (Campbell *et al.*, 1996).

In Malawi, the two most commonly found vegetation types are *miombo* woodlands and wooded savanna. They are mainly confined to the medium-altitude plateaus. In the *miombo* woodlands, *Brachystegia*, *Julbernardia* and *Isoberlinea* tree species

dominate whereas in the wooded savanna, the *Acacia, Piliostigma* and *Combretum* tree species are common (Masamba, 1999). The montane grassland vegetation dominates the high-altitude plateaus whereas the rift valley plains have a savanna bush-grassland and a thicket including some *Adansonia digitata* (Baobab), *Acacia* spp., *Sterculia* spp., and *Cordyla africana* (Bunderson *et al.*, 1995; Masamba, 1999).

Non-wood forest products like edible indigenous fruit, insects, mushrooms, traditional medicine, curios, fibres, vegetables and wild animals are collected from the woodlands (Brigham *et al.*, 1996). According to Peters (1995), non-timber forest products are resources other than timber harvested from the forests.

1.1.4 Land tenure

Land tenure in Malawi falls into three main categories namely, public land, private land and customary land. Public land, which constitutes 24% of the total land, belongs to the Government. It mainly includes national parks, game and forest reserves. Private land mainly comprises agricultural estates. The estate sector largely produces tobacco, sugar, tea and coffee for exportation. The land is acquired either under a freehold or a leasehold title or under the Registered Land Act. It constitutes 13% of the total land area. Customary land comprises all land under customary law and is governed by traditional leaders. It consists of agricultural land and the natural woodlands, estimated at 63% of the total land area in this category. Customary forests cover approximately 50% of the forested area in Malawi (GOM, 1996; Anon., 1998).

1.1.5 Population

In 1999, the country's population was 10.8 million people with an annual population growth rate of 2.4% and average population density was 114.7 people per km^2 (Table 1.1).

Table 1.1. Human population in Malawi :1995, 1998 and 1999

	1995	1998	1999
Total population	9.8 million	10.5 million	10.8 million
Population density (people/km²)	103.7	112.0	114.7
Annual population growth (%)	2.7	2.5	2.4
Rural population density (people/km²)	424.6	436.5	[1]INA

[1]INA denotes information not available.

Source: WDID, 2000.

1.2 Indigenous fruit in Malawi

A fruit is defined botanically as a ripened ovary of a seed plant. Indigenous fruit trees have been defined by Bunderson *et al.* (1995) as natives to a specific area and trees having not been introduced into the area. However, in this study, fruit trees that have been naturalised in Malawi like *Tamarindus indica* (Tamarind) and *Ziziphus mauritiana* have been included. Some sources such as Campbell (1987) and Clarke *et al.* (1996) have referred to indigenous fruit as wild fruit; this study uses both terms interchangeably.

Most of the edible indigenous fruit occur naturally in savanna woodlands. They include *A. digitata, Annona senegalensis, Azanza garckeana, Berchemia discolor, Diospyros kirkii, Flacourtia indica, Bauhinia thonningii, Sclerocarya birrea, Strychnos innocua, Strychnos spinosa* and *Vangueria infausta* (Mauambeta, 1994; Lawrence and Abbot, 1995; Malembo *et al.*, 1998). Indigenous fruit can have both nutritional and economical values (Malembo *et al.*, 1998). Saka and Msonthi (1994) reported 16 edible indigenous fruit growing in Malawi which were analysed for nutritional values. The highest energy value was from *S. spinosa* (1 923 KJ/100g). *Parinari curatellifolia* had the highest carbohydrate content of 88.2%.

Some indigenous fruit species like *Garcinia livingstonei, P. curatellifolia, S. spinosa, U. kirkiana* and *Z. mauritiana* are eaten fresh or after being processed. *Ziziphus mauritiana* is made into a local spirit (*Kachasu*) but is also dried and processed into

jams, jellies, chutneys and wine. Sometimes it is used as a sweetener in porridge (FRIM, 1997; Leakey, 1999). *Uapaca kirkiana* is made into an alcoholic drink (Pullinger and Kitchin, 1982; Malembo *et al.*, 1998; Meke, 1998). Marmalade can be made from the fruit of *S. innocua* and oil is extracted from the nut (Mateke *et al.*, 1995). *Parinari curatellifolia* is processed into alcoholic and non-alcoholic drinks, porridge and oil (Pullinger and Kitchin, 1982; Mateke *et al.*, 1995).

Fruit species that are reported to have commercial value include *A. digitata*, *A. garckeana*, *P. curatellifolia, T. indica*, *U. kirkiana* and *Z. mauritiana*. They are sold in local and main markets in Malawi and other countries (Pullinger and Kitchin, 1982; Minae *et al.*, 1995; Campbell *et al.*, 1997; FRIM, 1997; Malembo *et al.*, 1998; Meke, 1998).

Rural communities also use fruit trees as a source of traditional medicine. Tree parts utilised include the barks, leaves and roots. Trees like *B. thonningii, Diospyros mespiliformis, Ficus sycomorus, S. birrea* and *Ziziphus* spp. are reported to be effective against health problems resulting from malaria, pneumonia, intestinal worms and snake-bites among others (FAO, 1982; Pullinger and Kitchin, 1982; FAO, 1983; Storrs, 1995). Most indigenous fruit trees are used for fuelwood, carvings and tool handles. Dyes from the roots and tannin from the barks of some trees are extracted, for example *Parkia filicoidea* (bark) and *B. thonningii* (roots) (Pullinger and Kitchin, 1982; Storrs, 1995).

1.3 Legislation on customary land resource utilisation in Malawi

The current Forest Act of Malawi was enacted in 1997, replacing that of 1947, which was outdated. The 1947 Act overlooked the involvement of local communities in forest conservation and management on customary land. It also did not specify the rights communities had to own, sustainably manage and utilise forest resources on customary land (MNR, 1996). One of the purposes of the new Act is to promote the management and protection of forest resources on customary land to satisfy local communities' needs for forest produce. The Act provides for the demarcation and management of Village Forest Areas (VFAs) on customary land. It stipulates that local communities should be empowered to look after the VFAs through the

formation of Village Natural Resources Management Committees (VNRMCs). By-laws to safeguard the management and utilisation of forest resources on customary land are made by the village committees and approved by the Minister responsible. The Act also stipulates that any villager is free to collect forest produce for domestic use, including indigenous fruit from customary land. This provision excludes extraction of resources from VFAs since these are managed under the approved village regulations. Unless under a licence, charcoal production and commercialisation in customary forests, forest reserves and other protected areas is illegal in the country (MFFEA, 1997). One of the specific objectives of the Act is to remove any barrier that prevents local communities from having access to the utilisation of essential forest products on a sustainable basis (MNR, 1996; GOM, 1998).

1.4 Problem statement

Malawi remains one of the poorest countries in the world. It has no significant mineral resources but instead relies on agriculture as the backbone of its economy. Its Gross Domestic Product (GDP) per capita was US$190 in 1997 (WDID, 2000). Deforestation rates have been reported as being more than 2% per annum. The total forest cover in Malawi declined by 41% between 1972 and 1990 with about 90 000 hectares lost per year. This is an average loss of 2.3 % per annum. Much of the deforestation has been evidenced on customary land that is occupied by 90% of the country's population (Bunderson and Hayes, 1995; FSTCU, 1999). One of the factors contributing to deforestation is the high dependence on indigenous trees as a source of income to support rural communities. Bundles of firewood and bags of charcoal made from indigenous trees have long been sold along the major roads (Banda, 1999; Mweninguwe, 1999).

Effects of deforestation include loss of soil fertility, which negatively affects agricultural production. Another effect is that mostly women and children face the hardship of having to walk great distances and spend more time collecting fuelwood, which causes other activities like child care, education and farming to suffer (Bunderson *et al.*, 1995; Malembo *et al.*, 1998).

1.5 Justification for the study

Despite people's reliance on indigenous fruit for their nutritional, financial and other requirements, research on utilisation of indigenous fruit in Malawi is scanty (Malembo *et al.*, 1998). Quantities used and factors influencing rural community utilisation of indigenous fruit in Malawi have not been documented. Although there is growing interest by some non-governmental organisations (NGOs) in promoting natural resources management through community based projects, their efforts are focused on a wide range of non-timber forest products. The Wildlife Society of Malawi (WSM), for example, is not only engaged in promoting rural community commercialisation of indigenous fruit but also domestication of guinea fowl, cane furniture production, bee-keeping and briquette making (Mwamadi, 1999). In such a case, in-depth information on indigenous fruit utilisation is not available. Most projects are too young to provide enough information in the meantime (Chadza and Kamoto, 2000; Mkamanga and Chimutu, 2001). Clarke *et al.* (1996) noted that in general not much processing of indigenous fruit had been documented in the region. This study aims to fill some of the existing information gaps concerning indigenous fruit utilisation.

1.6 Aim, objectives and major research questions

The aim of this study is to document how rural communities can obtain non-destructive economic benefits from indigenous fruit trees so that they can broaden their livelihood strategies and reduce their dependence on indigenous wood for sale as a means to earn cash. It is envisaged that deforestation will be alleviated in the long run.

The objectives are:

I. To solicit and provide information on:
    a. The main factors that influence subsistence and commercial utilisation of indigenous fruit by rural communities.
    b. Problems associated with utilisation of indigenous fruit in rural communities.

II. To generate recommendations on:
    a. Promoting the utilisation of indigenous fruit by rural communities as a means of income generation.
    b. Reducing harmful effects of sustainable utilisation of indigenous fruit based on the current methods of harvesting.

Major research questions were:

1. Availability of indigenous fruit trees:
    a) What is the availability and distribution of indigenous fruit trees?
    b) What factors affect availability of indigenous fruit trees?

2. Harvesting of indigenous fruit:
    a) What are the harvesting methods of indigenous fruit?
    b) What factors influence destructive harvesting methods of fruit?

3. Shelf life, processing and storage of indigenous fruit:
    a) Does perishability of indigenous fruit affect the amount and type of utilisation?
    b) What fruit processing activities are being employed for subsistence and commercial purposes?
    c) What fruit storage activities and facilities are in place to prevent fruit losses?

4. Does the social group in terms of age, gender and household wealth affect fruit quantities utilised and type of utilisation?

2 MATERIALS AND METHODS

2.1 Study area

The study was conducted in Mwanza District, located on the western side of the southern region of Malawi from February to May 2001 (Figure 2.1). It comprised a resource assessment, and group, individual and key informant interviews. Mwanza District was chosen because it contains customary forests with a wide range of indigenous fruit trees whose fruit are utilised for both subsistence and commercial purposes. In addition, indigenous forests in the district are subjected to deforestation due to the sale of indigenous trees in the form of firewood and charcoal (Mlotha and Jambo, 1998).

Sixteen villages were identified as having met the research requirements with the assistance of the Mwanza District Forestry Officer and forestry extension workers in the district. The requirements were:

i. Being less than 2 km from customary forest with indigenous fruit trees.
ii. Proof of utilisation of indigenous fruit by the villagers for both commercial and home consumption.
iii. Occurrence of firewood and / or charcoal trade within the village or nearby areas.

Five of the sixteen villages were randomly chosen for sampling and were selected by using the lottery method. This method is most applicable to small sample sizes (Jayaraman, 2000). The villages selected were Kanselu, Limani, Mathotho, Mkoka and Ndelema (Figure 2.2).

2.2 Description of the sites

Mwanza town, the administration headquarters of Mwanza District, is approximately 100 km from Blantyre City. It is governed by six Traditional Authorities (TAs), namely Dambe, Kanduku, Mlauli, Ngozi, Nthache and Symon (Figure 2.2). The five villages fall under TA Symon's area but are directly governed by their respective headman or woman.

Kanselu and Limani are contiguous villages as are Ndelema and Mathotho. Ndelema had the largest number of individuals whereas Kanselu was the smallest (Table 2.1). Mathotho was the only village headed by a woman.

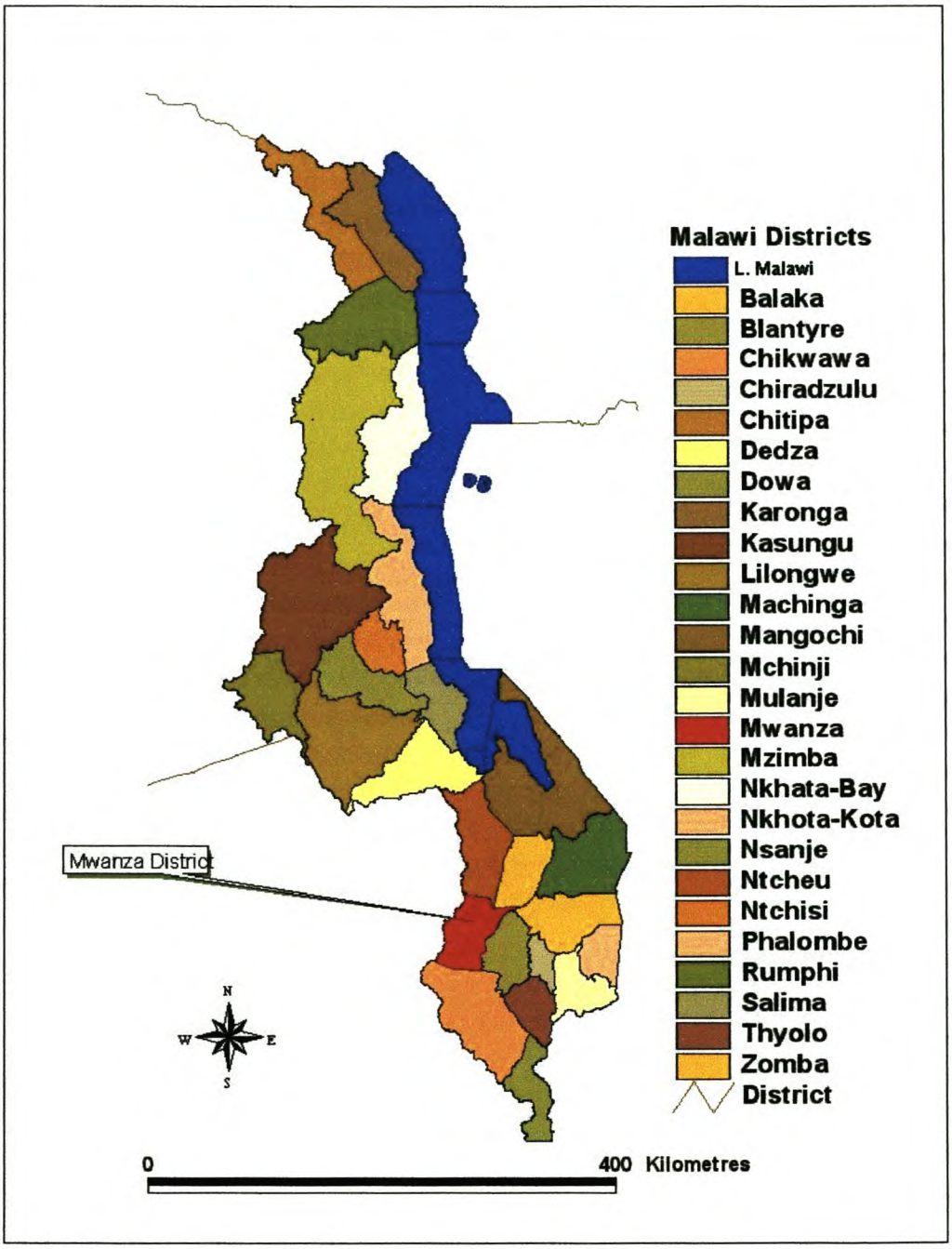

Figure 2.1. Malawi, showing its 26 Districts including Mwanza (FD, 2001).

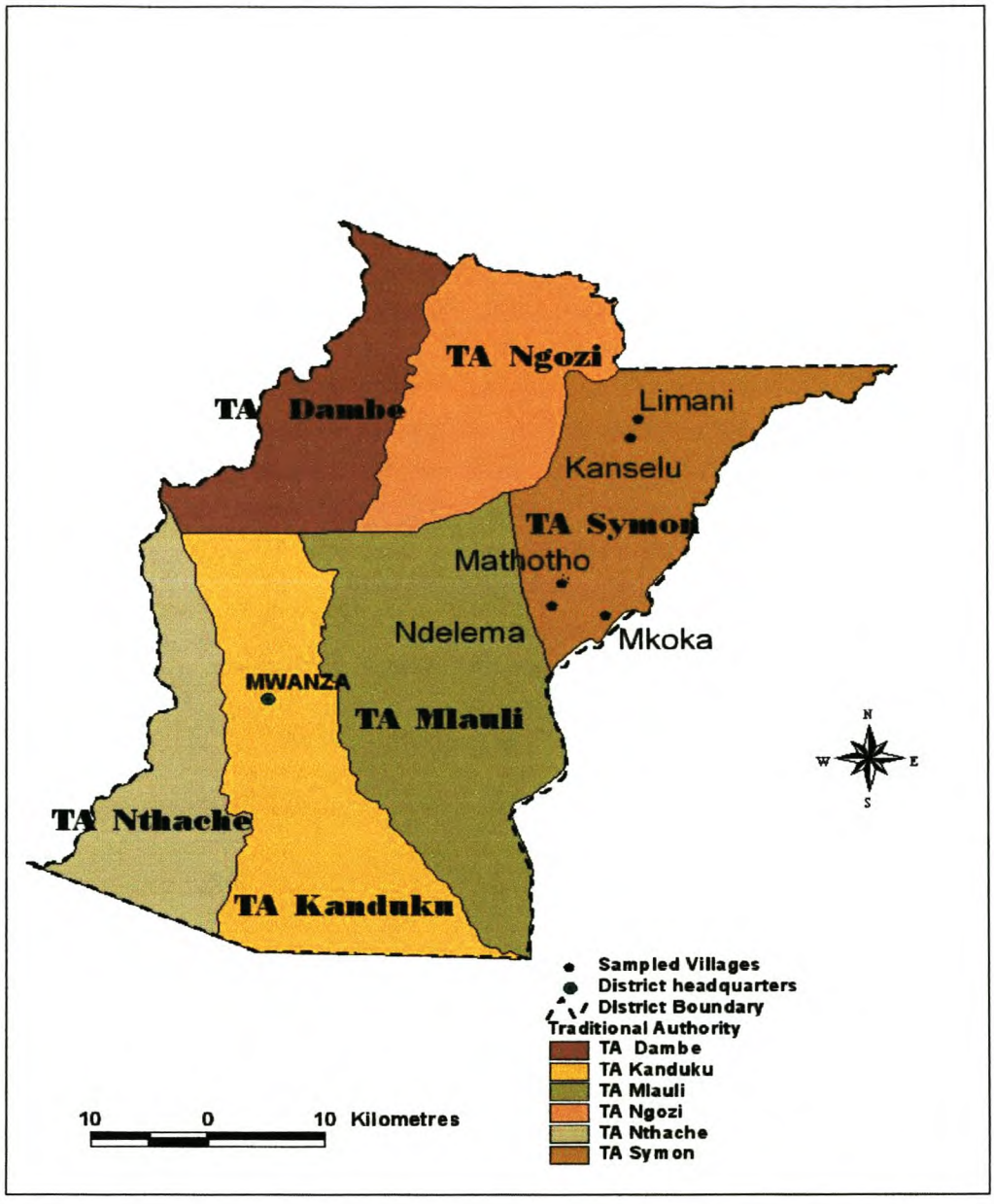

Figure 2.2. Traditional Authorities (TAs) and the sampled villages under TA Symon's area in Mwanza District (FD, 2001).

According to the classification by Hardcastle (1978), all the selected villages fall in the Ba silvicultural zone (Appendix 1.1). The altitude ranges from 200 to 500 m a.s.l. but most of the land is about 300 m a.s.l. (GOM, 1995; DS, 2000). Mean annual temperature for the zone is given as ranging from 21 to 25°C whereas mean annual rainfall ranges from 710 to 840 mm (Hardcastle, 1978).

Since the 1980s deforestation in eastern Mwanza has increased with the construction of a tarmac road between Blantyre and Lilongwe and between Mwanza and Blantyre Districts which passes through the district (Mlotha and Jambo, 1998). The area has a network of feeder roads leading to the main roads (Figure 2.3).

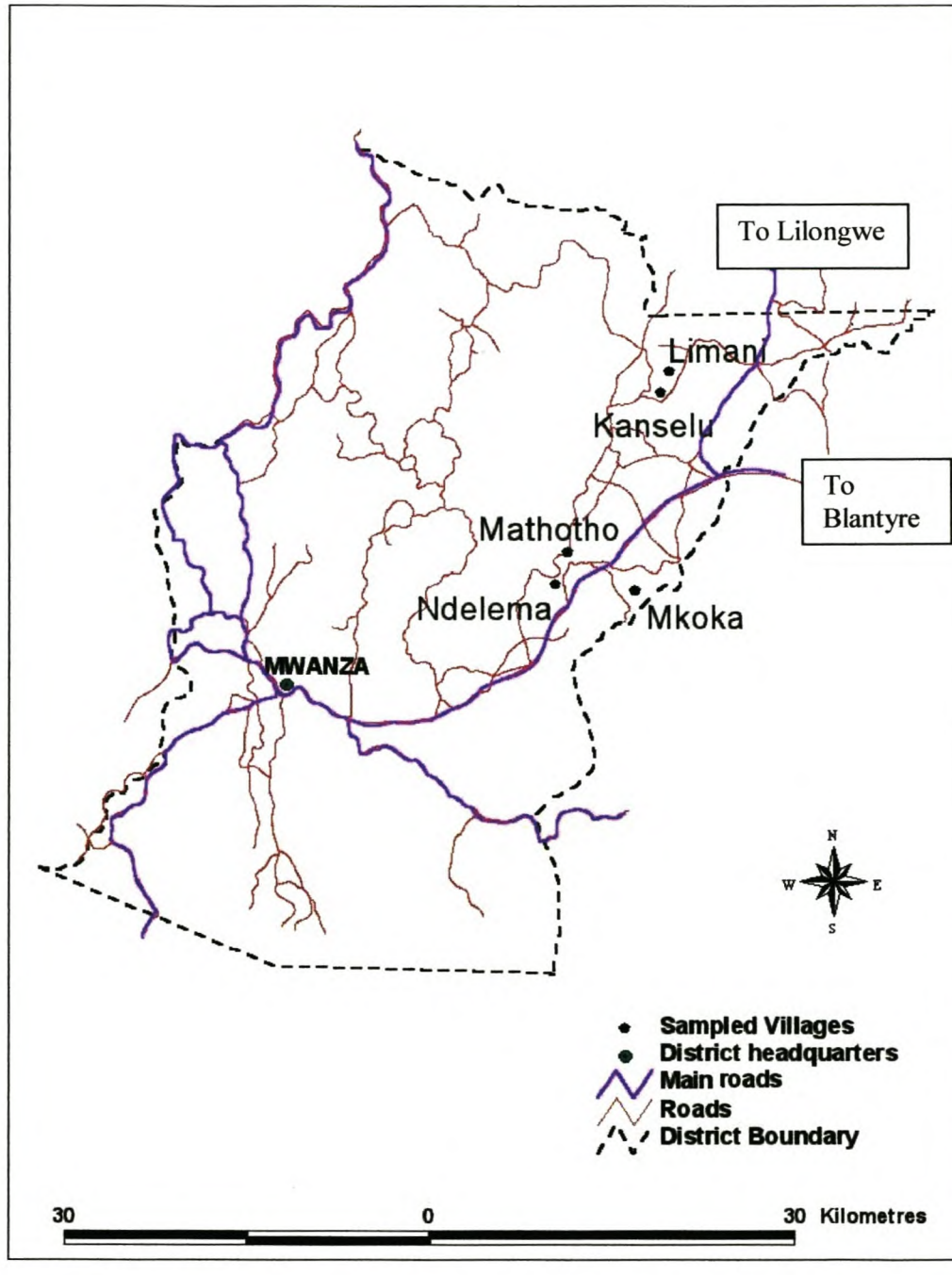

Figure 2.3. Road networks in Mwanza District including the study area (FD, 2001).

Table 2.1. Population of each sampled village in terms of numbers of households and individuals

Villages	Households[1]	Individuals[2]
Kanselu	45	107
Limani	48	297
Mathotho	35	291
Mkoka	70	376
Ndelema	147	699
Total	345	1 770

[1]Number of families in 2000

[2]Number of individuals in 2000

2.3 Research methods

Permission to conduct the research in Mwanza District to involve forestry officials was sought from the Director of Forestry. Two meetings were conducted with the District Forestry Officer (DFO) for Mwanza. The first was for briefing and identification of the villages that met the research requirements. The identification of the villages was also verified with the Wildlife Society of Malawi (WSM) personnel in the district. Random sampling of the identified villages was done, followed by a second meeting with the DFO to get information on the local forestry extension workers responsible for the selected villages. The extension workers were visited and briefed on the research. They were involved because of being familiar with the communities they work with and to assist in facilitating group interviews and resource assessment. However during individual interviews and market survey they were not involved.

Apart from holding meetings with forestry personnel, visits with them to the villages were made to meet traditional leaders for briefing and seeking permission to conduct the study in their villages. This process was conducted from one village to the next before commencement of the study. Upon acceptance, the plan of study activities was agreed on and village based health surveillance assistants in each village were visited to get updated information on the household names, numbers and population of the village. Participants were selected with the assistance of local forestry workers

and were informed about the study and their involvement. The villagers were told that the research was being conducted by a student under the sponsorship of the GTZ (The German Technical Cooperation Agency) for the communities to benefit more from their forest resources in a sustainable manner.

Resource assessment was done first and was followed by group then individual interviews. Each research component was completed in each village before embarking on the next to avoid confusion.

2.3.1 Resource assessment

The resource assessment was conducted from 26th February to 1st March 2001, with the assistance of selected villagers. The participants were selected by forestry extension workers and traditional leaders based on having wide knowledge in identifying indigenous trees and their uses. Different age groups were selected for participation even though all were male. The main roles of the participants were to identify trees and assist in marking and measuring plots so that they could report this information back to their village. Since all participants were male some of the questions that were asked during the assessment were also asked of women during group interviews that followed.

Two plots, each measuring 50 x 20 m were identified systematically and demarcated in each village. The first plot was demarcated at 950 m to the South and the second plot was at 1 950 m to the West of each village from the same starting point. The plots were demarcated with the use of a 30 m measuring tape, a compass for direction, pegs and four bright tapes to mark the plot boundaries. The participants then identified each tree and gave its uses in the local language (Chichewa). Tree diameter was measured at 30 cm in centimetres using calipers. Where the trees could not be measured with the calipers, tree circumference was taken and diameter calculated. The local names given were cross-checked with scientific names given in the literature (Binns and Logah, 1972; Pullinger and Kitchin, 1982; Storrs, 1995). Photographs and pressed samples of unidentified trees were taken to the National Herbarium and Botanic Gardens in Zomba for identification.

2.3.2 Group interviews

Informal group interviews were conducted in March 2001, together with the local forestry extension officer, using semi-structured questions. In each village, females and males, and some children, were interviewed in separate groups to allow full participation of women in the absence of men. Female group interviews were conducted first and were followed by male group interviews within a day per village. This was done to give enough time for females to continue with their domestic chores. For each group, 15 participants were selected from a village list of household names kept by village health surveillance assistants. These, according to the village headmen and extension workers who assisted in the selection, included indigenous fruit collectors, processors and vendors of different age groups. In Limani Village, children who were not fully represented in the interviews were interviewed separately to ensure full representation of all social groups. Participatory Rural Appraisal (PRA) methods were applied. These were facilitated in the local language and translated later into English.

2.3.2.1 Mapping

Participants were asked to draw a resource map of their village on the ground. Villagers were asked to explain the status of their forests and what products they collected from the forests. Local materials like stones, small branches and leaves were used to represent various features on the map. Maps were transferred to sheets of paper, one of which was a copy for the participants.

2.3.2.2 Species preference ranking

Participants were asked to list indigenous fruit they utilised from the forest and rank the three most important ones together with reasons for the selection. Questions and discussions followed to explore:

- Use of fruit trees and the fruit
- Access to fruit trees
- Factors influencing choice of fruit for utilisation
- Fruit processing activities
- Traditional beliefs or practices associated with fruit utilisation

2.3.2.3 Seasonal calendar of activities

A seasonal calendar of activities was drawn on the ground. Participants were requested to indicate important activities they carried out in a year that would include those associated with the chosen fruit species. Any additional information given during discussions was recorded.

2.3.2.4 Sources of household income

Participants listed and ranked important sources of household income. Ranking was based on votes for each particular source. Discussion followed on the magnitude and period of income generated from each source. It also covered what the money was used for and who the main decision-maker over use of income generated was in a household.

2.3.3 Individual interviews

One third of the number of households in each village was randomly selected for individual interviews. Stratified sampling from the selected households was done. This was to ensure that all social groups were part of the sample, to give a better cross-section of the population (Jayaraman, 2000). Ten strata were formed according to age and gender differences of the individuals from the selected households. This was done on the basis of supplementary information on age and gender from the village based health surveillance workers. An individual was to be randomly chosen from each selected household based on proportions of age and gender classes of each village. Whenever any household did not represent the required candidate, it was randomly replaced by another household. The target population was aged eight years and older. This age was chosen because children at that age can do some work on their own, like herding cattle and drawing water, but they can also collect fruit. Questions were asked in the local language and answers translated into English as for the group interviews. The questionnaire was categorised into the following subheadings (Appendix 2.1):

- Demographic data, which included age, marital status, household sizes and gender of the respondents
- Household ownership of resources to determine household wealth

- Preference and basis of ranking three most important indigenous fruit tree species
- Household ownership of indigenous fruit tree species
- Fruit harvesting methods and quantities harvested per season
- Subsistence utilisation of preferred fruit
- Processing and storage of the preferred fruit species
- Commercial utilisation of the preferred fruit species
- Availability of exotic fruit to determine their influence on utilisation of indigenous fruit

Three different coloured and sized plates were used for estimation of quantities of small sized fruit utilised by respondents. The capacities were 650 ml, 2 000 ml and 6 000 ml and the plates were labelled 1, 2 and 3 respectively. These were used to estimate the volume of *F. indica, T. indica, D. kirkii* and *V. infausta* fruit being harvested by a respondent for utilisation per season. *Flacourtia indica* and *V. infausta* fruit were separately filled in a 2 000 ml plate to the brim and weighed to obtain the mass. Since the fruit were of different sizes, several measurements were taken to calculate average mass of fruit filling the plate. Because the fruit were not in season and could not be weighed, the mass of *D. kirkii* and *T. indica* fruit were reported by WSM staff who had the measurements. However, volume of fruit harvested and utilised by respondents was estimated by respondents. *Adansonia digitata* fruit for being large sized were given in numbers when utilised in small quantities or in numbers of known bags when harvested in large quantities. These bags when filled with baobab were weighed and the number of fruit counted. Several measurements were made to get an average mass of the fruit.

Respondents were asked to indicate the size and numbers of a particular plate, of the three, filled with a particular fruit species harvested per given time. Frequency and amount of fruit and the period of fruit harvesting were recorded to calculate fruit volume harvested per season (Appendix 2.1). The fruit volumes were converted to kilogrammes based on the mass obtained per given volume.

2.3.4 Market survey

An indigenous fruit marketing survey was conducted in early June 2001. Indigenous fruit sellers in the local and main markets in Balaka, Blantyre, Mangochi, Mwanza

and Zomba Districts were interviewed. Anyone found selling indigenous fruit in these markets was interviewed after seeking their permission. Questions were asked in the local language but responses were recorded in English. The questions were categorised into the following (Appendix 2.2):

- Demographic data
- Type of indigenous fruit being sold
- Source of fruit
- Transportation
- Expenses incurred
- Experience in selling the fruit
- Quantities of fruit sold
- Selling prices
- Profits made from selling indigenous fruit
- Problems faced with selling indigenous fruit

2.3.5 Key informants

Key informant interviews focusing on use and sale of products from the woodlands included questions on charcoal and firewood production and commercialisation, fruit harvesting, processing activities and commercialisation. Key informants included a charcoal vendor, an extension officer, two fruit processors, two herd boys and one fruit retailer.

2.3.6 Data analysis

SPSS[1] was used to analyse individual interviews and market survey whereas SAS[2] was used to analyse resource assessment.

2.3.7 Reliability and validity of the study

Several questions were asked of respondents and participants in a number of different ways in the individual, group and key informant interviews, to compare the

[1] SPSS 10 for Windows (2000), http: //www.SPSS.com
[2] The SAS system for Windows (1996)

responses. Questionnaires were tested before the main study began and were only administered by the researcher.

3 RESULTS AND DISCUSSION

3.1 Introduction

Results from the individual, group and key informant interviews and resource assessment are presented and discussed together in this chapter. Although in the same chapter, results and discussion of the market survey are presented separately from those of commercial utilisation of indigenous fruit because the market survey was mainly conducted outside the study area. The words "PRA participants" refer to group interview participants whereas the word "respondent" refers to individual interviewee.

3.2 Research limitations

Part of this study focused on the sale of indigenous fruit in local markets and subsistence use. Because the research was conducted when two of the main three priority indigenous fruit were not in season, determination of their mass was based on reported figures, as the fruit could not be weighed directly. This may affect the estimated quantities of fruit utilised by respondents of the individual interviews.

Respondents may tell lies or decide not to reveal information about a question asked (Neuman, 1996). The benefit of using group interviews as well as a questionnaire survey is that participants are likely to give correct information in groups as a result of peer pressure. For sensitive information, however, individual surveys are more appropriate (Rocheleau *et al.*, 1988). The main use of asking similar questions through different types of interviews was to cross-verify research results.

3.3 Demographic data of the study area

In the individual interviews, 115 respondents were interviewed in all the sampled villages. The characteristics of the respondents in terms of household wealth and marital status are presented in Appendix 3.1. The categories of household wealth, being the poor, lower medium, medium, upper medium and the rich, are also explained in Appendix 3.1.

Table 3.1. Gender and age classes of respondents in the study area (n=115)

Variable	Category	Frequency	Percentage
Gender	Male	50	43.5
	Female	65	56.5
Total		115	100
Age	8-14 years	28	24.3
	15-25 years	23	20
	26-35 years	29	25.2
	36-45 years	13	11.3
	>45 years	22	19.1
Total		115	100

Table 3.1 shows that more respondents were females. This is because in Malawi the population of females is more than that of males (WDID, 2000). The maximum age of respondents interviewed was 70 years. Household sizes shown in Table 3.2 refer to the number of people who were staying together as a family in the sampled villages. The highest percentage of the respondents came from Ndelema Village, constituting 42.6% (n=115) whereas those from Mathotho Village constituted the smallest percentage, being 10.4% (n=115). The percentages are proportional to household numbers per village (Table 2.1).

Table 3.2. Household sizes of respondents in the study area (n=115)

Household size	Frequency	Percent
1-4 individuals	55	47.8
5-8 individuals	50	43.5
9-12 individuals	10	8.7
Total	115	100

In the group interviews, age of participants ranged from eight to approximately 70 years. The numbers of participants per village in terms of gender are given in Table 3.3. The numbers of participants in Limani Village also include the children who were interviewed separately.

Table 3.3. Numbers of group interview participants per group per sampled village (n=141)

Village	Number of participants		Total
	Male	Female	
Kanselu	10	14	24
Limani	16	17	33
Mkoka	13	14	27
Mathotho	14	15	29
Ndelema	14	14	28
Total	67	74	141

The number of male participants in Kanselu Village was the smallest because some participants who had been chosen for the interviews did not attend. They were said to be away from the village although they had been informed about the meeting. However the group was well represented in terms of age classes.

3.4 Resources in the study area

A total number of 52 indigenous tree species was sampled during the resource assessment. Of these, 17 were fruit tree species being utilised by villagers in the sampled villages. During group interviews in the study area, a total number of 26 indigenous fruit species was mentioned as being utilised by communities (Table 3.4). The nine fruit tree species not found during the resource assessment but mentioned as being utilised in the study area were *A. senegalensis, Ficus natalensis, Ficus sycomorus, Friesodielsia obovata, Garcinia livingstonei, S. innocua, Vitex payos, Z. mauritiana* and *Ziziphus mucronata*. These were not found probably because the assessment was conducted only in two sites of each village. It is also possible that the tree species were not found in the sampled villages but were being utilised from the neighbouring villages. *Adansonia digitata*, *T. indica*, *D. kirkii*, *F. indica*, *S. spinosa*, *V. infausta* and *X. caffra* were the most commonly mentioned species as being utilised in all the villages (Table 3.4). This could be related to the availability and people's preference of the fruit species. A list of non-fruit indigenous trees that were found in the sample plots is given in Appendix 3.2. The study shows that communities utilise a wide range of indigenous fruit species available in their area as all those sampled and mentioned were being utilised.

Table 3.4. Indigenous fruit species utilised in the sampled villages according to group interview participants (n=141)

Indigenous fruit utilised	Vernacular name	Villages				
		Kanselu	Limani	Mathotho	Mkoka	Ndelema
Adansonia digitata	mlambe	*	*	*	*	*
Annona senegalensis	mpoza	*	*		*	*
Azanza garckeana	mtowo	*	*	*	*	*
Berchemia discolor	mtaja		*	*	*	*
Cordyla africana	matondo					*
Diospyros kirkii	ntchenje	*	*	*	*	*
Diospyros squarrosa	kasukuswa			*	*	*
Dovyalis macrocalyx	ng'ambo				*	
Ficus natalensis	kachere				*	
Ficus sycomorus	mkuyu			*	*	*
Flacourtia indica	nthudza	*	*	*	*	*
Friesodielsia obovata	mchinga			*	*	*
Garcinia livingstonei	mphimbi		*			*
Grewia flavescens	msupani			*	*	*
Grewia monticola	theza			*	*	*
Lecaniodiscus flaxinifolius	mtalala		*	*	*	*
Sclerocarya birrea	mfula	*		*		*
Sterculia appendiculata	njale			*	*	*
Strychnos innocua	mateme		*	*	*	
Strychnos spinosa	makangadza	*	*	*	*	*
Tamarindus indica	bwemba	*	*	*	*	*
Vangueria infausta	mbirima	*	*	*	*	*
Vitex payos	mpsyimpsya				*	
Ximenia caffra	mpinjipinji	*	*	*	*	*
Ziziphus mauritiana	masawi			*		*
Ziziphus mucronata	kankhande			*		*

* denotes fruit species utilised

Some of the fruit tree species mentioned by male participants as being utilised in their village differed from those mentioned by female participants of the same village. The differences only are shown in Table 3.5. In four of the five villages, with the exception of Limani, male participants mentioned more different fruit species as being utilised in their village than those mentioned by female participants. This could be attributed to males knowing and utilising more indigenous fruit species in the woodlands than females. It was generally noted amongst the male participants in the villages that boys contributed more when asked about fruit species utilised in their villages than men. This correlates with what van Eck *et al.* (1997) found in their survey in the Eastern Cape Province in South Africa, where boys in particular

knew which fruit species were edible and which ones were not. In the study area, boys were reported by key informants as spending much time on eating wild fruit mainly when herding livestock which probably enabled them to know many fruit.

Table 3.5. Differences in the indigenous fruit species mentioned as being utilised per sampled village according to gender of participants (n=141)

Village	Different fruit species mentioned by participants		Total species mentioned[1]
	Female participants	Male participants	
Kanselu	*V. infausta* *X. caffra*	*A. senegalensis* *A. garckeana* *S. birrea*	10
Limani	*A. senegalensis*	*A. garckeana*	13
Mkoka	*G. flavescens* *S. innocua*	*A. senegalensis* *D. macrocalyx* *F. natalensis* *F. sycomorus* *V. payos*	21
Mathotho		*F. obovata* *S. appendiculata* *S. birrea* *Z. mucronata*	20
Ndelema	*B. discolor* *F. sycomorus* *G. livingstonei* *G. monticola* *Z. mauritiana*	*A. senegalensis* *C. africana* *F. obovata* *S. birrea* *S. appendiculata* *Z. mucronata*	22

[1]Total number of fruit species mentioned as being utilised per village

In Kanselu, Mathotho and Ndelema Villages only males mentioned *S. birrea* as being utilised in their villages while in Kanselu and Limani Villages *A. garckeana* fruit was also mentioned by male participants only. These fruit species could possibly be linked to gender preferences. However, the data available are insufficient to test the existence of a gender preference.

3.4.1 Resource mapping

During the participatory mapping sessions in the sampled villages, common features represented on the ground by the participants were as follows:

- Village boundaries were marked by features like streams, rivers, paths and roads. Besides marking the boundaries these features were also depicted within the sampled villages (Figure 3.1).

- Buildings comprised dwellings, churches and shops. In each sampled village there were at least two different churches, which showed that communities in each sampled village belonged to different religious groups. This shows that the communities were not homogeneous.

- Forested areas were depicted close to and away from dwellings. Generally trees were shown as being scattered but concentrated in some places. All the sampled villages were reported as having Village Forest Areas reaching 5 hectares per village. Indigenous fruit trees were reported as being found in household areas, agricultural fields and in communal land from where villagers collected fruit.

- Agricultural fields in which crops like maize, cotton and vegetables were grown were depicted in several sites such as near dwellings, along rivers and streams and distant places from village sites. Most vegetable gardens were shown along the streams and rivers, which were reported as being favourable for vegetable production because of the fertile soils and availability of water for irrigation.

- Graveyards were also depicted by each group in all the sampled villages. There were two separate graveyards per village, one being for dead infants not exceeding three months of age.

Differences in features depicted by group interview participants in the sampled villages were as follows:

- The topography varied from village to village, with most of the study area being low lying.

- Water pumps, also known as boreholes, were only shown in Kanselu, Mkoka and Ndelema Villages. The boreholes were reported by participants as being drilled

by the government to provide safe drinking water to rural communities. Participants in Mathotho and Limani Villages reported that they collected water from adjacent villages.

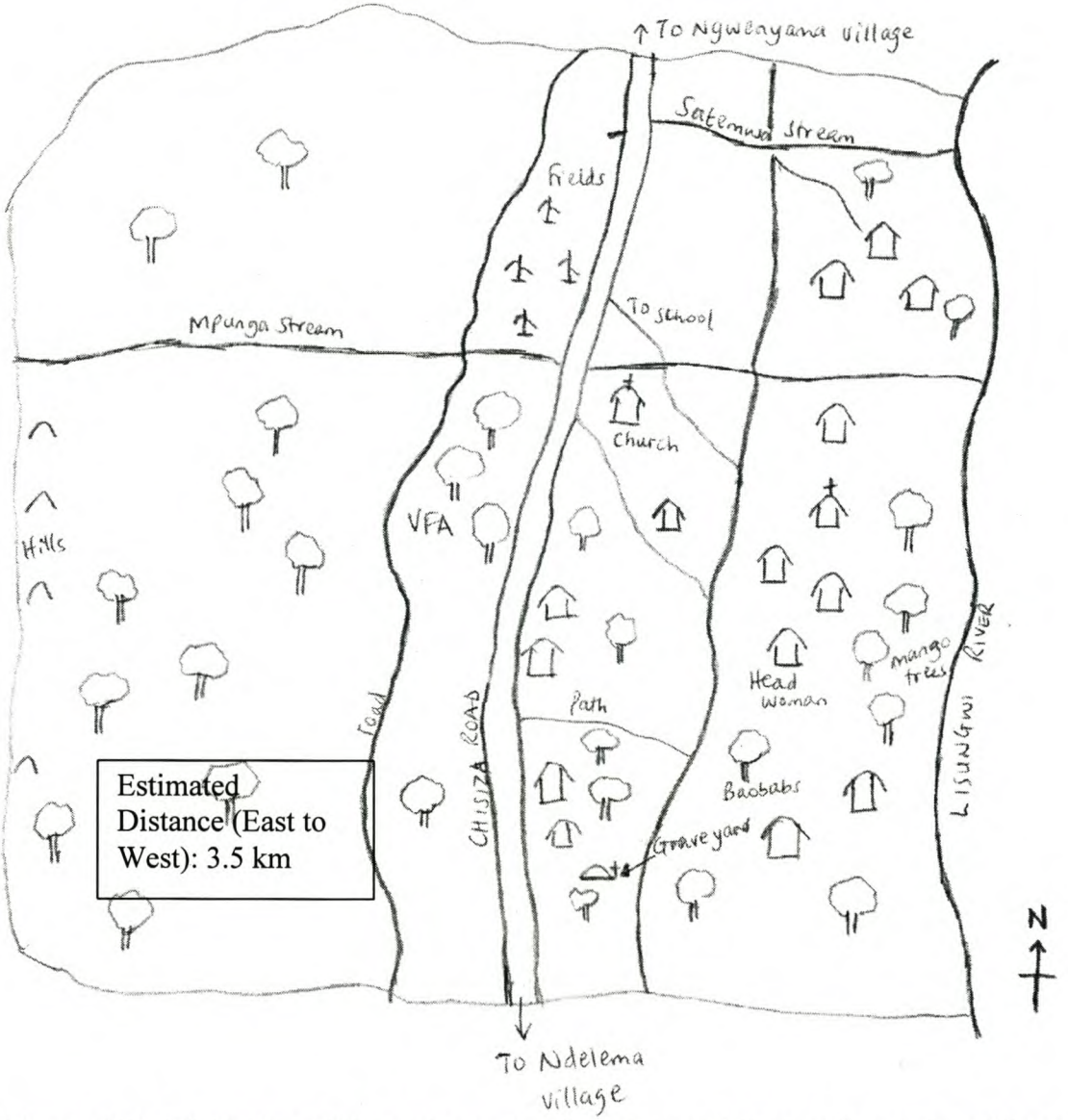

Figure 3.1. Mathotho Village drawn by female participants from the village during group interviews (n=15)

- Meeting places were represented on the ground by participants in Limani and Mkoka Villages. Village meetings were said to take place under large indigenous trees within the villages. The other sampled villages mostly met at the village headman's or headwoman's house. Village meetings were reported as having varying purposes. Some concerned development projects within the villages

such as clearing the bush along paths and roads while others could relate to passing judgment on cases.

- Primary schools were depicted in Ndelema, Limani and Mkoka Villages. School children from Kanselu and Mathotho Villages where there were no schools, attended school in other villages within a distance of 3 km.

Gender differences in resource mapping were noted in the study area. Some differences were common amongst the sampled villages while others were not. In Kanselu Village, male participants took a relatively shorter time to draw the village boundaries than females. This difference was also observed in Limani and Mkoka Villages. Females argued over the placement of the boundaries probably because they had little knowledge about the features that marked the village boundaries. According to the village headman in Mkoka, female participants in the village erroneously depicted a stream as marking the village boundary which males in the village correctly showed on their map. In contrast the opposite happened in Mathotho Village where Kambiya stream which males depicted as marking the boundary with Ndelema Village was not correct according to the village headwoman for Mathotho (Figure 3.2). The headwoman said that females had correctly drawn the village boundaries. Probably the difference was because the village headwoman was one of the female participants who could advise the group on where the village boundaries were.

More streams were depicted on the maps drawn by males than females in Mkoka, Kanselu and Limani Villages. In Ndelema and Mathotho Villages, more roads were shown on the maps drawn by males than those drawn by females. Probably the differences arose because some male participants in the two villages were employed to do piecework in road maintenance within the villages. As a result they recalled the details of road networks within the villages. Another reason is that males travel more than females. According to a local forestry worker, males who also were involved in charcoal production depicted diverted roads, which were used for the transportation of charcoal from the woodlands to the villages and main roads.

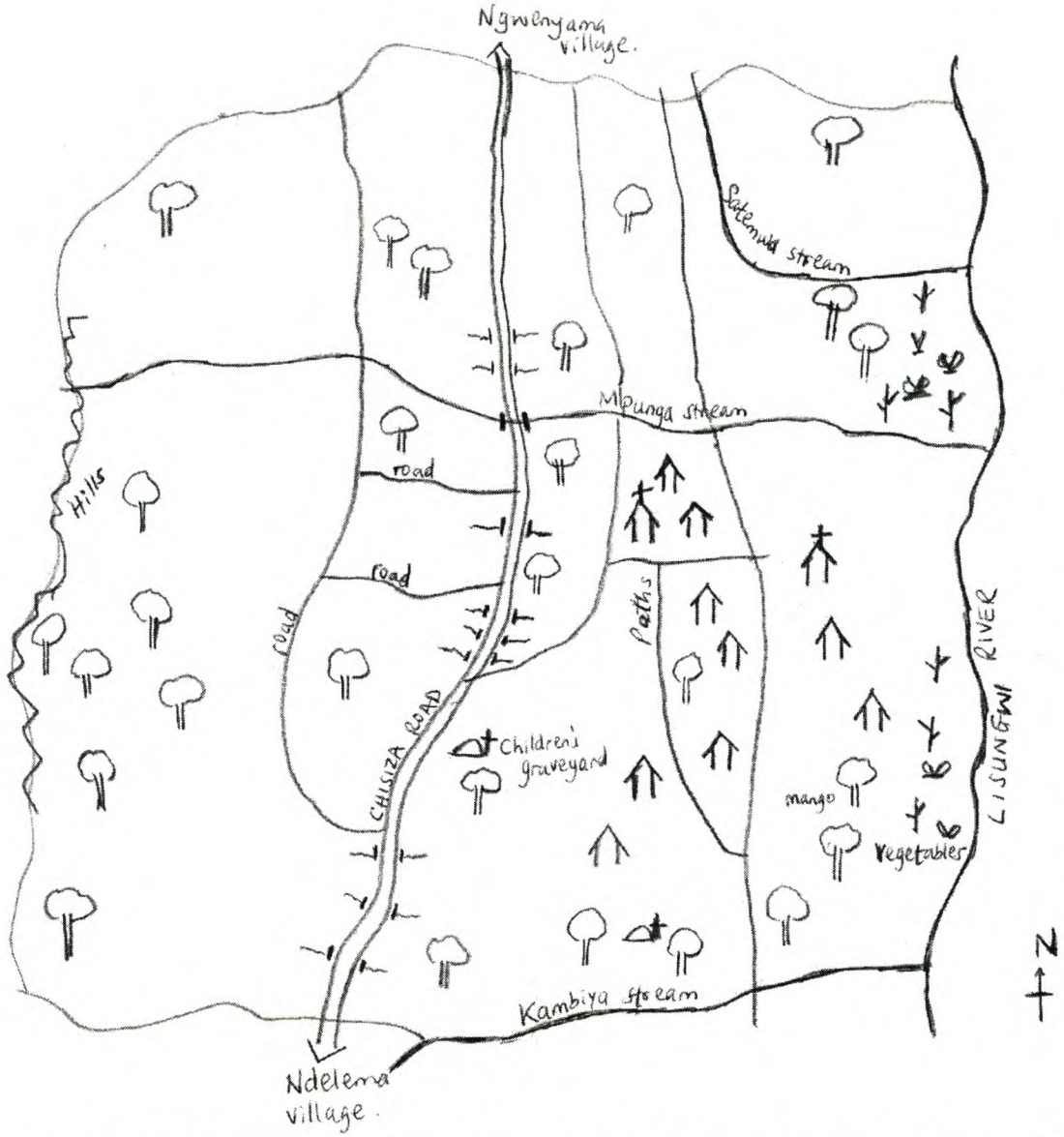

Figure 3.2. Mathotho Village drawn by male participants from the village during group interviews (n=14)

In Mkoka village, one non-functioning borehole was depicted on the map drawn by males while females excluded it on purpose. The female participants in the village insisted that they could not include it on their map because it was of no use to them. Women being the ones who usually draw water for their households could differentiate between a functioning and a non-functioning borehole.

Surprisingly enough, females in Mathotho Village did not include the graveyard for infants yet women are the ones who bury dead infants (Figure 3.1). This could be attributed to the females concentrating more on other resources that were important to them such as the forested areas where they collected fuelwood.

Besides gender differences, age also appears to have lead to some differences in resource mapping. In Limani Village, the children group did not show any graveyard as being found in their village yet on both maps drawn by men and women in the village these burial places were depicted. Probably the difference is because young people do not get as much involved during funerals as adult people do or possibly they did not regard them as being important.

3.4.2 Resource assessment

Table 3.6 shows that most fruit tree species sampled in the first plot were not found in the second plot. In addition all fruit tree species were not commonly found in all the sampled villages, with *A. digitata* being the exception. Mathotho was the only village in which baobab trees were found in both plots. This result does not provide enough evidence to prove that the village had the highest quantities of baobab trees. Because of its fibrous nature neither charcoal nor firewood is produced from the baobab tree (Storrs, 1995). This is possibly why it was the most commonly sampled species in an area where charcoal was being produced. In addition to this, removal of baobab bark by communities for string making does not cause damage to the tree as it quickly heals over (Pullinger and Kitchin, 1982). Another factor is related to the ability of the tree species to survive drought conditions as Campbell *et al.* (1997) reported a study in Zimbabwe.

Kanselu and Limani Villages had high counts of *D. kirkii* trees in the sampled plots (Table 3.6). These villages being contiguous may possibly have similar characteristics like favourable soils for the growth of the tree species. The species is reported as growing well on coarse sandy soils and vertisols (FAO, 1983). Due to the small size of data available, it cannot be concluded that the tree species was the most abundant in these villages of all the sampled villages. In addition, the sampling design whereby not all village sites were sampled may have contributed to this result.

Fruit tree species such as *X. caffra*, *D. squarrosa* and *Grewia* spp. are commonly removed when fields are cleared for agriculture hence the difference in abundance of these species in plots close to and further from the village. *Vangueria infausta* trees were probably also removed when clearing land (Tables 3.6 and 3.7).

Table 3.6. Numbers of indigenous fruit trees found per species per 0.1 ha plot in the study area (n=10)

Indigenous fruit tree species	Villages									
	Kanselu		Limani		Mathotho		Mkoka		Ndelema	
	Plot		Plot		Plot		Plot		Plot	
	1	2	1	2	1	2	1	2	1	2
Adansonia digitata	1	0	2	0	3	1	1	0	2	0
Azanza garckeana	0	0	0	0	0	0	0	0	1	0
Berchemia discolor	0	0	1	0	0	0	1	0	0	0
Cordyla africana	0	1	1	0	0	0	0	0	0	0
Diospyros kirkii	15	1	0	18	0	1	0	0	1	3
Diospyros squarrosa	0	0	0	0	0	0	0	0	0	3
Dovyalis macrocalyx	0	0	0	0	0	0	1	0	0	0
Flacourtia indica	5	0	0	15	2	0	0	0	0	0
Grewia flavescens	0	9	1	0	0	0	1	3	1	2
Grewia monticola	0	0	0	0	0	0	0	0	0	3
Lecaniodiscus flaxinifolius	0	0	0	0	0	1	5	2	0	0
Sclerocarya birrea	0	0	0	0	0	0	0	0	3	0
Sterculia appendiculata	0	0	0	0	0	0	1	0	0	0
Strychnos spinosa	2	0	0	0	0	0	0	0	0	0
Tamarindus indica	0	1	0	0	0	0	7	0	3	0
Vangueria infausta	0	0	0	0	0	2	0	2	0	3
Ximenia caffra	0	3	0	1	0	0	0	0	0	0
Total	23	15	5	34	5	5	17	7	11	14

Tamarind and baobab trees were generally found more in plots 1, which were closer to the villages than in plots 2 (Tables 3.6 and 3.7). For baobab, this appears to be a common phenomenon. Sibidé *et al.* (1996) in their study in Mali found that baobab trees were more concentrated in current and former village sites while Malembo *et al.* (1998) in their study of eight districts in Malawi found baobab trees near villages. This could mean that the villagers settled in places where baobab trees were commonly found and protected them as trees of economic value. Alternatively fruit seeds were spread by humans and the seedlings were protected near villages. The available data is not sufficient enough to prove that the fruit tree species could be found closer to the villages.

Although *C. africana* trees were found in Kanselu and Limani Villages (Table 3.6), they were not mentioned as being utilised by the villagers except in Ndelema. This suggests that the fruit species was not commonly preferred by the communities.

Table 3.7. Numbers of fruit trees found per species in the combined plots 1 and plots 2, each plot being 0.1 ha, in the study area (n=10)

Indigenous fruit tree species	Numbers of fruit trees		
	Plots 1 (n=5)	Plots 2 (n=5)	Total
Adansonia digitata	9	1	10
Azanza garckeana	1	0	1
Berchemia discolor	2	0	2
Cordyla africana	1	1	2
Diospyros kirkii	16	23	39
Diospyros squarrosa	0	3	3
Dovyalis macrocalyx	1	0	1
Flacourtia indica	7	15	22
Grewia flavescens	3	14	17
Grewia monticola	0	3	3
Lecaniodiscus flaxinifolius	5	3	8
Sclerocarya birrea	3	0	3
Sterculia appendiculata	1	0	1
Strychnos spinosa	2	0	2
Tamarindus indica	10	1	11
Vangueria infausta	0	7	7
Ximenia caffra	0	4	4
Total	**61**	**75**	**136**

Analysis of variance (ANOVA) was conducted to determine if there were any significant differences in the numbers of indigenous trees sampled in the study area according to the data presented in Table 3.8. The analyses of differences in the numbers of trees were as follows:

- (1) between fruit tree species and other indigenous tree species
- (2) between plots
- (3) amongst the sampled villages
- (4) based on the interactions between (i) village and plots,
  (ii) village and tree type (fruit tree or other tree)

(iii) plots and tree type

Table 3.8. Numbers of wild fruit trees and other indigenous trees sampled per 0.1 ha plot per village in the study area (n=10)

Plot (n=2) and Distance from village	Tree species	Villages					Total
		Mathotho	Ndelema	Mkoka	Kanselu	Limani	
1 (1 km)	Fruit trees	5	11	17	23	5	61
	Other trees	4	30	2	17	7	60
2 (2 km)	Fruit trees	5	14	7	15	34	75
	Other trees	5	22	7	12	45	91

Log_{10} transformation of data was done because the data was not normal after conducting a normality test. The results, after data transformation, in all the comparisons showed no significant differences in the numbers of indigenous trees in all five villages ($p>0.05$). Although insignificant, it can be noted that the difference in numbers of indigenous trees amongst the sampled villages was the highest ($p = 0.06$) (Appendix 3.3). Due to limiting resources only two plots were sampled per village, thus the northern and eastern sites of each village were not included in the comparisons, as a result, the small sample is not a precise enough estimate of the total population.

A chi-square test to compare the numbers of fruit trees in plot 1 and plot 2 per village was conducted on the data presented in Table 3.9. The results showed that significant differences between numbers of fruit trees in plots 1 and 2 existed ($\chi^2 = 26$, $df = 4$, $p < 0.001$) but did not show which village plots had the significant differences.

Table 3.9. Numbers of wild fruit trees per 0.1 ha plot in the study area (n=10)

Village	Plot 1	Plot 2	Total
Mathotho	5	5	10
Ndelema	11	14	25
Mkoka	17	7	24
Kanselu	23	15	38
Limani	5	34	39
Total	61	75	136

When the same test was conducted on the same data from each village, at a time, to determine the difference in numbers of fruit trees between plots (Plot 1 and 2) the results were as follows:

There were significant differences in numbers of fruit trees between plots 1 and plots 2 in Mkoka and Limani Villages ($p<0.05$). Plots in Limani Village showed a higher significant difference in numbers of fruit trees ($\chi^2 = 21.56$, df = 1, $p < 0.001$) than those in Mkoka Village ($\chi^2 = 4.16$, df = 1, $p < 0.05$). The significant difference in numbers of fruit trees in Limani Village was based on trees in plot 2 being more than those in plot 1 whereas in Mkoka the opposite was true (Table 3.9). Thus no clear patterns in distribution of fruit trees relative to settlements were found. In Limani, only *D. kirkii* and *F. indica* trees contributed 97% (n=34) of the total counts in plot 2. This could be due to clumping of the trees which contributed to the significance in the difference between fruit trees in the plots.

Another chi-square test was conducted on the row totals in the data presented in Table 3.8 to compare:

- The total numbers of fruit trees found 1 km and those found 2 km away from the villages.
- The total numbers of non-fruit trees found 1 km and those found 2 km away from the villages.

The results showed no significant difference between the total numbers of fruit trees found closer to and further from the villages ($p>0.05$) but there was a significant difference between the numbers of non-fruit trees found closer to and further from the villages ($\chi^2 = 6.36$, df = 1, $p < 0.05$). The number of non-fruit trees was significantly more in further distance (2 km from the villages) than closer to the villages (1 km). No concrete conclusion can be drawn because of the small size and possible clumpness of the data. When the numbers of fruit trees to non-fruit trees between plots 1 and 2 were tested, there was no significant difference ($\chi^2 = 0.78$, df = 1, $p > 0.05$).

Size classes of fruit tree species except for baobab were generally small in all the sampled villages (Appendix 3.4). This is because most of the fruit species found

such as *G. flavescens* and *V. infausta* grow in the form of shrubs or small trees (Pullinger and Kitchin, 1982; Taylor *et al.*, 1996). Another factor is that, some trees were young stems regenerating from stumps. For example, *D. kirkii* trees were observed regenerating from stumps at Kanselu and Limani Villages. Stump diameter sizes ranged from 20 to 60 cm and according to the resource assessment participants in the villages, these sizes were amongst those preferred for charcoal production.

Precise quantification of fruit trees that were bearing fruit was possible for those that were in season during the resource assessment period. *Berchemia discolor* and *S. spinosa* trees were in season but fruit tree species like *A. digitata, T. indica*, *F. indica* and *V. infausta* were not. However, young fruit of *A. digitata* and *V. infausta* for example could be observed in the trees as a sign that the trees were productive. All *S. spinosa* (n=2) and *B. discolor* (n=2) trees that were found in the study area were bearing fruit. Sixty-eight percent of the *F. indica* (n=22) and 47% of the *V. infausta* trees (n=7) were fruit bearing. With the assistance of the resource assessment participants, approximately 82% of the *T. indica* trees (n=11) were identified as bearing fruit. The other *T. indica* trees (18%) were said to be too young. Most of these *T. indica* trees were found in Mkoka Village (Table 3.6).

3.4.3 Products collected from the woodlands

According to the group interview participants, the main products collected from the woodlands by villagers in the study area were as follows:

- Wood, for fuelwood, poles and latex for trapping birds
- Medicine from bark, roots and leaves
- Honey collected from indigenous trees including baobab
- Fruit for subsistence and commercial utilisation
- Wild vegetables such as baobab leaves
- Wild animals which included mice
- Fibre from bark for mat making and house construction
- Grass for thatching roofs and animal grazing
- Edible insects such as flying ants
- Bamboos, mentioned by villagers in Mkoka and Kanselu Villages. In the other villages bamboos were reported as not being commonly found.

- Reeds, mainly found along streams and rivers
- Mushrooms, some of which were associated with baobab trees

In all the villages, participants reported that forest resources including indigenous fruit trees were diminishing compared to the previous five to 10 years. Most indigenous trees were said to be decreasing in quantities because of charcoal production and expansion of land for agricultural cultivation. Charcoal was reported as being produced due to unemployment while expansion of agricultural fields was said to be done because of population increase. Reduction of trees due to agricultural expansion was also reported by Malembo *et al.* (1998). New settlers were reported in Ndelema, Mkoka and Mathotho Villages. These came from places such as Thyolo and Chiradzulu Districts (Figure 2.1) where land for cultivation was said to be scarce. A key informant revealed that some of these settlers were only interested in charcoal production. Some of them were believed to be agents of charcoal traders from cities. This was said to be exacerbating the depletion of woodland resources in the study area.

Female participants reported that they spent at least an hour to collect and bring home fuelwood for three days as a result of the reduced forest resources in the woodlands. In the early 1990s they spent only approximately 20 minutes to collect the same amount of fuelwood. In Mathotho Village, females spent the longest time, being approximately 2 hours to collect and bring home a similar quantity of fuelwood, probably because fuelwood trees were becoming the scarcest in that village compared to the other villages.

3.4.4 Household ownership of indigenous fruit trees

Of all the 115 respondents who were interviewed individually, 88.7% came from households who owned indigenous fruit trees in their agricultural fields, household areas or both (Plates 3.1 and 3.2). Wild fruit trees found in a cultivated field or a homestead were said to be more protected by the owners than those found in the communal lands because these latter areas were accessible to all villagers. Similarly, Karmann and Lorbach (1996) in their survey in Mozambique reported that natural woodlands were associated with open access utilisation of trees and their products.

Plate 3.1. Baobab trees growing in an agricultural field in Mathotho Village (Photo: F. Chilimampunga)

Plate 3.2. Pollarded *D. kirkii* trees left growing in an agricultural field in a household area, Ndelema Village (Photo: F. Chilimampunga)

In total, seven indigenous fruit tree species were mentioned as being owned by households in the study area (Figure 3.3). Only respondents from Ndelema Village reported ownership of *S. birrea* trees in their households. This may not suggest that the fruit tree species was owned in the village only. The fruit did not appear to be of great value to the villagers in the study area, as the fruit were observed lying unused and rotting on the ground. This is because *S. birrea* fruit is not commonly eaten in the country (Bunderson *et al.*, 1995).

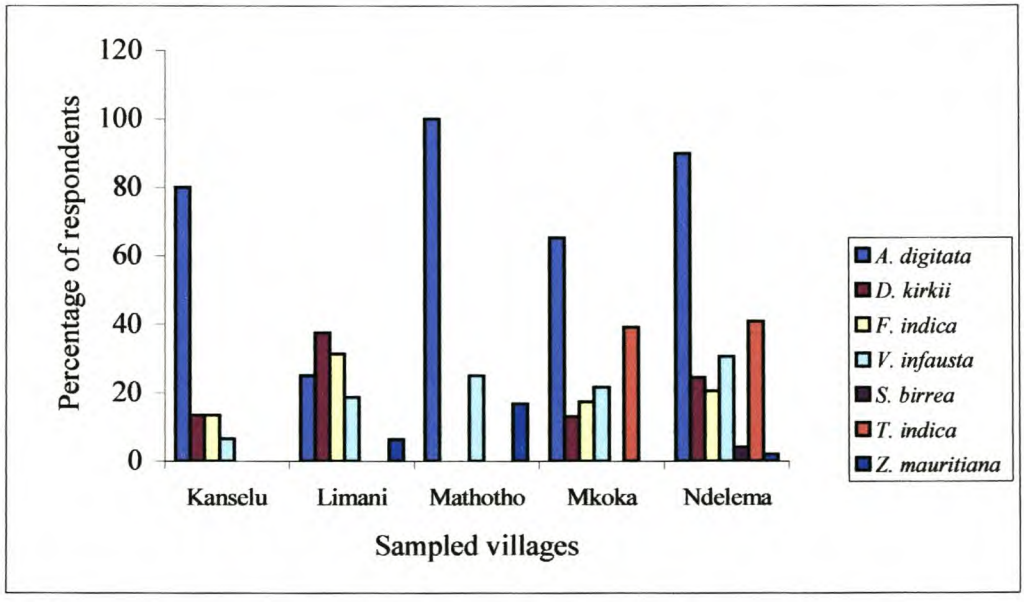

Figure 3.3. Indigenous fruit trees owned by households in the study area presented as percentages of ownership, Mwanza District, Malawi

Mathotho was the only village where 100 % (n=12) of the respondents mentioned that their households owned baobab trees. This could be linked to the highest frequencies of baobab trees found in the village of all the five villages.

Table 3.10 shows the ownership of different fruit species in numbers in the study area. During the individual interviews in Ndelema Village, *D. kirkii* trees in particular were observed in several household areas. Some *D. kirkii* trees that had been pruned were growing within agricultural fields that were located near household areas (Plate 3.2) while others were observed growing within household areas not necessarily in the agricultural fields. Similarly FAO (1983) reported that *D. kirkii* trees are mostly left standing in the fields by East African farmers.

Table 3.10. Numbers of indigenous fruit trees owned per species by households and percentages of the households per village

Village	Fruit tree species	Numbers of fruit trees owned			
		1-4	5-10	11-15	>15
Kanselu (n=15)	*A. digitata*	40	27	7	7
	D. kirkii	7	7	0	0
	F. indica	7	7	0	0
	V. infausta	7	0	0	0
Limani (n=16)	*A. digitata*	19	6	0	0
	D. kirkii	31	6	0	0
	F. indica	25	6	0	0
	V. infausta	19	0	0	0
	Z. mauritiana	6	0	0	0
Mathotho (n=12)	*A. digitata*	8	58	25	8
	V. infausta	8	0	17	0
	Z. mauritiana	17	0	0	0
Mkoka (n=23)	*A. digitata*	52	13	0	0
	D. kirkii	9	4	0	0
	F. indica	9	4	4	0
	V. infausta	17	0	0	4
	T. indica	35	4	0	0
Ndelema (n=49)	*A. digitata*	27	47	12	4
	D. kirkii	4	12	6	2
	F. indica	4	12	2	2
	V. infausta	22	4	4	0
	S. birrea	4	0	0	0
	T. indica	37	4	0	0
	Z. mauritiana	2	0	0	0

Ziziphus mauritiana trees were reported to be owned by households in three villages, Limani, Mathotho and Ndelema. A local forestry worker reported that young trees of this species were browsed by animals and that possibly some large trees of the species were being cut for charcoal production. *Ziziphus mauritiana* wood is good for fuel and charcoal while its foliage is preferred by livestock (FAO, 1982). Most villagers who owned this tree species were said to have planted them within homesteads to ensure more protection from animal browsing and charcoal production. This tree species was also said to be planted close to households to reduce the distance and time required to harvest fruit. During the individual interviews in Ndelema Village, two *Z. mauritiana* trees were observed in two

household areas and were said to have been planted by the household owners. The tree species also grows mostly on disturbed land, particularly in old fields and not in the indigenous woodland (Grundy, 1996).

In general, household ownership of indigenous fruit trees shows the value attached to the trees by the owners. Karmann and Lorbach (1996) found in Cabo Delgabo, Mozambique, that farmers planted only indigenous fruit tree species they valued most, such as *S. birrea* and *Z. mauritiana* trees. Fruit trees such as tamarind were retained in the fields because of the fruit benefits expected from the tree. Campbell (1987) reported that 70% of his respondents in a survey in Zimbabwe retained fruit trees in the fields to promote fruit availability. Similarly Minae *et al.* (1995) reported that 17 out of 52 tree species identified by farmers as retained in the fields of their sampled districts in the country were indigenous fruit trees.

Planting of indigenous fruit trees by rural communities seems to be uncommon. Sibidé *et al.* (1996) found that in some places in Mali, villagers grew baobab in the field boundaries, but in this study area, according to key informants, baobab trees were not being planted but left to grow in the fields. According to the local forestry worker, planting of indigenous fruit trees such as *A. digitata*, *D. kirkii* and *V. infausta* in the study area was not a common practice. Wild fruit trees were said to be regarded as resources naturally found in the bush therefore most people did not feel the need to plant them. Malembo *et al.* (1998) similarly reported that some of their respondents did not plant indigenous fruit trees because they associated them with gifts from God.

Some fruit trees are reported to take many years to grow and start producing fruit (Malembo *et al.,* 1998). In Ndelema Village a participant reported that a *T. indica* tree he had planted three years before had not yet started producing fruit. Similarly, Maghembe (1995) reported that *T. indica* trees started producing pods only four years after planting while *S. birrea* and *S. spinosa* trees had not yet flowered four years after planting. Grafting can reduce the time it takes to produce fruit. For example, in Botswana, grafted *S. birrea* trees started fruiting four to five years after planting whereas ungrafted trees took eight to 10 years before fruiting (Taylor *et al.,* 1996).

Farmers' lack of technical knowledge on propagation of indigenous fruit trees may also result in reduced numbers of planted wild fruit trees. Malembo *et al.* (1998) stated that some of their respondents reported deaths of indigenous fruit trees they had planted.

3.5 Preferred indigenous fruit species

Three most important indigenous fruit species available and utilised in the study area were ranked based on their importance by group interview participants and individual interview respondents. The three fruit species mostly preferred by both categories, participants and respondents, were similar, these being *A. digitata*, *T. indica* and *D. kirkii* for first, second and third preference respectively (Figure 3.4). *Flacourtia indica* and *V. infausta* fruit species were also preferred by some individuals but *B. discolor* was mentioned only during the individual interviews in Mkoka Village. Group interview participants in all the 10 groups selected *A. digitata* and *T. indica* for first and second preference. *Diospyros kirkii* fruit was given a third rank of importance by all the groups except female participants from Kanselu and Limani Villages who chose *F. indica* and male participants from Mathotho Village who selected *V. infausta* fruit.

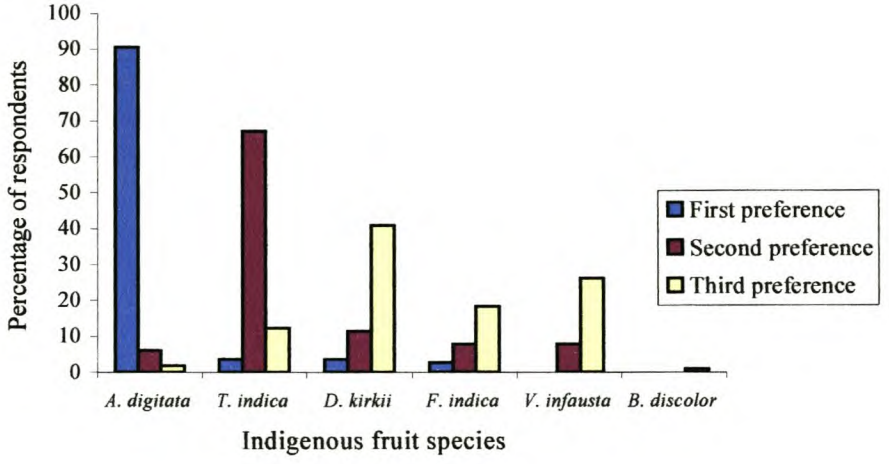

Figure 3.4. Individual ranking of the preferred indigenous fruit species by respondents in the study area (n=115)

Edible indigenous fruit can be ranked by the utilisers based on different criteria. Indigenous fruit species were seen by respondents to be important for subsistence as mentioned by 53% (n=115) while commercial gain was mentioned by only 22.6%. Other respondents (24.3%) mentioned both subsistence and commercial utilisation as being their bases of ranking the preferred fruit.

Minae *et al.* (1995) reported farmers' prioritisation criteria of fruit, which were also based on the marketing potential and food supply contributed by the fruit. Similar to the finding of the present study, food contribution of fruit to households in their study was the main prioritisation criterion, which was mentioned by more than 80% of the respondents. Commercial value may also be an important criterion for ranking importance of indigenous fruit species. In Namibia, villagers preferred *B. discolor* fruit because of its commercial value and abundance (Lusepani, 1999).

During group interviews in the study area, the following were mentioned by participants as being reasons for preferring the fruit species:

a) Adansonia digitata

- Eaten as meal during hunger periods
- Selling relatively better than *T. indica* fruit
- Being relatively abundant and constant and the fruit could be stored for up to one year.

b) Tamarindus indica

- Eaten as meal during hunger times
- Marketed to intermediate buyers

c) Diospyros kirkii

- Eaten in place of a meal when food reserves were inadequate but could also be eaten as a snack.

Flacourtia indica fruit was preferred for tasting sweet whereas *V. infausta* fruit was reported as filling when eaten as a meal.

3.6 Fruit seasonality and variations in production

3.6.1 Seasonality of indigenous fruit

Indigenous fruit are seasonal in the study area. Participants showed this in the seasonal calendars of important activities they carried out, including those related to the utilisation of preferred wild fruit species. Although the calendars were drawn by different group participants, many activities were carried out in common (Table 3.11). Some activities were shown to be carried out throughout the year, including charcoal and fuelwood production, mat making, production of hoe handles and clay pots and herding of livestock. These have been left out of Table 3.11.

Table 3.11 shows that the main three preferred indigenous fruit species were in season in the dry season. Dry season is the period when most labour demanding activities related to agricultural production are already complete (Mauambeta, 1994). Weeding was regarded as the most labour demanding agricultural activity in the study area. According to the group participants weeding was done in the wet season between December and February. During this period, which is associated with low food reserves in rural communities, most communities would need fruit to supplement their dietary requirements (FAO, 1995; Malembo *et al.,* 1998; Meke, 1998) yet the preferred fruit are not in season. The availability of most fruit in the dry season was also reported by Mauambeta (1994) and Abbot (1999). It is a common miombo phenomenon as in Zambia, only 30% of the 40 edible indigenous fruit species that were studied were available in the wet season when they were required most (Mateke *et al.*, 1995).

Some sources from the literature report that reliance on indigenous fruit by rural communities during famine period was decreasing. The reasons given for this were the acquisition of food aid by the rural communities from the government and a decreased availability of wild food from the forest (Arnold, 1995; FAO, 1995). Contrary to this, group interview participants in the study area reported that almost every year there was hunger in the villages and that although aid was supplied to relieve hunger for a short time, this did not reduce their reliance on indigenous fruit for subsistence. In addition it was reported that not all communities received the aid.

Table 3.11. Common important activities carried out in the study area as shown in the seasonal calendars drawn by participants (n=141)

Activities	J	F	M	A	M	J	J	A	S	O	N	D
Harvesting *A. digitata*												
Harvesting *T.indica*												
Harvesting *D. kirkii*												
Harvesting *V. infausta*												
Harvesting *F. indica*												
Agricultural field preparation												
Weeding												
Harvesting maize												
Harvesting cotton												
Harvesting thatching grass												

3.6.2 Fruit production variation

Variation in indigenous fruit production was reported in the study area. Indigenous fruit tree species including *A. digitata, T. indica*, *F. indica* and *D. kirkii* were reported as varying in fruit quantities produced per season. Two cattle herders explained that in one season, a baobab tree could bear fruit enough to fill six 50 kg size sacks[3]. In the following season the same tree might bear fruit only enough to fill one 50 kg size sack. Besides this variation, the sizes of baobab fruit within a tree varied in distribution. In one season the tree might bear small sized fruit at the top while larger fruit would be borne at the lower branches and the following season the opposite would be observed. Baobab fruit shape was reported as being specific to particular trees. A tree bearing ovoid or oblong shaped fruit would usually maintain the same shape every season.

In Limani and Mathotho Villages, resource assessment participants reported production variations of tamarind fruit with the seasons. In general climatic changes were mentioned as influencing the variations in fruit production in the study area. Too much rainfall was associated with a reduction in the production of tamarind fruit. In Mkoka Village, during the group interviews, male participants predicted that tamarind fruit production that season would be lower than the previous season

[3] These 50 kg size sacks refer to sacks that, filled with maize, would weigh 50 kg.

because of unusually heavy rains. *Flacourtia indica*, *V. infausta* and *D. kirkii* trees were reported by resource assessment participants as also varying in fruit production.

Chidumayo and Frost (1996) linked mast fruiting, variation in fruit production or fruit failure, with variation in pollination, flower abortion and bud predation among other factors. Drought and changes in rainfall conditions are reported as causing fruit abortion in *V. infausta* trees (Taylor *et al.*, 1996). Probably the heavy rains that were associated with low tamarind fruit production could cause flower abortion and lead to the low fruit production.

3.7 Uses of the preferred fruit tree species

Table 3.12 shows that trees of the preferred fruit species in the study area were also used for other purposes apart from fruit. This shows that the preferred indigenous fruit trees were of economic value to the villagers in the study area.

3.7.1 Subsistence utilisation of the preferred fruit species

According to the group interview participants, subsistence utilisation of indigenous fruit by communities in the study area was by all the age classes and both gender categories. However children in particular were reported as eating most indigenous fruit species compared to adults. In his study of wild fruit in Zimbabwe, Campbell (1987) similarly stated that over 95% of households represented by his respondents ate wild fruit but children ate them most. Most group interview participants reported that they utilised fruit as a snack when carrying out other activities. Females stated that they consumed fruit such as *D. kirkii* when collecting firewood and harvesting thatching grass while males collected fruit while hunting, making charcoal and collecting poles from the woodlands. Coote *et al.* (1993) and Campbell *et al.* (1997) similarly reported this opportunistic collection of wild fruit.

Fruit quantities utilised for subsistence

Quantities of the preferred indigenous fruit reported as being utilised by respondents in the study area refer to freshly harvested fruit. The quantities reported refer to those utilised per season for subsistence while those utilised for commercial use are

reported separately. The mass for each fruit species refers to that for the entire fruit, thus with all fruit contents.

Table 3.12. Uses of preferred fruit tree species mentioned by participants in the study area (n=141)

Indigenous fruit tree species	Parts used	Use
Adansonia digitata	Bark	Medicine and making string for mats
	Flowers	Cooked as vegetable
	Fruit and seed	Eaten and processed
	Leaves	Cooked as vegetable
	Roots	Medicine
Diospyros kirkii	Bark	Medicine
	Fruit	Eaten fresh
	Leaves	Medicine
	Roots	Medicine
	Wood	Charcoal, firewood, poles and hoe handles
Flacourtia indica	Fruit	Eaten fresh
	Leaves	Medicine
	Roots	Medicine
	Wood	Charcoal, firewood, poles
Tamarindus indica	Bark	Medicine
	Fruit	Eaten and processed
	Leaves	Medicine
	Wood	Charcoal, firewood, hoe handles, poles and dug out canoe
Vangueria infausta	Fruit	Eaten fresh
	Leaves	Medicine
	Wood	Charcoal, firewood and poles

Results of conversion of fruit volume to mass to estimate the quantities of preferred fruit utilised by rural communities were as follows:

- On average, a normal 50 kg size bag when filled with baobab fruit to capacity weighed 17 kg and contained approximately 85 baobab fruit.
- Two litres of *F. indica* fruit on average weighed 1.017 kg while the same volume of *V. infausta* fruit on average weighed 0.985 kg.
- According to the Wildlife Society of Malawi staff, on average a 20-litre bucket of *T. indica* fruit was reported to weigh 15 kg while a litre of *D. kirkii* fruit was reported to weigh 0.560 kg.

The fruit quantities estimated as being harvested by respondents were based on their memory, which could lead to errors like over or under-estimation of the quantities.

According to group interview participants, respondents and key informants, subsistence utilisation of *A. digitata, T. indica, D. kirkii* and *V. infausta* fruit included consumption of the fruit as a snack and a meal whereas *F. indica* fruit was primarily utilised as a snack.

Respondents who preferred and harvested baobab fruit for subsistence utilisation constituted 96.5% (n=115). Of these, 90% (n=111) harvested up to 100 kg of the fruit per season but the average amount utilised per respondent ranged from 51 to 75 kg. Figure 3.5 shows that high percentages of respondents ate small amounts of baobab fruit with only few people utilising large quantities. Baobab fruit was consumed as a snack in most cases. However some respondents utilised great quantities reaching 300 kg. Those respondents who utilised more than 200 kg of baobab belonged to the poor households. The fruit of baobab is said to be a good source of vitamin C (Saka and Msonthi, 1994). Leakey (1999) reported that the amount of vitamin C present in baobab fruit is at least 10 times greater than that contained in an orange fruit (*Citrus sinensis*).

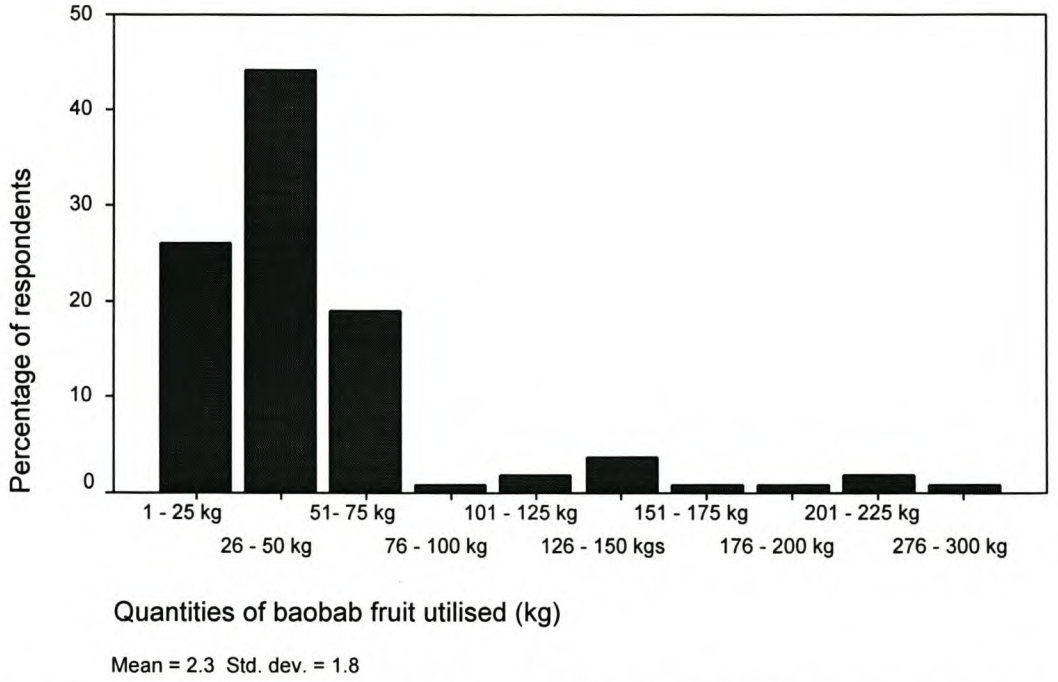

Figure 3.5. Quantities of baobab fruit (kg) utilised for subsistence purpose by respondents in the study area (n=111)

Key informants reported that monkeys preferred baobab fruit but were not commonly seen in the study area. Pullinger and Kitchin (1982) similarly reported this saying that they break open the fruit pod to eat the pulp.

Most respondents utilised between 11 and 50 kg of tamarind fruit for subsistence purposes (Figure 3.6) but on average each respondent harvested from 41 to 50 kg of tamarind fruit per season. Respondents who utilised more than 100 kg of tamarind fruit for subsistence purpose were few (9.1%, n= 88). Amongst these, none belonged to the rich or the upper medium wealth households.

Group interview participants such as those in Limani, Kanselu and Mathotho Villages stated that eating raw tamarind fruit caused a problem of sores that could develop in the mouth. This was said to be common with the sour tasting tamarind fruit, consequently only one to three tamarind fruit were said to be enough per day when eaten fresh.

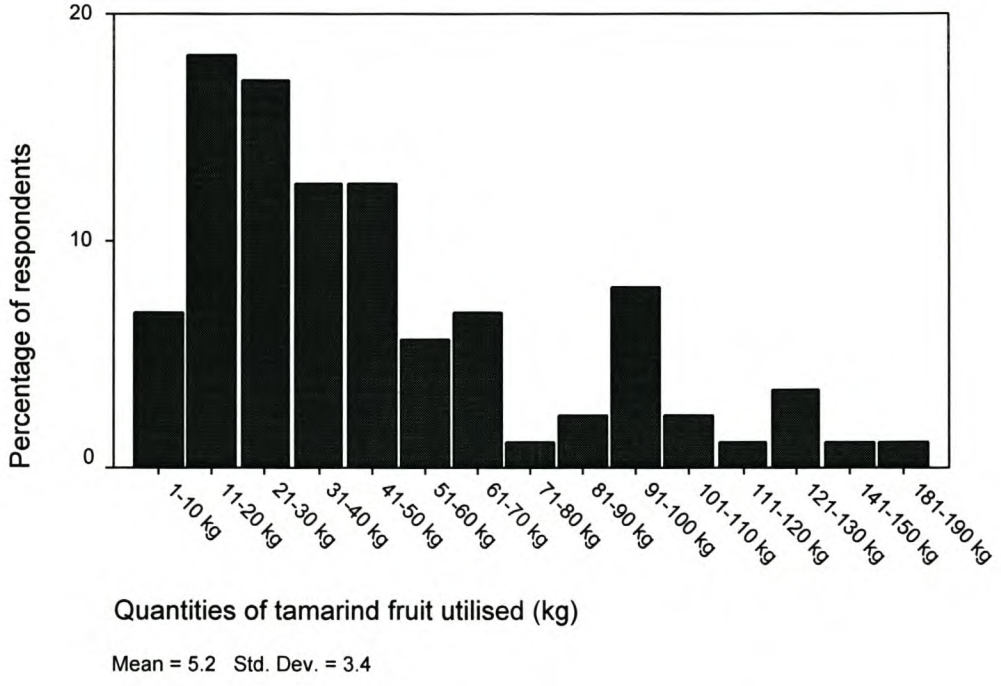

Figure 3.6. Quantities of tamarind fruit (kg) utilised for subsistence purpose by respondents in the study area (n=88)

Baboons and monkeys were reported by Pullinger and Kitchin (1982) as also eating tamarind fruit. Similarly in Mkoka Village, male participants stated that monkeys in particular were observed consuming the fruit in the natural woodlands. The animals were reported as being found far away from the village and that fruit from tamarind trees that were close to the village were not being eaten by the animals. This suggests that it is easier to protect tamarind fruit trees close to household areas from monkeys.

On average, based on the mean given in Figure 3.7, each respondent utilised between 36 and 40 kg of *D. kirkii* fruit per season for subsistence. Respondents who utilised over 100 kg of the fruit per season belonged to the poor and the lower medium wealth households constituting 60% and 40% (n=5) respectively. Those who utilised only up to 5 kg of *D. kirkii* fruit belonged to the rich households, being 1.7% (n=59).

Two cattle herders stated that birds preferred *D. kirkii* fruit while a respondent in Ndelema Village stated that monkeys too preferred the fruit but were commonly found in distant places from the villages. *Diospyros mespiliformis,* which is closely related to *D. kirkii* fruit species is also said to be liked by birds and several mammals such as baboons and monkeys (Pullinger and Kitchin, 1982; Storrs, 1995).

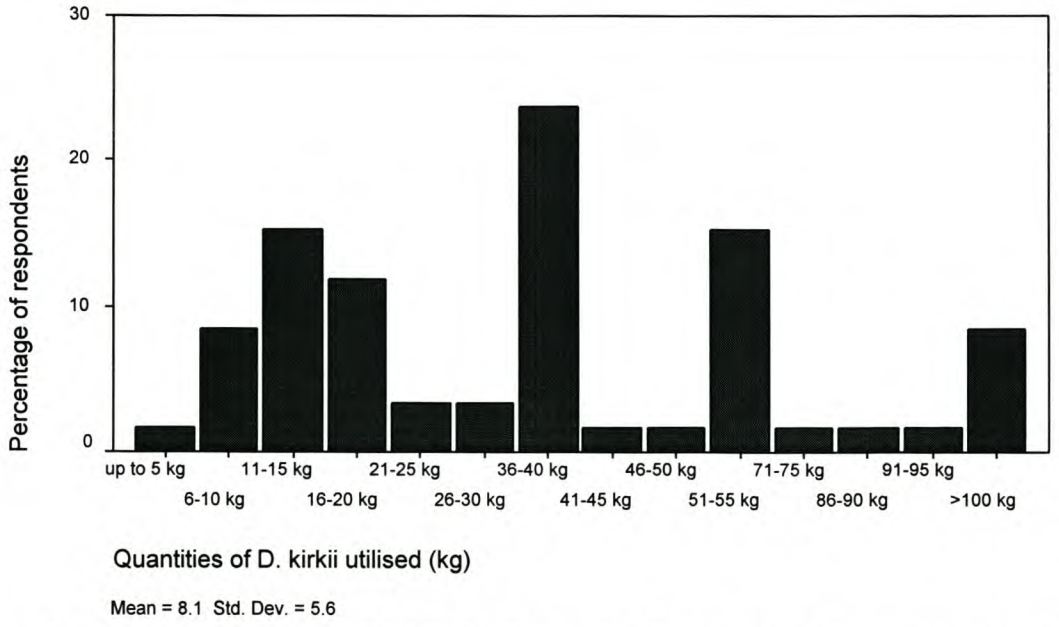

Figure 3.7. Quantities of *D. kirkii* fruit (kg) utilised per season by respondents for subsistence in the study area (n=59)

The mean quantity of *F. indica* fruit utilised per respondent per season was between 11 and 15 kg. The maximum quantity utilised per respondent per season was 25 kg (Table 3.13) and of those interviewed no respondent from a rich household utilised the quantity. Respondents from rich households in the study area utilised small quantities of *F. indica* fruit compared to the poor. Birds were also reported by resource assessment participants in Mathotho, Kanselu and Limani Villages as eating very ripe *F. indica* fruit and two cattle herders reported the same. In addition the herders estimated that birds would consume one out of 20 *F. indica* fruit per tree. The implication was that birds did not consume much of *F. indica* fruit and could not lead to big competition with people in eating the fruit.

Table 3.13. Quantities of *Flacourtia indica* (kg) utilised per season for subsistence purpose by respondents in the study area (n=39)

Amount utilised	Frequency	Percent
Up to 5 kg	9	23.1
6-10 kg	9	23.1
11-15 kg	7	17.9
16-20 kg	9	23.1
21-25 kg	5	12.8
Total	39	100

Table 3.14 shows that 25% of the respondents (n=28) who preferred *V. infausta* fruit utilised only up to 5 kg of the fruit per season. All these respondents belonged to the medium and rich households in the study area while those who utilised more than 40 kg of the fruit per season were from the poor households.

Table 3.14. Quantities of *Vangueria infausta* (kg) utilised per season for subsistence purpose by respondents in the study area (n=28)

Quantities utilised	Frequency	Percent
Up to 5 kg	7	25
6-10 kg	9	32.1
11-15 kg	6	21.4
21-25 kg	2	7.1
26-30 kg	1	3.6
31-35 kg	1	3.6
36-40 kg	0	0
>40 kg	2	7.1
Total	28	100

The results of subsistence utilisation of the preferred indigenous fruit species in the study area show that the poor households heavily depended on the fruit species, with the exception of *F. indica* fruit, for food security by utilising them as a meal in times of food shortages. This is shown by the large quantities the poor utilised the fruit. This was probably because they also had open access to utilisation of the fruit species in the natural woodlands. The poor groups within most communities in developing countries rely on forest food when access to the forests is unrestricted and during food shortages (Arnold, 1995; FAO, 1995). The rich showed minor dependence on all the fruit species preferred in the study area. Obviously they had enough food reserves throughout the year and would be able to purchase them when required.

3.7.2 Other fruit tree uses

Baobab was the only fruit tree whose flowers were cooked for food. This was reported as being done only when food supplies were limited. The tender leaves of baobab are reported to be rich in several minerals, which include calcium, iron, potassium, magnesium and zinc (Leakey, 1999). The seed, which is used in place of groundnut, has more protein content than groundnut besides being rich in minerals such as calcium and iron (Leakey, 1999). Baobab wood was reported as not being of any direct value to the villagers in the study area because of its fibrous nature. Only the bark is used.

The cutting of indigenous fruit trees for charcoal production and fuelwood was mentioned by the group interview participants in Kanselu, Limani and Mathotho Villages. During the group interviews in Kanselu Village, a *S. spinosa* tree that was bearing fruit was observed cut near a homestead. Obviously the fruit were of lesser value than the wood to the owner. Tamarind trees were also reported as being cut by charcoal producers in the sites where the trees were little protected by villagers particularly in the natural woodlands. However, this practice was not very commonly done amongst the rural communities. Use of fruit trees for fuelwood is done by particular individuals, communities and areas. For example, van Eck *et al.* (1997) found that *V. infausta* trees were not used for fuel by communities in the Eastern Cape Province, South Africa, but only the fruit.

Male participants in Mkoka said that canoes were made from tamarind wood after the trees were no longer productive. The village was situated near the Shire River where fishing was said to be done. However, hardly any villagers used canoes for fishing because they used lines to catch fish from the river bank.

All the preferred fruit tree species were mentioned as being of medicinal value to rural communities in the study area. The parts of fruit trees used for medicine were said to be carefully extracted and were collected in small amounts to avoid damaging the trees. In Ndelema Village, the male participants reported that usually part of a root would be enough for effective treatment against a disease. They revealed that local medicines were made of mixtures of different plants therefore small quantities only were utilised from one plant species. In Kanselu Village, the female participants reported that only a handful of *D. kirkii* leaves could cure an adult person complaining of general body pains. Male participants in the same village revealed that when indigenous tree species that could heal a particular disease were not found near the village, fruit tree species that were effective could then be used for medicine. However, female participants in Limani Village reported that all types of trees whether fruit trees or not were used for medicine if proved effective against diseases. Parts of specific tree species were used for effective treatment and if those parts were of fruit trees there was no choice but to collect them.

According to the local forestry worker in the study area, damage to fruit trees could be caused if for instance harvesting of plant parts was done excessively. Similarly Taylor *et al.* (1996) reported that harvesting pressure caused by the need to commercialise some plant parts like roots and barks could kill the plant or lead to its destruction but proper traditional extraction of the plant parts could protect the plants from depletion.

Some sources in the literature cite uses of the preferred indigenous fruit trees such as water storage in the hollow trunks of baobab (FAO, 1982) and its roots as having the potential to make red dye (Pullinger and Kitchin, 1982). A local fruit vendor in the study area reported that baobab fruit pods were being used as fuel for heating in urban areas. In addition, ash from the pod is used for soap manufacturing (FAO, 1982). There was no need for communities in the study area to store water in baobab

trunks however, because water as a resource was not limiting to them. In addition fruit pods were not required for use as fuelwood because communities could obtain fuel from the woodlands. Besides the uses of tamarind trees mentioned in the study area, its leaves, flowers and seeds when boiled are edible in some parts of Malawi (Pullinger and Kitchin, 1982). Tamarind trees are also reported as being used to create firebreaks (FAO, 1982). There is potential for communities in the study area to utilise some fruit tree parts like tamarind leaves.

Besides the provision of several products, some fruit trees such as *T. indica* and *D. kirkii* species provide shade. Storrs (1995) reports that *T. indica* is planted to provide shade in West Africa while young trees of *D. kirkii* are described by FAO (1983) to be suitable for shade. During the individual interviews in Mathotho Village, two young men were observed making mats under a tamarind tree. This can be an additional incentive for rural communities to retain or plant such trees in homestead areas.

Trees including fruit species are described by Falconer (1990) as serving judicial functions when grown to mark boundaries. They are reported as being "witnesses" in judicial disputes.

3.8 Access to fruit

Generally, according to group interview participants, villagers in the study area had little or no control over utilisation of indigenous fruit found in communal lands. People who did not belong to the villages in the study area, also known as outsiders, had free access to fruit from the woodlands.

Traditionally, permission had to be sought for the collection of tree products including fruit found in other people's agricultural fields and household areas, even amongst the villagers themselves. However, male participants from Kanselu Village revealed that some people could still utilise fruit without obtaining permission or punishment from owners of the resources. Mandondo (2000) also found that villagers from five traditional villages in Zimbabwe collected resources like wild fruit, fuelwood, timber and mushrooms from within and outside their village

boundaries. In particular, wild fruit were the most collected of all the resources, which came from other villages. In addition members of all adjacent villages in that study collected wild fruit from within and neighbouring villages, probably due to intermarriages and geographical proximity. These factors also applied to the study area as well as inadequate or no implementation of the village committee rules, which were made to protect Village Forest Areas.

It was reported during group interview meetings that not all villagers knew the rules about Village Forest Areas and that some committee members were not performing their duties. Chadza and Kamoto (2000) cited similar findings from some villages in eastern Mwanza District and attributed these to infrequent or no village meetings held by Village Natural Resources Management Committees to inform villagers about the rules of managing the forest areas.

Conflict over resource use may arise between different societies having different geographical origins. In Mkoka Village, participants expressed concern over the collection of baobab fruit from the village by some traders from Blantyre District without permission. Chipepo (2000) similarly reported of a conflict in Chawa Game Management Area in Zambia that resulted from migrant cattle herders and tour operators. These outsiders freely utilised resources like grass, poles and sand that were meant for subsistence utilisation by the rural community (insiders), for commercial purposes without any reward or consent.

According to tradition, nobody in the study area was allowed to utilise fruit from a graveyard. Doing so was associated with practising witchcraft, which was commonly believed to be a source of awkward illnesses, unexpected deaths and bad omen. The only exception was when gravediggers, during funerals, collected and ate fruit while performing their duties. Even then, one could not take any fruit home. This tradition was highly respected in all the villages in the study area. In Nyamaropa communal area, Zimbabwe, similar local rules applied but in addition, places where sacrifices were offered to ancestors were also protected from extraction of resources (Mandondo, 2000).

3.9 Choice of fruit to harvest

Taste played an important role in the choice of fruit for subsistence utilisation by villagers in the study area. According to group interview participants and key informants, sweet tasting fruit were mostly preferred for subsistence consumption. On the other hand, both sour and sweet tasting baobab and tamarind fruit were being harvested for commercial purposes. However, in times of hunger, any edible fruit available would be consumed regardless of taste.

In general, for subsistence utilisation, fruit collected directly from a tree were preferred compared to those collected from the ground. Fruit such as *V. infausta* and *T. indica* found on the ground were rarely utilised in most cases, being associated with contamination. For commercial utilisation, as long as the fruit were not rotten or reduced in quality, collection of the fruit from the ground was done by villagers in the study area.

Fruit size was said to influence choice. Generally local fruit vendors in the study area preferred harvesting large baobab fruit when selling them in retail outlets. Size was reported as being equally important for subsistence utilisation. A key informant explained that harvesting large fruit whether for subsistence or commercial purposes saved time compared to harvesting small fruit. Large baobab fruit were reported as filling up a sack more quickly than small fruit.

3.10 Indigenous fruit harvesting

Harvesting of the preferred indigenous fruit species in the study area was done by 98.3% (n=115) of the individual interviewees. The few respondents (1.7%, n=115) who did not harvest any of the preferred fruit species were females aged between 65 and 70 years. When asked the reason for this, they responded that, because of old age, they relied on other people to harvest fruit for them.

3.10.1 Harvesting methods used

When respondents were asked to mention the main methods they used to harvest the three particular fruit species they preferred, five harvesting methods were described.

Some methods were specific to particular fruit tree species while others were used for several preferred fruit species. The methods are summarised in Table 3.15.

Table 3.15. Percentages of respondents who used the main harvesting methods of the preferred fruit species in the study area

Main harvesting methods	Indigenous fruit species				
	A. digitata (111)[a]	*T. indica* (86)	*D. kirkii* (61)	*V. infausta* (28)	*F. indica* (39)
Picking from the ground	91	0	0	0	0
Hand picking	0	20.9	45.9	96.4	94.9
Throwing objects (*Zigile*)[b]	8.1	0	0	0	0
Tree climbing	0	53.5	50.8	3.6	5.1
Using a long stick	0.9	25.6	3.3	0	0

[a]Figures in brackets denote the number of respondents for the particular preferred fruit harvested.

[b] Pieces of wood mostly ranging from 20 to 30 cm long and 3 to 5 cm in diameter thrown to dislodge baobab fruit from the tree

a) *Adansonia digitata*

Picking the fruit from the ground was the main harvesting method mentioned by 91% (n=111) of all the respondents who harvested baobab. Of these, 59.4% (n=101) were females probably because it was the easiest harvesting method since the fruit fell to the ground in the wind. Baobab fruit are not usually damaged when they fall to the ground. Use of a long stick was the least baobab harvesting method used, being mentioned by females between 36 and 45 years of age. Respondents who mentioned "throwing objects" like pieces of wood also called *zigile* were mostly males. All the age groups except those below 15 years of age said that they mainly threw objects to harvest baobab fruit. According to key informants, throwing *zigile* required vast energy. Male participants in Mathotho Village stated that this method was mostly used when harvesting sweet tasting baobab fruit and when the fruit could not be found adequately on the ground. A cattle herder reported that baobab trees with several branches on the lower parts could be climbed to harvest fruit without difficulties.

b) *Tamarindus indica* and *D. kirkii*

Tree climbing was the most frequently mentioned harvesting method of *T. indica* and *D. kirkii* fruit species (Table 3.15). Sixty-three percent of respondents (n=46) who mentioned tree climbing as their main method of harvesting tamarind fruit were males and were dominated by respondents below 15 years of age. Similarly, of those who mentioned climbing as their main harvesting method of *D. kirkii* fruit, 64.5% (n=31) were males. This implies that boys mostly climb *T. indica* and *D. kirkii* trees to harvest the fruit. Cattle herders reported that with tree climbing one could harvest large quantities of fruit such as *T. indica* and *D. kirkii*.

Hand picking[4] and the use of long sticks as tamarind fruit harvesting methods were dominated by female respondents who constituted 68.2% (n=22) and 72.2% (n=18) respectively. Similarly, 78.6% of respondents (n=28) who hand picked *D. kirkii* fruit as their main harvesting method were females. However use of long sticks to harvest *D. kirkii* fruit was associated with age of respondents as both males and females above 45 years of age in particular used long sticks to harvest *D. kirkii* fruit. This fruit is rarely picked from the ground (FAO, 1983).

c) *Vangueria infausta* and *F. indica* fruit

Hand picking was the main harvesting method of *V. infausta* and *F. indica* fruit species. Most *V. infausta* and *F. indica* fruit could be hand picked because the trees are mostly small. *Flacourtia indica* trees are thorny (Prins and Maghembe, 1994) and as a result climbing them was uncommon in the study area. The main harvesting methods of *V. infausta* and *F. indica* were not correlated with any human factors.

Most respondents mentioned use of *zigile* as the most difficult fruit harvesting method because of arms becoming painful. Tree climbing was mentioned by most adults as another difficult fruit harvesting method. These methods were mostly used when fruit could not be easily harvested like hand picking.

[4] Hand picking refers to the harvesting of fruit by hand without climbing the tree.

3.10.2 Destructive harvesting methods

Some fruit harvesting methods used in the study area were destructive while others were not. It appears that the need to harvest great quantities of fruit results in destructive methods of harvesting indigenous fruit mainly for commercial purpose.

During the group interviews in Limani Village a woman disclosed that at times, villagers broke or cut tamarind tree branches bearing a heavy crop as a method of fruit harvesting. Key informants attributed this harvesting method to commercial utilisation of the fruit by villagers. Mauambeta and Mwamadi (1999) also reported similar harvesting methods used by rural communities who sold tamarind fruit to a project adjacent to their villages in Mwanza East. Inadequate extension programmes and training on the proper methods of harvesting indigenous fruit could have led to this destructive fruit harvesting method (Mauambeta and Mwamadi, 1999). Probably harvesters resorted to this because they could collect as much tamarind fruit as was possible within a short time, and with the least effort.

Destructive harvesting methods of indigenous fruit species other than those preferred in the study area were reported. Meke (1998) in his study on *Uapaca kirkiana* reported that harvesters debarked the tree species by hitting the trunk with big stones to shake it so that large quantities of fruit could fall. The problem with destructive harvesting methods is that they can lead to low yields or destruction of the tree (FAO, 1995).

3.11 Fruit processing and storage

3.11.1 Fruit processing

Of all the preferred indigenous fruit species, villagers in the study area only processed baobab and tamarind fruit for subsistence use. According to PRA participants, individual respondents and key informants, the main fruit processing done in the study area were to make porridge and local juices from baobab and tamarind fruit and drying the fruit.

Baobab and tamarind fruit processing

Of all the respondents who harvested baobab, approximately 75% (n=111) processed it (Figure 3.8). According to two key informants, baobab porridge was made by breaking open the fruit pod, soaking the pulp and seed in water and removing the seeds when the pulp became detached from the seeds. Stirring was done in some cases to speed up the process. The pulp liquid was then cooked with maize bran or flour to prepare a meal particularly in times of food shortages. When maize bran or flour was not available, nothing was added to the pulp liquid. Only two to three large fruit of baobab were enough to prepare 1 litre of porridge. Local juice was made by soaking fruit in water and removing the pulp. The juice was drunk at any time not necessarily during mealtimes. In addition, key informants said that mixing baobab pulp liquid with milk produced a favourite drink. Group interview participants in all the villages mentioned the production of alcoholic drinks from baobab. However, the drinks were reported as not being made as often as the local fruit juices, the reason being that communities often preferred alcoholic drinks made from sugarcane.

Of the respondents who preferred and harvested tamarind fruit, 64.1% (n=92) made local juice (Figure 3.9). Tamarind porridge and juice were made, using the same methods for baobab. Usually sugar was added to the porridge to neutralise the sour taste of tamarind fruit. Depending on the individual's preference, either sugar or *Combretum imberbe* (*mtsimbiti*) ash was added to the juice to neutralise the sour taste of the fruit. Baobab seeds when roasted and ground into powder were said to be used by some households in place of groundnuts to flavour cooked pumpkin leaves and other vegetables. Ash from the pod was added to cooked vegetables (like okra) in place of sodium bicarbonate. Processing of fruit pods as a substitute to sodium bicarbonate implies that rural communities saved some money.

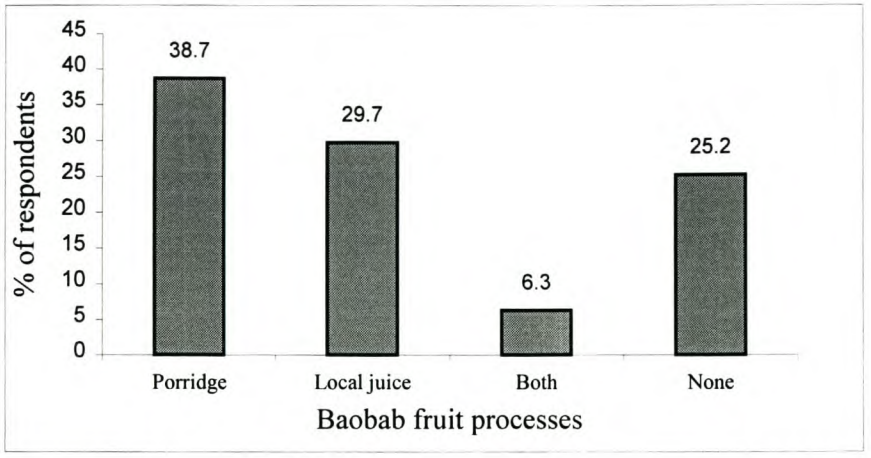

Figure 3.8. Percentages of respondents who preferred and processed baobab fruit in the study area (n=111)

The majority of respondents who processed baobab and tamarind fruit were females (Table 3.16). Food is normally prepared by women in Malawi, unless men have nobody else to cook for them. Warner (1997) reported that in eastern Africa, generally women have the responsibility of preparing food in a household.

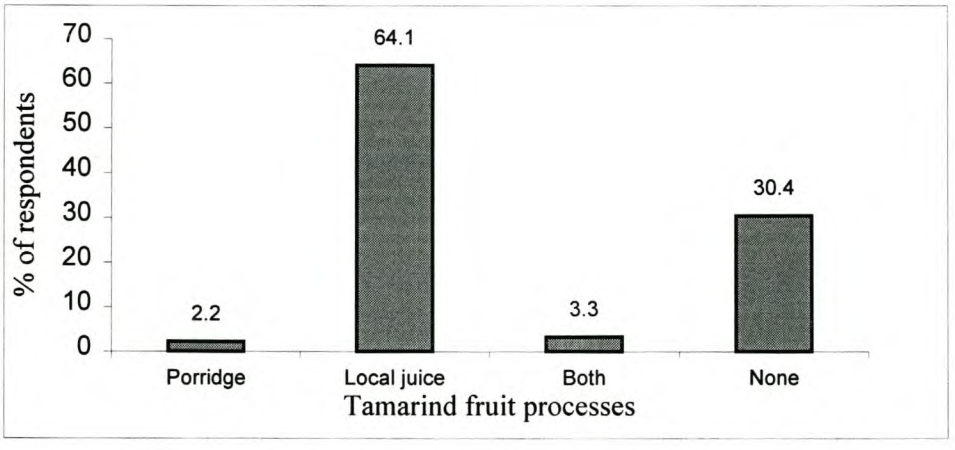

Figure 3.9. Percentages of respondents who preferred and processed tamarind fruit in the study area (n=92)

Drying was another process carried out particularly on tamarind fruit. According to key informants, in most cases baobab fruit were collected from the ground already dry. However, when collected while the fruit were not fully dried, they were spread on the ground for sun drying in household areas. This process was said to be carried

out when the fruit were meant for long periods of storage such as over six months. Tamarind fruit were normally tied together in bunches and put on a line for sun drying before storage. However, over-drying the fruit was reported to attract weevils that damage the fruit and to avoid this, daily monitoring of the fruit condition during the process was required. In some cases the fruit would be dried for a few days depending on the severity of the sun heat. Other fruit species are also dried before storage. For example, Lusepani (1999) reported the drying of *Berchermia discolor* fruit by communities in Namibia.

Table 3.16. Percentages of male and female respondents who processed fruit porridge and juices in the study area

Fruit processing	Indigenous fruit species processed by gender					
	A. digitata			*T. indica*		
	Male	Female	n	Male	Female	n
Porridge	11.6	88.4	43	50	50	2
Local juice	54.5	45.5	33	30.5	69.5	59
Porridge and local juice	14.3	85.7	7	0	100	3
No processing	82.1	17.9	28	78.6	21.4	28

Other uses of *D. kirkii* fruit apart from eating the fruit fresh are not known (Storrs, 1995). *Vangueria infausta* fruit although not dried could be cooked as a substitute for apple sauce (Pullinger and Kitchin, 1982). According to FAO (1983), *F. indica* fruit are dried in some communities and stored for future consumption.

Wild fruit are also processed elsewhere in Malawi. In Mwanza East, a project involved in the promotion of income generating activities for rural communities has encouraged the processing of indigenous fruit. Baobab and tamarind juice production commenced in 1998. A 500 ml bottle filled with baobab juice is processed from one fruit of average size. A similar volume of tamarind juice is processed from only 0.5 kg of tamarind fruit (Mkamanga and Chimutu, 2001).

Tamarindus indica fruit is reported as being processed into jam and sweets and is also used in chutneys and curries elsewhere (Pullinger and Kitchin, 1982; Leakey, 1999). The fruit was also found to have a normal pH for wine making with an alcoholic percentage of 14 (Ngwira, 1996). *Sclerocarya birrea* fruit is reported as

being made into several products, which include juice and local beer in Botswana, a liqueur known as *Amarula* in South Africa and wine in Zambia (Leakey, 1999). In West Africa, the powder of baobab fruit is also used to flavour cool and hot drinks. The only difference with the study area in processing the fruit is that in West Africa the powder is not heated but added to the drinks when cool (Sibidé *et al.*, 1996).

Berchemia discolor fruit can be made into porridge by mixing with millet flour (Mateke *et al.*, 1995; Storrs, 1995). In the study area, group interview participants in Mkoka Village reported that *B. discolor* fruit was only eaten fresh. If the villagers learnt this processing activity they could adopt it and increase the number of indigenous fruit species added to meals. The fruit species would play an important role in supplementing the food requirements of rural communities in the study area because it is in season during the hunger period. However, the major limitation would be in the adoption of fruit processing methods. Attitude, beliefs and perceptions often play an important role in influencing individual's choice to consume a particular food (FAO, 1995).

3.11.2 Fruit storage period, materials and spaces used

Storage period refers to the length of time the fruit was stored after harvesting it ripe. Respondents said that they stored baobab fruit for up to a year (Figure 3.10), but to be stored for a long period without being damaged, fruit was harvested when it was mature and dry. Afterwards it would be kept in dry places that were raised from the ground and the fruit would be sprinkled with *C. imberbe* wood ash. The ash was reported by key informants to prevent termites and other pests from damaging the stored fruit. Ash is commonly used to preserve wild fruit in southern Africa. For example, Lusepani (1999) cited sprinkling of wood ash on dried *B. discolor* fruit before storage by respondents in northern Namibia.

The highest percentage of respondents in the study area stored baobab fruit for four to six months (Figure 3.10). Similar figures were reported by Malembo *et al.* (1998).

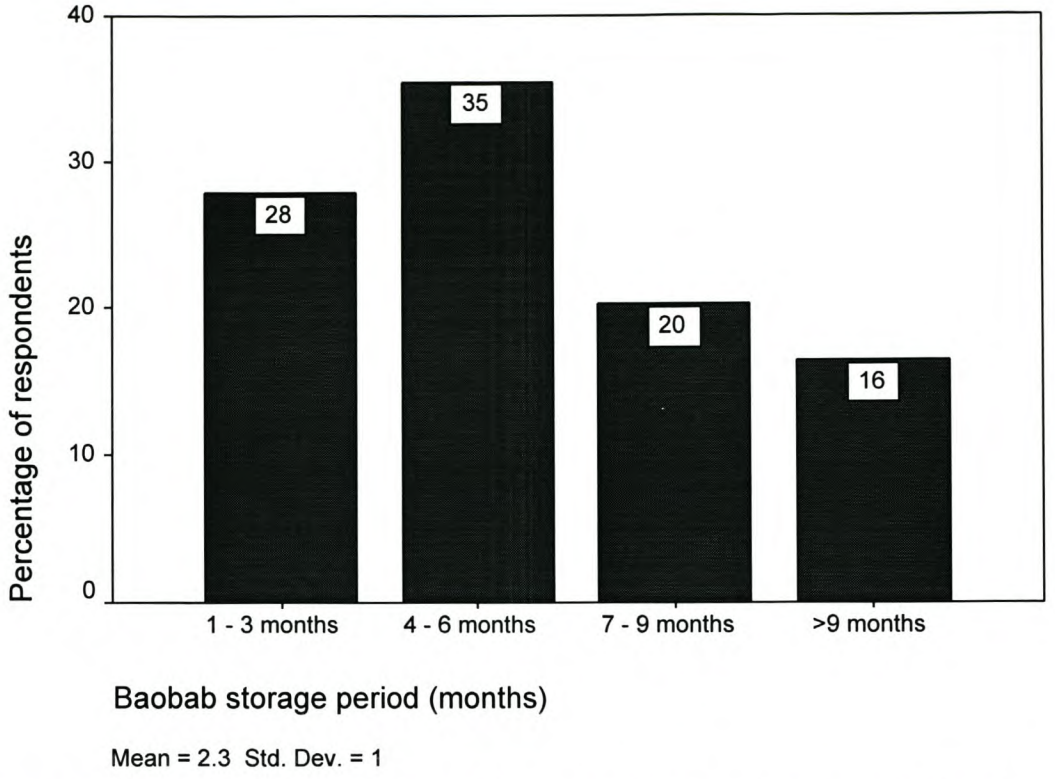

Figure 3.10. Storage period for baobab fruit mentioned by those respondents in the study area who preferred and stored the fruit (n=79)

Figure 3.11 shows that the highest percentage of respondents (47%) stored *T. indica* fruit for one to two months. The fruit rots easily and is attacked by insects but it can be stored for longer than six months if it is dried. Similar conditions to baobab are required for the storage of tamarind fruit.

Most villagers who preferred *D. kirkii*, *F. indica* and *V. infausta* fruit species said that these fruit species could be stored up to two days before they began to rot. These results suggest that *A. digitata* is the least perishable fruit followed by *T. indica*. *Diospyros kirkii*, *F. indica* and *V. infausta* fruit were the most perishable of the five indigenous fruit species, hence being stored for short periods.

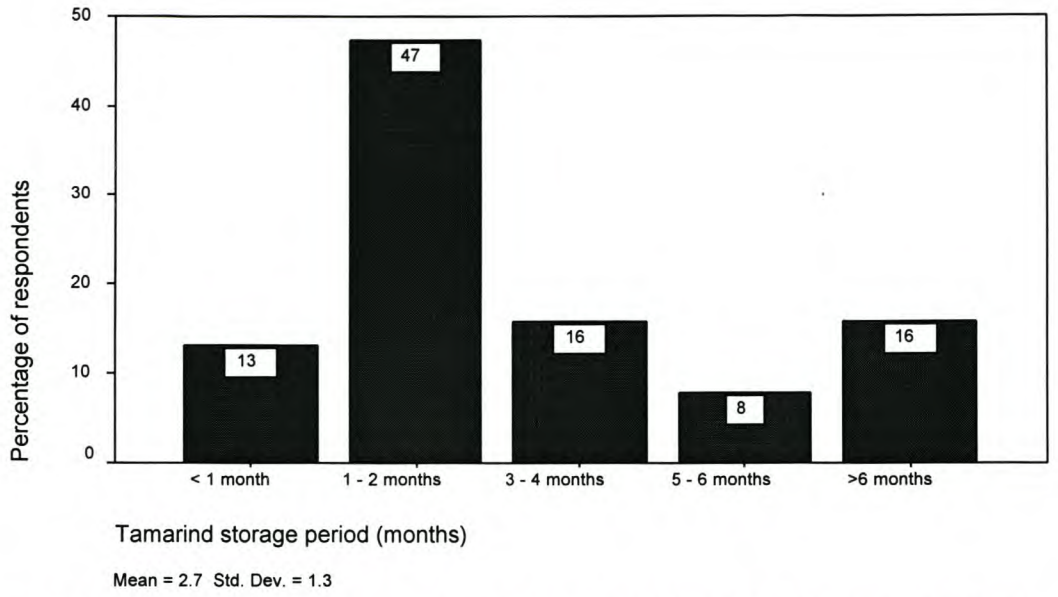

Figure 3.11. Storage period for tamarind fruit mentioned by those respondents in the study area who preferred and stored the fruit (n=38)

Malembo *et al.* (1998) reported that most indigenous fruit had a short shelf life. The three most perishable fruit species of the five in the study area also have short ripening periods. This means that communities have few opportunities to utilise the fruit over a long period.

Dried foods tend to have a prolonged shelf life as they resist microbial attack due to their low water contents (Salunkhe and Desai, 1984). This implies that foods with high water contents tend to have short shelf life. Saka (1995) reported the dry matter contents of various indigenous fruit species. *Adansonia digitata* and *T. indica* fruit had 86.8% and 73.1% dry matter contents respectively whereas *F. indica*, *D. kirkii* and *V. infausta* fruit contained 19.2%, 26.5% and 28% dry matter respectively. This would mean that *A. digitata* and *T. indica* fruit could be kept longer because of having a low water content whereas the other three, *F. indica*, *D. kirkii* and *V. infausta* fruit, would not keep long after ripening because of having a high water content.

Salunkhe and Desai (1984) also reported that besides water contents of foods, temperature and humidity influence their storage period. They stated that high ambient temperatures accelerate deteriorative changes of stored foods. According to

them, these changes which include loss in nutritional value, flavour, colour and texture can not be stopped but their reduction is possible with food conservation technology.

According to respondents, several storage places including granaries were used for storage of indigenous fruit. Granaries are structures locally constructed for storage of cereals, in particular maize. Table 3.17 shows that *A. digitata* fruit was most frequently mentioned by respondents as being stored in granaries. *Adansonia digitata* fruit could be stored in loose form or in sacks in a granary and *T. indica* fruit also was stored in sacks after being dried.

Only up to 4% (n=76) of the respondents used ash during storage period of baobab and tamarind fruit species. This was because some individuals who could afford to buy chemicals for protecting maize against pests in granaries said that the chemicals also protected stored fruit from weevil attack. Granaries were preferred storage places because they were raised from the ground, which to some extent protected stored food from termites and other pests. All the preferred fruit species were also said to be kept in houses but in small quantities because of space limitations. Other storage containers like clay pots and drums were not commonly used. Lusepani (1999) also reported use of granaries, sacks, baskets and clay pots as some of the fruit storage places and containers used in Namibia.

Table 3.17. Storage places and containers of the preferred fruit and percentages of respondents who used them in the study area (n=76)

Fruit storage places and containers used	**Preferred indigenous fruit species**				
	A. digitata	***T. indica***	***D. kirkii***	***V. infausta***	***F. indica***
Granary	63	13	3	0	0
Drum	3	0	0	0	0
Carton	1	1	0	0	0
Plastic bag	0	0	1	1	0
Wood ash	4	3	0	0	0
Sack	45	20	0	0	0
Plate	0	1	16	0	7
Clay pot	1	3	0	0	0
Basket	3	1	1	0	1

3.12 Sources of household income

- *Charcoal*

PRA participants in all the sampled villages ranked charcoal as the main source of household income in their villages because it is sold throughout the year and generates greatest income due to its high demand by traders. The wholesale price of charcoal per bag (50 kg size) within the villages in the study area ranged from MK60[5] to MK80 but when sold along major roads, each bag fetched MK100. On average, a charcoal producer was said to generate income ranging from MK1 500 to MK3 000 per month from charcoal sales. Male participants in Mkoka, Limani and Ndelema Villages revealed the amount of income generated from charcoal sales after much probing because according to the local forestry extension worker males were heavily involved in the illegal production of charcoal.

According to a key informant, a regular charcoal vendor could produce 100 bags of charcoal per month, generating income that could reach MK6 000 per month when sold within the villages. Charcoal trade in the study area was said to be well organised. He stated that traders from Blantyre brought empty sacks ranging in number from 80 to 100 to be filled with charcoal by villagers in the study area. The traders would later transport the charcoal bags in hired trucks to cities where the product was in high demand. Some villagers could cycle a distance of approximately 70 km with charcoal bags to generate more income than they would when selling within the villages. The forestry officer explained that villagers in the study area were sensitised enough during village meetings on the dangers of illegal charcoal production but did not stop the malpractice. He attributed this to village leaders, including some village headmen, who took part in the illegal industry.

- *Firewood*

Group interview participants in the study area with the exception of Mathotho Village ranked firewood as the second most important source of household income. According to participants from Mathotho Village, firewood was not sold in the

[5] 1 USD = MK63.00 as of 22nd October, 2001 (*Daily Times* newspaper, 2001)

village because of low demand. The villagers instead decided to concentrate on commercial charcoal production. Communities from the other four villages sold firewood throughout the year at MK10 per bundle and a seller was said to generate an approximate maximum of MK2 000 per month. They sold within the village and along major roads.

- *Livestock and crops*

Livestock and agricultural crops were amongst the top ranked sources of household income in the study area. Livestock, in particular cattle and goats, generated great income to households. Large cattle could be sold at a maximum price of MK15 000 each whereas a goat could fetch MK1 200. Prices were reported as being charged depending on season. During the hunger period, which was reported as sometimes beginning in October, prices for the same animals in terms of size were relatively low, being MK10 000 for cattle and MK900 for goats.

Amongst the agricultural crops that were sold in the villages, cotton was the main source of household income, contributing up to MK8 000 to a household per year. Following this were vegetables such as tomatoes, which could generate up to MK1 000 per month. Income from agricultural crops was said to vary with supply, which largely depended on climatic conditions. Demand within the villages for vegetables was also reported as being low because most villagers grew vegetables.

- *Indigenous fruit*

In all the villages, indigenous fruit were given a relatively low rank, fifth position being the highest rank of importance in the study area because of being seasonal and having limited sales. *Adansonia digitata* and *T. indica* were the main indigenous fruit sold in the study area apart from *Z. mauritiana* fruit which was rarely sold because of being scarce. According to the group interview participants in the study area, individuals who sold indigenous fruit (baobab and tamarind) were said to generate between MK100 and MK300 per season.

In Uganda, Nabanoga and Gombya-Sembajjwe (2001) also found that the sales of charcoal, firewood and agricultural produce were the most predominant sources of income for four rural settlements they were studying. The settlements that were closer to the tarred road had more income contributions to households than those further. In the study area, communities could walk to the tarred road hence selling charcoal and firewood along the main road.

Other sources of income that were seasonal and generated a small amount of income to households in the sampled villages were given a low ranking. These included thatching grass, hunting, fishing, piecework and selling alcoholic drinks. Some of these are shown in the ranking by Kanselu Village participants (Table 3.18)

A seasonal calendar of activities drawn by participants showed that thatching grass was harvested for three months only, being June to August. The grass sales at MK15 per bundle could contribute between MK150 and MK300 to a household during that period (Table 3.11). Villagers caught fish and hunted animals from November to February and August to October respectively. Piecework, such as employment to do road maintenance under the Malawi Social Action Fund Project (MASAF), was said to be found occasionally. Sale of locally-made alcoholic drinks was reported as being less frequently done during the periods when people were working in the fields. During this period, also associated with food shortages, sales of alcoholic drinks were said to be very low.

Table 3.18. Ranking of main sources of household income by female and male participants in Kanselu Village (n=24)

Female participants (n=14)	Rank	Male participants (n=10)
Charcoal	1	Charcoal
Firewood	2	Firewood
Agricultural crops	3	Livestock
Livestock	4	Agricultural crops
Alcoholic drinks	5	Mat making
Indigenous fruit	6	Piecework
Thatching grass	7	Indigenous fruit
Piecework	8	

Some sources of household income were gender based. For instance, besides charcoal production, males generated household income from selling fish, wild animals, mats and hoe handles. On the other hand, females generated household income from selling thatching grass, alcoholic drinks and clay pots among others. Female participants from Mathotho Village revealed that sales of livestock belonging to male-headed households were under the control of males who could decide on when to sell the animals.

Household incomes generated were reported as being used for buying basic necessities such as food and clothing. Other uses included purchasing agricultural implements, payment of hospital bills and groceries. In addition, households could use the money for payment of maize milling services. Some boys and girls during PRA interviews in Limani, Mathotho and Kanselu Villages mentioned school materials such as pencils and pens as being bought when they sold indigenous fruit.

3.13 Commercial utilisation of indigenous fruit in the study area

Traders were reported by a key informant as often using a two joined 50 kg size bag (maize bags) which on average contained 160 baobab fruit of mixed sizes and weighed 32 kg. The estimation of mass of this bag size with baobab fruit could have some errors because the joining points varied though not largely.

3.13.1 Market structure and roads in the study area

Key informants, individual interview respondents and all the group interview participants reported that there were no formal indigenous fruit market places in the study area. Marketing of indigenous fruit was reported as being done at a local level within the sampled villages and selling of the fruit was done on an individual basis. Group interview participants reported that fruit gatherers largely sold indigenous fruit to middlemen who came to the study area but some villagers in the study area although few, sold baobab fruit at distant markets.

Roads were untarred in all the villages as depicted in Figure 2.3. According to a key informant, vehicles travelled to the villages mostly for collection of charcoal bags

and not for the purchasing of indigenous fruit. Fruit traders were reported as largely hiring carts and labour to transport bags of baobab fruit from the sampled villages to the main road (tarmac) between Mwanza and Blantyre in the case of Ndelema, Mathotho and Mkoka Villages and the main road between Lilongwe and Blantyre Districts in the case of Limani and Kanselu Villages (Figure 2.3). The only improvements required on most roads in the study area were on bridges, which were reported as not being strong to stay up to two years.

3.13.2 Fruit species sold

Ziziphus mauritiana fruit was reported by female participants in Kanselu Village as being sold by some individuals in the village although in very rare occasions. *Adansonia digitata*, *T. indica* and *Z. mauritiana* fruit were reported as being sold raw. Although female participants in Limani Village said that some individuals sold alcoholic drinks made from baobab fruit, none of the respondents in the study area sold the drinks.

In some places within and outside the country, similar and different indigenous fruit species have been reported as being sold by communities. According to the group and individual interviews in the study area, *D. kirkii*, *F. indica* and *V. infausta* fruit were not sold because no traders ever came to buy the fruit. In contrast, in some districts in the country *F. indica* and *A. garckeana* were amongst the fruit species reported as being sold by rural communities (Malembo *et al.,* 1998). In Mozambique, Karmann and Lorbach (1996) reported *A. digitata, T. indica* and *Z. mucronata* fruit species as being sold in the local and urban markets. These differences could be due to differences in demand for a particular fruit species as Minae *et al.* (1995) reported that limited or no markets for indigenous fruit could mean that there is low demand for the fruit.

a) Commercial utilisation of baobab fruit

A key informant stated that traders from Blantyre who came to the study area to buy baobab fruit brought empty sacks, which were distributed to baobab fruit gatherers, mostly children. The traders would return another day to purchase the fruit from

dwellings, which posed as market places but at times the collectors would sell the fruit to the traders at any household area in a village.

According to group interview participants, respondents and a key informant, traders controlled the packing and pricing of baobab fruit, leaving the villagers with little or no bargaining power. A 50 kg size bag packed to capacity by traders ranged in price from MK20 to MK25 depending mainly on the buyer's decision and period in the season. The youths in Limani Village revealed that at times buyers could pay them as little as MK15 during the peak period around the month of July.

Villagers could employ children to collect baobab fruit for them and pay them low wages. A key informant revealed that some men in the study area mainly in Ndelema Village bought baobab fruit from children at prices ranging from MK10 to MK15 per 50 kg bag and resold the fruit to traders within the village or to customers at distant markets. Children were reported as accepting the low prices because to them the money meant a lot.

Figure 3.12 shows that 49.5% (n=111) of the respondents who preferred and harvested baobab fruit were not involved in the commercialisation of the fruit. The mean quantity of baobab sold per respondent per season was between 51 and 75 kg. This amount is equivalent to three to five 50 kg size bags of baobab fruit.

Nine percent of respondents (n=111) sold the fruit in quantities greater than 200 kg but of these, none came from the rich households. From the results, similar to subsistence utilisation of indigenous fruit, the rich seemed not to be dependent on income from indigenous fruit sales compared to the poor households.

The highest percentage of respondents who sold great quantities of baobab fruit was from Mathotho Village constituting 40% (n=10). This village was also the one with the highest number of baobab trees sampled during the resource assessment (Table 3.6). The large quantities of baobab fruit sold in the village could relate to the abundance of the fruit. Sales in large quantities of baobab fruit have been reported elsewhere in southern Africa. In Jinga, a region with abundant baobab trees in Zimbabwe, individual villagers sold baobab fruit in large quantities ranging from 40

to 100 bags (each bag containing over 250 fruit) to transporters (Campbell *et al.*, 1997).

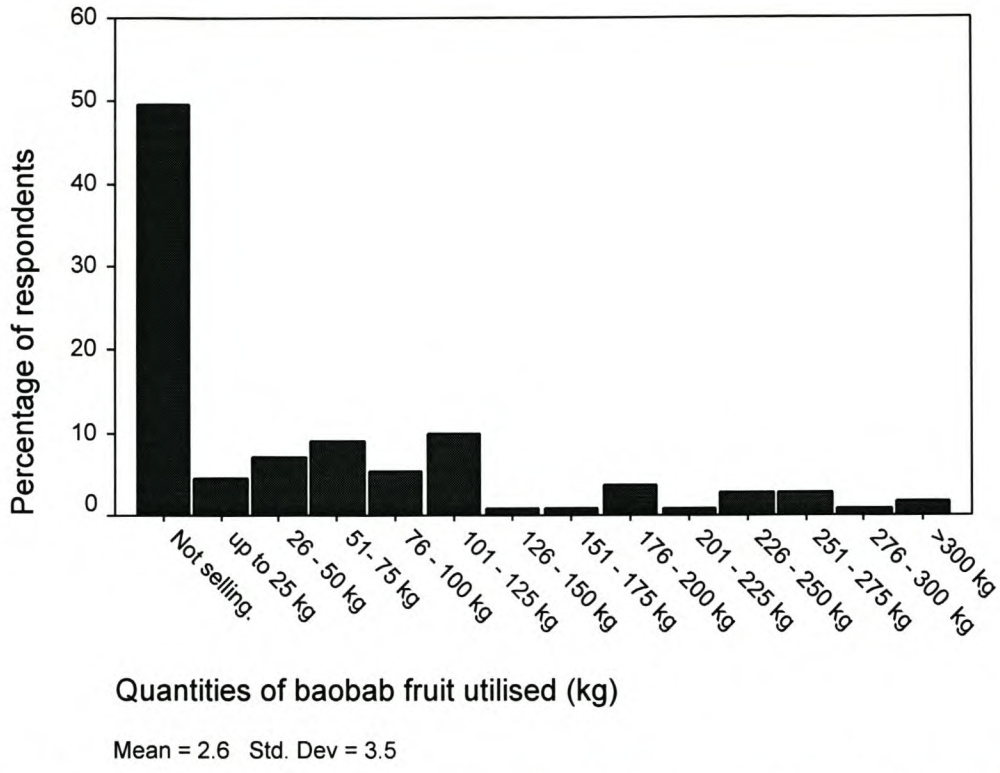

Figure 3.12. Quantities of baobab fruit (kg) sold by respondents per season in the study area (n=111)

The mean quantities of baobab fruit utilised for subsistence and commercial purposes did not differ much according to Figures 3.5 and 3.12 although the average for commercial utilisation was slightly higher than that for subsistence utilisation. This is because many individuals in the study area did not sell baobab fruit.

Table 3.19 shows that the largest age class selling baobab fruit was between eight and 14 years. This finding is similar to Campbell's (1987) finding that primary school children in Zimbabwe were the main utilisers of indigenous fruit. Similarly Lusepani (1999) reported *Strychnos* sp. as being mainly sold by children in northern Namibia.

Commercialisation of baobab fruit by rural communities in other places is done on processed fruit to add value. In West Africa, the fruit was sold by rural communities

in powder form packed in polythene sachets to prevent damage from moisture and foreign objects (Sibidé *et al.*, 1996).

Table 3.19. Age classes and percentages of respondents who sold baobab fruit in the study area (n=57)

Age classes	Frequency	Percent
8-14 years	22	38.6
15-25 years	13	22.8
26-35 years	13	22.8
36-45 years	4	7.0
> 45 years	5	8.8
Total	57	100

b) Commercial utilisation of tamarind fruit

Most respondents who preferred and harvested tamarind fruit (94.3%, n=88) did not sell the fruit (Figure 3.13). Of those who sold the fruit, only one person sold more than 200 kg per season, selling at a distant market, the fruit being sold by male respondents aged between 15 and 25 years. It appears that selling tamarind fruit at distant markets was associated with selling large quantities, because there were more buyers in the distant markets than in the sampled villages. The mean quantity of tamarind fruit utilised by respondents for commercial purpose per season ranged from 1 to 10 kg. This is lower than that for subsistence utilisation probably because most respondents did not sell the fruit.

According to respondents who sold tamarind fruit, the price ranged from MK40 to MK50 per 50 kg size bag. A 50 kg size bag full of tamarind fruit would weigh approximately 40 kg and the price would be MK1.25 per kg when sold in the sampled villages. Male participants in Limani Village said that people could sell tamarind fruit at MK140 per 50 kg size bag, which was MK3.50 per kg to a local project. However because of the long distance and that the village was not part of the project, the villagers could not manage to sell the fruit frequently during the season.

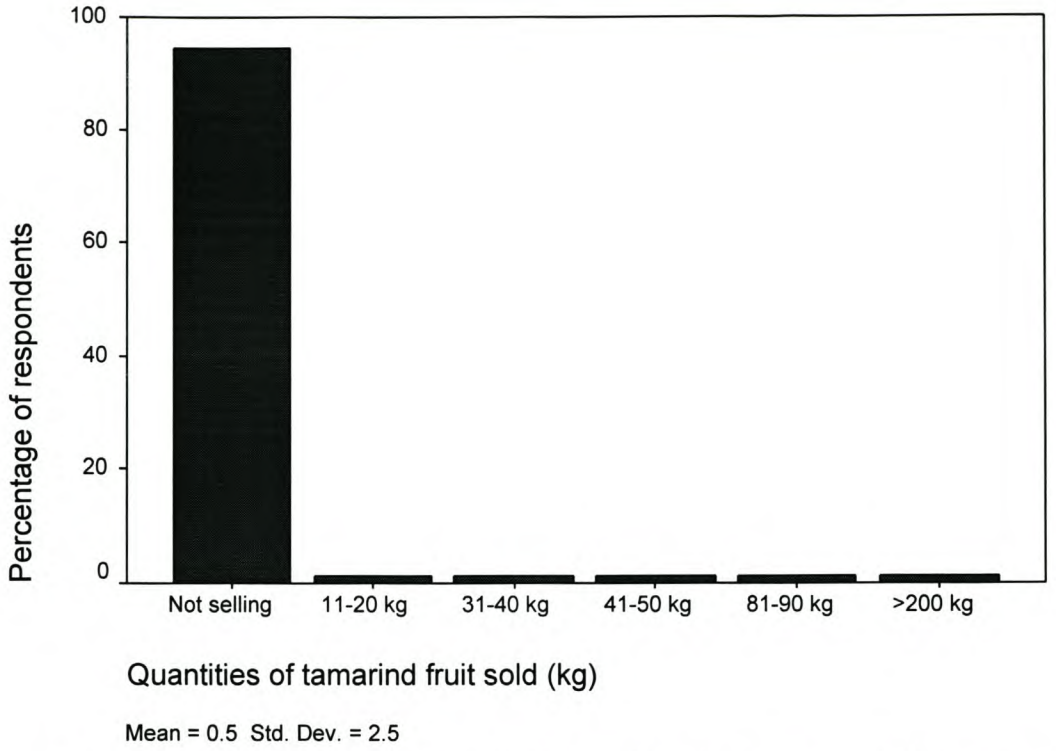

Figure 3.13. Quantities of tamarind fruit (kg) utilised for commercial purpose by respondents per season in the study area (n=88)

Tamarind fruit sold to intermediate buyers in the study area had a low price because the aim of buyers was to maximise profit. FAO (1995) reported that collectors of non-timber forest products often receive small benefits from middlemen. At the GTZ project the aim of buying fruit from rural communities was to assist them in generating income (Mwamadi, 1999).

c) Commercial utilisation of *Ziziphus mauritiana* in the study area

The females in Kanselu Village reported that some women sold the fruit to school children in the neighbouring village. A woman reported having sold in total a bucket (6 litres) full of *Z. mauritiana* fruit in 2000. She reported that the fruit were obtained from planted trees available within her household area. The price of *Z. mauritiana* fruit was reported as being MK1.00 per 250 ml plate. According to her, school children and some adults did not complain about the price because the fruit species was not commonly found in the study area.

3.13.3 Income generated from selling indigenous fruit

Income generated from indigenous fruit sales refers to the sales of baobab and tamarind fruit combined. This was done because few respondents sold tamarind fruit.

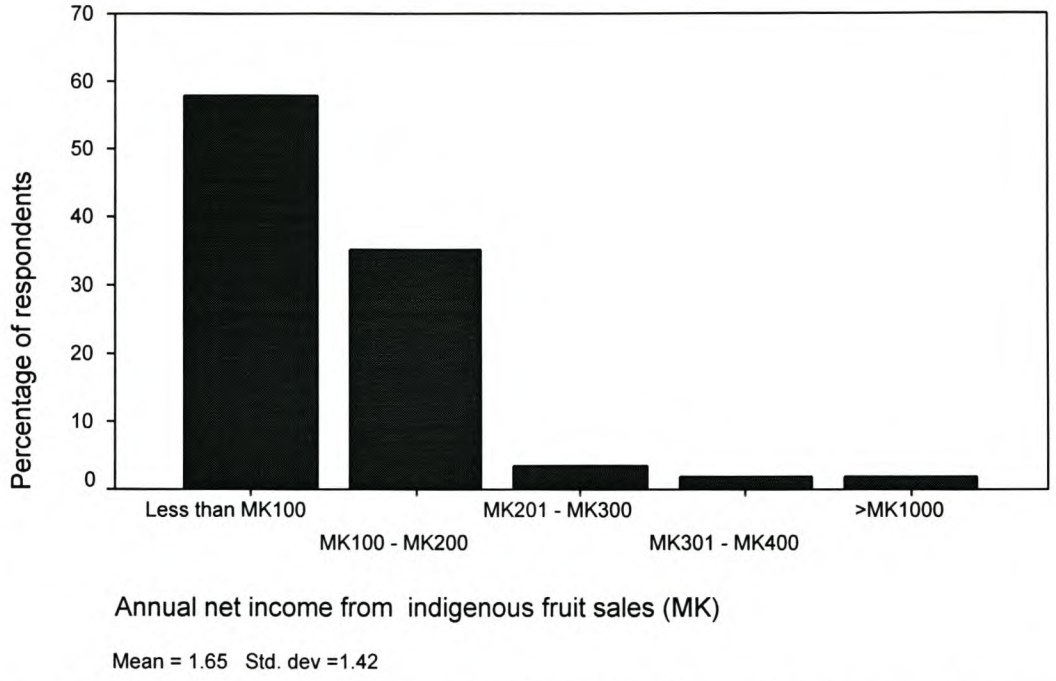

Figure 3.14. Annual net income in Malawi Kwacha (MK) generated from baobab and tamarind fruit sales by respondents in the study area (n=57)

Figure 3.14 shows that of the respondents who harvested and sold *A. digitata* and *T. indica* fruit in the year 2000, most (58%, n=57) generated an annual income of less than MK100 per respondent while the mean was between MK100 and MK200. Only one of the respondents (n=57) generated slightly above MK1 000 in 2000 because of selling fruit at distant markets. Selling fruit at distant markets was said by the respondent to enable him to generate more income than selling within the villages to traders because of differences in prices and large numbers of buyers. In Senegal, a household could generate approximately US$33 (MK2 079) per season from baobab sale as reported by Ndour *et al.* (1994, quoted in Bounkoungou *et al.* 1999).

3.13.4 Problems with commercial utilisation of indigenous fruit

When asked to identify problems experienced when selling indigenous fruit or those that prevented them from selling indigenous fruit, respondents mentioned eight problems. According to the respondents, the main problems were scarcity of fruit buyers and low fruit prices as mentioned by 58.3% and 50.5% (n=115) respectively (Table 3.20). Scarcity of fruit buyers mainly referred to *T. indica* fruit buyers and the other preferred fruit species with the exception of *A. digitata,* whereas low-selling prices concerned *A. digitata* fruit. Scarcity of indigenous fruit for commercialisation was associated with *T. indica* as well as *Z. mauritiana* trees.

Table 3.20. Problems mentioned by respondents in association with commercial utilisation of indigenous fruit in the study area (n=115)

Problems associated with fruit marketing	% of respondents
Scarcity of buyers	58.3
Low selling price	50.5
Scarcity of indigenous fruit trees	13.1
Transport problem	10.4
Labour demand	7
Risk of snakes	4.3
Children's activity	4.3
Lack of capital	2.6

Most respondents (67%, n=12) of those who mentioned transport as a problem were males because they were more interested than females in selling fruit at distant markets. Labour demand problem referred to the difficulty in harvesting some fruit such as tamarind which were scattered. Peters (1995) reported that trees that are sparse pose a problem when extracting their products.

An additional problem was reported by a key informant who said that most traders were unwilling to reveal market information to villagers in the study area possibly because they were avoiding competition with the villagers. The few villagers who went to distant markets were said to be more willing to reveal market related information such as prices offered, costs incurred and markets where good prices were offered among others. Still, the villagers were reported as lacking experience

as they had only started travelling to the urban markets recently. Pswarayi-Riddihough and Jones (1995) reported that inadequate market information which included prices and factors affecting the prices was a common problem not only in Asia but also in developing countries.

Of the problems mentioned, some also related to subsistence utilisation of indigenous fruit in the study area which were the scarcity of indigenous fruit trees, difficulties in harvesting tamarind fruit and risk of snakes.

3.14 Availability and influence of exotic fruit

Thirty-seven percent of respondents (n=115) came from households which sold exotic fruit. Of these, 51.2% (n=43) sold the exotic fruit they bought from other sources whereas 48.8% sold exotic fruit grown in households.

According to group interview participants, three main exotic fruit, namely *Mangifera indica* (mangoes), *Musa parasidiaca* (bananas) and *Carica papaya* (pawpaws), were grown in the study area mostly along streams and rivers. Only bananas were reported as being in season throughout the year (Table 3.21). *Citrus* fruit such as *C. sinensis* (oranges) and *C. reticulata* (tangerines) were reported as not being grown in the study area due to unfavourable climatic conditions. Group interview participants in Ndelema and Mathotho Villages stated that instead they bought the fruit from TA Mlauli's area (Figure 2.2) particularly for sale from May to July. Some mangoes were reported as also being bought from TA Mlauli's area and sold in the study area.

Table 3.21. Exotic fruit sold by respondents in the study area (n=43)

Fruit sold	% of respondents selling	Period sold
Bananas	66	Throughout the year
Mangoes	30	Nov (end) to January
Tangerines	28	May to July
Oranges	21	May to July
Paw paws	7	May to August
Lemons	2	April to July

Most respondents who sold mango fruit were of the lowest age class (below 15 years of age). Mangoes are in season when children are on school holidays in December and that is the period they mostly sell the fruit.

The preferred indigenous fruit were less attractive to rural communities in the study area compared to exotic fruit. All the respondents (115) revealed that they regularly bought exotic fruit but not any of the preferred indigenous fruit species (whether within or outside the study area) because they were commonly found in the area.
A key informant said that indigenous fruit not found in the study area, such as *Uapaca kirkiana,* were bought externally depending on individual preference.

All participants in the study area revealed that both indigenous and exotic fruit were equally important to them because they could obtain food from both types of fruit, besides selling some. Malembo *et al.* (1998) reported that some farmers in their study obtained food from exotic fruit trees as substitutes to indigenous fruit in their homesteads.

Rural communities may prefer exotic fruit to indigenous fruit based on the amount of income generated from them. Participants in Ndelema and Mathotho Villages reported that *Citrus* fruit, although not found in their villages, generated more income to them when bought and sold than *A. digitata* and *T. indica* fruit. As a result, they sold more exotic fruit in June and July than indigenous fruit in that period. Similarly, in Zambia, Mateke *et al.* (1995) stated that during the period when the season of *Citrus* fruit coincides with that of indigenous fruit such as baobab, preference for the indigenous fruit is expected to be low.

3.15 Market survey outside the study area

The main indigenous fruit being sold in the period the market survey was conducted was *A. digitata. Tamarindus indica* fruit was not in season during the time of interviews while *Z. mauritiana* was just in the beginning period of its season.

3.15.1 Sample characteristics and categories of baobab vendors

a) Sample size and districts visited

Forty-nine respondents were interviewed as baobab vendors. Approximately 80% of the respondents were retailers while wholesalers constituted 10.2% and those who operated both as retailers and wholesalers also made up 10.2% (n=49). Apart from these, three respondents were *Z. mauritiana* vendors, one interviewed in Mangochi District and the other two in Lilongwe District.

Figure 3.15 shows that the highest percentage of baobab traders was interviewed in Blantyre markets. This was because baobab fruit from Mwanza District were mostly sold in these markets.

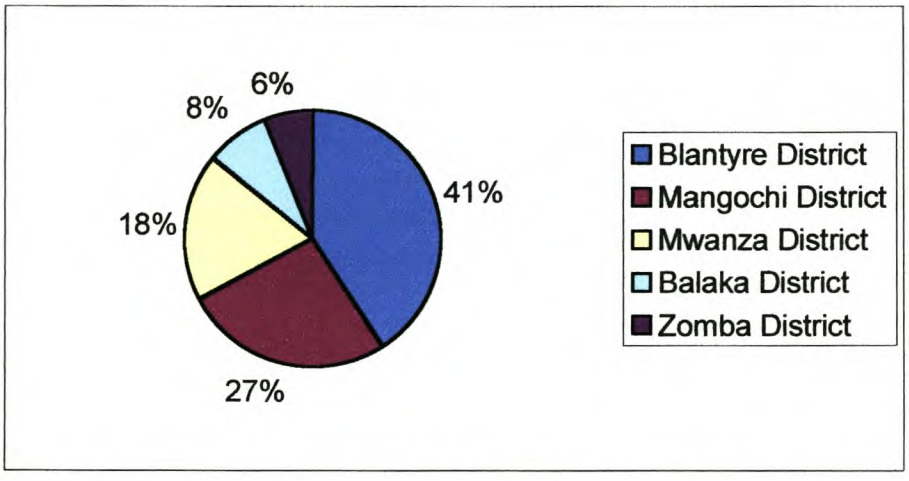

Figure 3.15. Percentages of baobab fruit vendors interviewed in a market survey outside the study area (n=49)

b) Gender and categories of baobab fruit vendors

The majority of baobab fruit vendors were males (86%, n=49). Of those interviewed along the road, most were retailers (73%) and dominated by males (84.2%). Wholesalers (15.4%), all males, were interviewed while awaiting transport to distant market places, mainly to Blantyre District. Eleven percent of respondents selling along the road operated as both wholesalers and retailers, all males. In the

established market places, retailers were the most common (90.9%) and dominated by males (80%). Nine percent operated as both, all males. Similar to the finding in the study area and the other districts, Clarke *et al.* (1996) reported that in Zimbabwe, more men than women sold wild fruit at distant markets.

c) Age of respondents

The social groups involved in the marketing of baobab fruit in terms of age of respondents are given in Figure 3.16. The largest group of baobab fruit vendors in terms of age was aged between 26 and 35 years. The smallest groups of respondents were aged less than 15 years and more than 45 years, each group making up 8.2% (n=49). The young ones were few probably because most were at school during the interviews whereas individuals above 45 years might not be interested in selling fruit.

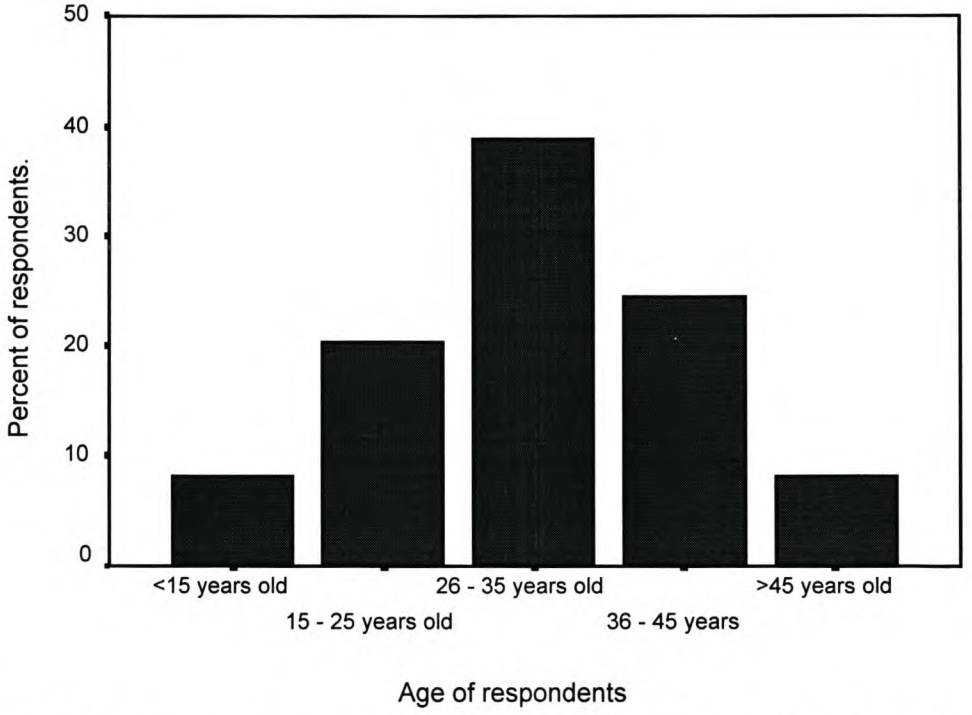

Figure 3.16. Percentages and age classes of baobab fruit vendors interviewed in the five districts (n=49)

3.15.2 Source and transportation of fruit being sold

Most fruit sold had been bought from fruit gatherers and traders, as was mentioned by 79.6% of respondents (n=49). However, some vendors (16.3%) harvested the

fruit from trees they owned while others (4.1%) used both sources. Wholesalers bought fruit from villagers and sold the fruit to retailers but some retailers bought baobab fruit directly from the rural communities. Wholesalers selling in Blantyre stated that they often bought baobab fruit from Mwanza, Chikwawa and Nsanje Districts (Figure 2.1). Most retailers who were interviewed in Mangochi District said that they bought baobab fruit from rural communities within the same district and sold the fruit along the main road.

Transportation of baobab fruit to the selling places was largely by hiring vehicles and labour depending on the distance to be covered. Approximately 65% of the vendors (n=49) transported the fruit either by vehicle, train or hired labour while the rest usually carried the bags on the head for a short distance. From Chikwawa and Mwanza Districts, baobab fruit were transported by vehicles on major roads whereas from Nsanje District the fruit were transported by train because of the availability of this mode of transport which was low-cost although slow.

3.15.3 Number of seasons selling baobab and quantities sold per season

Most vendors (75.5%) stated that they had been selling baobab fruit for up to three seasons while approximately 12.2% of all the respondents reported that they sold the fruit for at least 10 seasons. Most of these vendors who had been selling baobab fruit for a long period also sold large quantities of the fruit per season. Thus the respondents had a vast market information related to baobab fruit sales.

Eight percent of respondents sold baobab in quantities greater than 10 000 kg per season. These were wholesalers (50%) and those who operated as wholesalers and retailers. The mean quantity of baobab fruit sold per vendor per season was between 2 001 and 3 000 kg but most respondents sold the fruit in quantities that were less than 1 000 kg per season (Figure 3.17). These were dominated by retailers (93.1%).

Approximately all the vendors interviewed stated that they utilised the fruit more for commercial than for subsistence purposes.

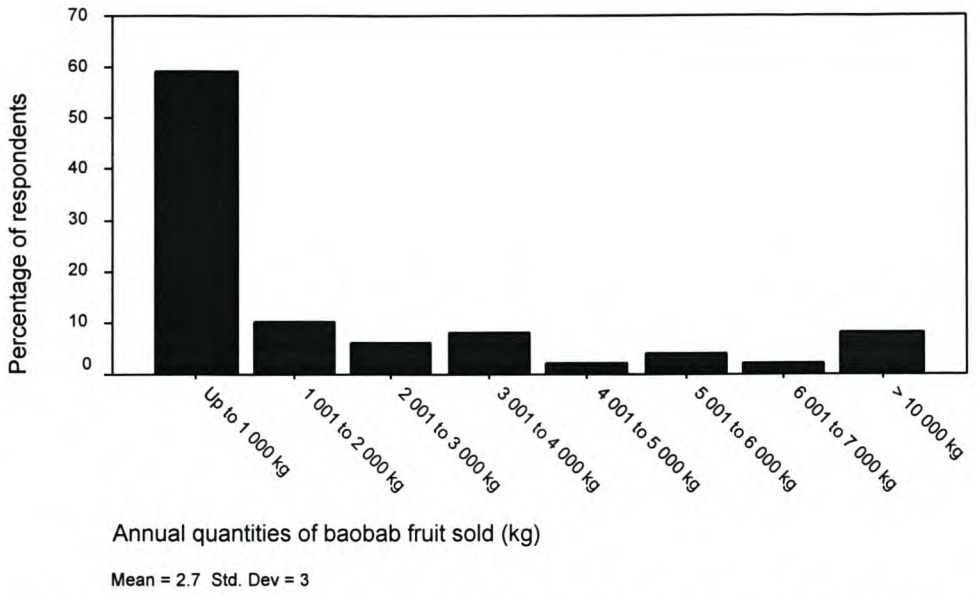

Figure 3.17. Percentages of fruit vendors and quantities of baobab fruit (kg) sold per season in the five districts outside the study area (n=49)

3.15.4 Baobab fruit prices

Prices of baobab fruit depended on a variety of factors, including fruit size, supply, demand and selling place. Retailers in all the markets except for Mangochi District sold the fruit depending on size. Prices ranged from MK0.50 to MK5.00 per fruit, the largest fruit having higher market value. In Mangochi District, the fruit in bunches of four, was sold mainly by retailers, at MK10 per bunch. They sold the fruit along the road, targeting visitors leaving the district. Wholesalers, mainly selling in Blantyre District, sold 50 kg size bags at prices ranging from MK250 to MK300 per bag. Selling baobab fruit per bunch meant that the price was MK2.50 each whereas at wholesale the price of the fruit would range from MK1.56 to MK1.88 each when converted.

Demand for the fruit was said to be high towards the beginning (April) and the end of the fruit season (October to early November). In Mangochi District fruit price would be reduced to MK5.00 per bunch when supply was high. Wholesalers were equally affected as prices per bag (50 kg size) were reported as dropping to MK200. Lamien *et al.* (1996) reported similar factors affecting market prices of tamarind fruit which included availability of the product and season. They noted that tamarind fruit

prices in Burkina Faso rose when the fruit were in high demand during the fasting period. During this period the fruit were largely being used in porridge.

3.15.5 Main costs incurred in the marketing of baobab fruit

Costs incurred also played a role in determining the market value of baobab fruit. In Blantyre City market, fruit prices ranged from MK10 to MK20, being of similar size and quality as those offered by other vendors at prices ranging from MK0.50 to MK5.00 each. The Blantyre City Council, which owned the market, charged high market and storage fees to maintain cleanliness in the city, hence the high market values of baobab fruit. Just outside the market, fruit prices ranged from MK2.50 to MK5.00 each, the reason being that those selling outside the market did not pay market or storage fees.

Vendors who transported baobab fruit to long distances incurred costs on transport, food, accommodation, selling fee (MK11.00 to MK13.00 per day), storage, sacks (MK25 each) and buying the fruit. Some costs could be avoided or reduced while others could not.

According to the wholesalers who bought baobab fruit in Mwanza District, accommodation costs could be avoided. They stated that after buying the fruit they could just sleep along the road while waiting for vehicles (trucks) going to Blantyre where they resided and sold the fruit. In contrast, villagers selling the fruit in Blantyre had to meet daily accommodation costs for security reason, the cheapest being MK50 per day. Transport costs for a 75 km distance was said to range from MK80 to MK90 per person and approximately MK100 per bag regardless of size. Traders used extra large bags (bales) each containing five to eight joined 50 kg size bags which were also reused to reduce costs.

Food expenses were reported as varying with individual's choice but most vendors selling away from home stated that they incurred up to MK50 per day. Storage costs were at MK50 per period of up to a week although in some cases the costs would be lower than this depending on the demand for storage space in the established markets.

Fruit buying procedure slightly differed. In Mangochi District, wholesalers could be asked by the owner to pay a fixed amount of money per baobab tree from which they harvested the fruit. Prices ranged from MK200 to MK300 per tree depending on factors such as the estimated amount of fruit per tree, bargaining and period of buying the fruit. In general, baobab tree owners harvested the fruit themselves and sold it to buyers.

3.15.6 Net income realised from baobab fruit sales

The mean net income realised from baobab fruit sales was between MK6 001 and MK8 000 per vendor per season but most vendors realised less than the mean (Figure 3.18). Most vendors generating income above MK20 000 from baobab sales sold the fruit in large quantities per season for over 10 years. These respondents belonged to all the categories of vendors but the largest group consisted of those selling as both wholesalers and retailers (50%), followed by wholesalers (33%) and retailers (17%, n=49).

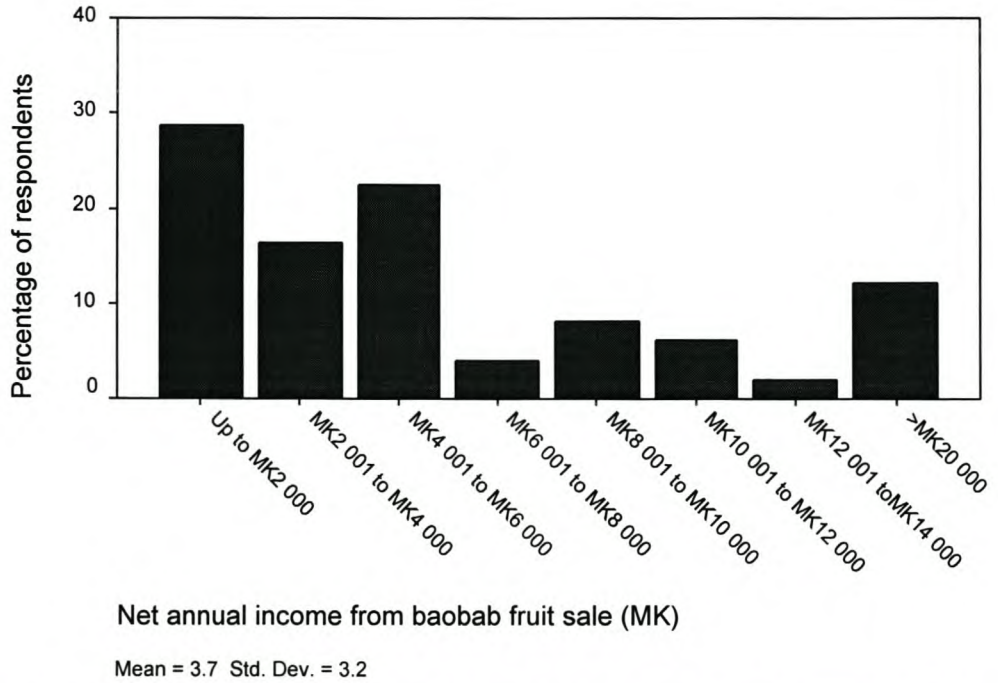

Figure 3.18. Percentages of baobab vendors outside the study area and their net annual income in Malawi Kwacha (MK) obtained from selling the fruit (n=49)

Pearson correlation showed significant association between net income obtained per vendor from baobab fruit sales and each of the following variables:

- Quantities of baobab fruit sold per season ($r = 0.73$, $p<0.01$)
- Number of seasons selling the fruit ($r = 0.42$, $p<0.01$)
- Food expenses ($r = -0.45$, $p<0.01$)
- Accommodation expenses ($r = -0.44$, $p<0.01$)
- Selling fee ($r = -0.39$, $p< 0.01$)

When multivariate regression analysis was conducted on the five independent variables only two variables namely, "Quantities of baobab fruit sold per season" and "Number of seasons selling the fruit" were included in the correlation coefficient table whereas the rest were excluded.

R^2 value was 0.594, which meant that the two independent variables together influenced 59.4% of variance in the net income obtained from baobab sales per vendor per season. Other factors apart from these variables must have contributed 40.6% of the remaining variance. "Quantities of fruit sold per season" had a higher ß value being 0.668 than that for "Number of seasons of selling baobab fruit" being 0.243. This means that the quantities of baobab fruit sold per season relatively contributed to the influence on net income realised from selling the fruit by approximately 67%. The number of seasons of selling baobab fruit relatively contributed to the influence on net income realised from selling baobab fruit by approximately 24%. Therefore, more influence on income from baobab fruit sales was due to quantities sold. Most traders, particularly wholesalers, outside the study area made huge profits from selling the fruit compared to rural communities because of quantities sold and wide knowledge of the fruit markets besides other factors.

The middlemen (wholesalers) mostly generated income of above MK20 000 each from baobab fruit sales per season compared to rural communities in the study area who on average could obtain up to MK200 from wild fruit sales per season. Thus, the communities in the study area could generate only 1% of what middlemen earned from fruit sales per season. Retailers selling in towns and cities made profits which could reach MK20 000 but 80 % (39) of all the retailers sold fruit along the road and in local markets and generated up to MK8 000 per season.

3.15.7 Problems with baobab fruit sales

When respondents were asked to list problems they faced when selling baobab fruit, five problems emerged as outlined in Table 3.22. Fruit rot was the most frequently mentioned problem (55.1%, n=49). Vendors stated that fruit rot was associated with fruit that had not been completely dried when bought. Retailers said this was their biggest problem saying that they made losses because customers returned rotten fruit for replacements. A retailer in Blantyre District stated that at times he could lose 30% of his baobab stock because of damage. This was reported as happening throughout the season.

Table 3.22. Percentages of baobab fruit vendors who mentioned particular problems of marketing baobab outside the study area (n=49)

Problems mentioned	% of respondents
Rotten or damaged fruit	55.1
Unreliable transport system	20.4
Takes long to be bought	18.4
Low selling price	18.4
Shortage of capital	18.4

A wholesaler interviewed in Mwanza District expressed concern over the unreliable transport system from the district to Blantyre. He stated that at times vendors could spend up to four days along the main road waiting for trucks going to Blantyre to pick them. This was said as being one of the reasons for buyers not willing to sell easily perishable fruit. Similarly, FAO (1995) reported that often middlemen selling non-wood forest products take high risk of selling their products under tough conditions which include transport problems and selling perishable fruit.

Of those who mentioned shortage of capital (cash) as a problem, 67% were retailers. The requirement of cash was for buying and selling more baobab fruit to enable them to hire vehicles from buying to selling places. Vendors who mentioned the problem belonged to all the age classes except those below 15 years of age. Probably the children did not have plans to sell baobab fruit on a large-scale basis that would require more funds.

3.15.8 Marketing of *Ziziphus mauritiana*

In Mangochi District, the fruit was being sold along the road at MK1.00 per 250 ml cup. Although the prices in Mwanza and Mangochi Districts were the same, in Mangochi, *Z. mauritiana* trees were said to be commonly found and the prices would decrease with the peak period of fruiting. During the 2000 season a vendor revealed that she obtained MK240, selling at the same price throughout, after harvesting the fruit from an owned tree.

According to the fruit vendors interviewed in Lilongwe District, *Z. mauritiana* fruit mainly sold in the district came from Mangochi and Salima Districts, which were approximately 100 km away (Figure 2.1). The cost of the same volume of *Z. mauritiana* fruit (250 ml) ranged from MK5.00 to MK10.00 depending on fruit size and market places. Approximately 1 kg of the fruit was being sold at a time for MK100 at the Lilongwe City market while the largest fruit were sold at MK0.50 each in one of the markets outside the city. The *Z. mauritiana* tree is reported to produce up to 570 kg of fruit per season (FRIM, 1997). This means that a single tree, producing the maximum amount could generate MK57 000 in Lilongwe City market. However, there are several problems related to the marketing of the fruit, which would limit vendors from obtaining maximum benefits from selling the fruit.

The main problem pertaining to the marketing of *Z. mauritiana* fruit as mentioned by the seller in Mangochi District was that the fruit sales were slow within the district and that the fruit perished rapidly. In Lilongwe too, a vendor who was interviewed mentioned the same problem of fruit rot. Damaged fruit of the species are most prone to fungal decay (Abbas, 1997). To minimise the problem, mature fruit that were not yet ripe were the ones vendors bought for resale. Abbas (1997) also reported that post harvest ripening of fruit such as *Z. mauritiana* occurs when the fruit are picked in mature condition. However, the problem with fresh *Z. mauritiana* fruit is that it has a high water content which ranges from 64 to 85%, as a result it can not be stored for more than six weeks even at temperatures around 0°C in a refrigerator (FAO, 1982).

3.15.9 Marketing of indigenous fruit juices

Under the GTZ project in Mwanza East, baobab and tamarind fruit juices made by the project staff show the importance of adding value to indigenous fruit. Mkamanga and Chimutu (2001) reported that the market value of one baobab fruit was up to MK5.00 but when processed into local juice and filled in a 500 ml plastic bottle it fetched MK25 and MK37 at wholesale and retail prices respectively. Similar increases in value were obtained for tamarind.

The products were being sold in chain stores found in the districts such as Blantyre, Lilongwe, Mangochi and Mwanza and were being transported by a project vehicle. The juices were also reported as being appreciated by consumers but supply was not sufficient to meet the demand even though 800 bottles of juice were produced per day (Mwamadi, 1999). According to male and female group interview participants in Limani and Kanselu Villages, there was an oversupply of fruit to the project. This was attributed to the fact that storage capacity was limiting.

During the market survey in the five districts, samples of baobab and tamarind fruit juices produced by the project were shown to respondents after the interviews. Most were surprised and showed interest in the products. Some traders in Blantyre City wanted to learn more about where they could buy the products for resale. The lack of knowledge about the product by most people interviewed could mean that the products were not highly advertised.

Organisations that would process indigenous fruit bought at reasonable prices from rural communities in the villages could encourage commercialisation of the fruit by villagers. In Zambia, *Uapaca kirkiana* fruit was bought by a wine processing company from villagers (Packham, 1993). However, this would need monitoring on harvesting quantities and methods to avoid destruction of fruit trees and maintain availability of fruit for both subsistence and commercial use.

Large-scale processing of indigenous fruit for sale by rural communities may not be economically feasible due to high cost implications. These costs would include procurement of a processing plant, containers, labels, preservatives and

transportation of products to markets. However, on small-scale basis with minimal costs, commercial fruit processing is foreseen to improve rural community income generation. Selling semi-processed fruit such as baobab pulp as done in West Africa could enhance rural income generation. However, this would need adherence to acceptable hygienic conditions when processing the fruit (Mkamanga and Chimutu, 2001).

4 CONCLUSIONS AND RECOMMENDATIONS

Rural communities in the study area utilise a wide range of wild fruit from the woodlands, homestead areas and agricultural fields. These are utilised for subsistence and commercial use by the communities. Fruit trees have multiple uses for rural communities apart from fruit utilisation. There is evidence that rural communities own some indigenous fruit trees in their gardens and within household areas.

Baobab trees were commonly found in the study area probably because of factors like not being used for charcoal or fuelwood production, ability to survive drought conditions and protection by rural communities. Most fruit tree species had no specific pattern of availability with respect to distance from villages. The study shows no sufficient evidence to conclude that certain species occur nearer to or further from the sampled villages. However, availability of wild fruit species for both subsistence and commercial utilisation is probably influenced also by seasonality, mast fruiting, perishability of fruit and to some extent utilisation of fruit by wild animals. The study suggests that fruit species available within homesteads are more protected from being eaten by large wild animals.

Size classes except for *A. digitata* trees were small because of the shrub form of trees such as *V. infausta* and *Grewia* species and other young trees that were regenerating from stumps. Most preferred fruit trees that could bear fruit were not commonly cut because of fruit value attached to the species.

Because of open access, trees found in communal land are less protected than those in homestead areas. Locally-made rules were not fully implemented to protect the trees found in most Village Forest Areas.

Boys in particular seemed to have a wide knowledge of wild fruit species utilised in the study area because of eating them most when herding livestock. The poor heavily depended on fruit in times of food shortages and in generating income.

Taste is the main determinant of choice of indigenous fruit for subsistence utilisation. Promotion of the availability of sweet tasting varieties of indigenous fruit species will help satisfy subsistence fruit requirements by rural communities. Traditional rules regarding wild fruit utilisation are highly respected by rural communities. To avoid conflicts and promote common understanding with the communities, their tradition should be taken into account before any intervention relating to promotion of wild fruit utilisation is introduced.

Most indigenous fruit harvesting methods used seem to have been influenced by age and gender of communities. Any intervention that involves fruit harvesting by rural communities should take this into account. Destructive harvesting methods of fruit were associated with the need to harvest larger fruit quantities particularly for sale. Any project that seeks to promote commercial utilisation of indigenous fruit has to be cautious of this malpractice that is most likely to be done often by outsiders who come to collect fruit and go as fast as possible.

Villagers, particularly women have useful knowledge in the local processing of tamarind and baobab fruit and storage activities. However more knowledge is required on the processing of easily perishable indigenous fruit such as *D. kirkii* fruit, which has not yet been commercialised. Fruit processing for commercial purposes adds value to the fruit. This could help rural communities increase the income generated per unit of indigenous fruit sold. However large-scale fruit processing activities may not be feasible for rural communities because of cost implications.

Children and females mainly sold baobab fruit within the villages but children sold most and were not much concerned about prices. Men sold at distant markets to fetch better prices. Low fruit price is one of the major influencing factors in the commercialisation of indigenous fruit. Other factors include knowledge of market information, availability of markets and buyers, access to markets, transport, capital and perishability of fruit. Middlemen who bought indigenous fruit from rural communities both within and outside the study area benefited from the sales at the expense of rural communities who had little or no bargaining power. Because of the large quantities of fruit sold by the middlemen and their experience in selling the indigenous fruit, they obtained highest incomes from fruit sales.

Access to commercially important exotic fruit such as *Citrus* spp. appears to influence sale of wild fruit such as baobab because both fruit coincide in fruiting season. However, both exotic and wild fruit are important to rural communities for subsistence and commercial use.

For a place like the study area where charcoal is being produced as the main income generating activity for rural communities, it is difficult to convince them to fully participate in indigenous fruit marketing at the current low prices. In order to promote sustainable utilisation of indigenous fruit and reduce the destructive harvesting methods the following recommendations are made:

- Policy makers should set guidelines that will enable rural communities to sell indigenous fruit at reasonable prices. The communities should also work under Village Natural Resources Management Committees or form groups that will regularly make price negotiations with traders at the local level so that communities obtain price incentives to manage their resources sustainably.

- There is need to support further domestication of the preferred indigenous fruit species by the rural communities. This will promote fruit supply and private ownership of fruit trees. Research on domestication should continue to work on the desired fruit qualities for both subsistence and commercial purposes and aim to improve on them.

- Government, NGOs and interested stakeholders should collaborate in soliciting research funds for determination of sustainable fruit harvesting levels. Ways for rural communities to participate in the regular monitoring of harvesting methods and quantities of fruit and other resources should also be identified.

- Regular provision of updated marketing information to rural communities on the existence of potential fruit markets, availability of more lucrative fruit marketing channels and the fluctuations in the market. These could be provided by the Government, NGOs and other stakeholders who should as much as possible also link indigenous fruit producers to the international markets. More wild fruit

marketing research could be conducted throughout the selling seasons in the local and established markets to document sufficient marketing information.

- Identify improved but simple fruit processing technologies that are based on the existing traditional practices in order to assist fruit processors add more value to fruit and generate higher income per fruit. Women should be the most targeted for being the main processors and also one of the vulnerable groups in rural communities. Trainees should be provided with new technologies.

- Integrate existing indigenous technical knowledge in fruit storage with low cost and applicable scientific knowledge in storage of wild fruit particularly the most preferred species to promote longer periods of utilisation by rural communities.

- Government, NGOs and other stakeholders could facilitate the provision of loans to rural communities interested in marketing fruit at distant markets. Loans could be provided at affordable interest rates as an incentive to the communities. In addition, training on business management skills could be offered to the borrowers.

- There should be democratic elections of Village Natural Resources Management Committee members who are transparent and can voluntarily safeguard the resources without expecting any benefits from their duties. Extension workers should enhance their extension and training programmes so that all rural communities are aware of the locally-made Village Forest Area rules in order to protect the resources from being depleted.

- Government, NGOs and other stakeholders should make concerted efforts in identifying potential alternative income generating activities for the rural communities, in particular charcoal producers, as a way of alleviating deforestation.

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APPENDICES

Appendix 1.1 Silvicultural zones of Malawi

Zone	Altitude[1]	Rainfall[2]	Temperature[3]
A	<200	710 - 840	25+
Ba	200 - 700	710 - 840	21 - 25
Bb	1 000 - 1 200	710 - 840	21 - 25
C	500 - 1 000	840 - 960	21 - 23
D	1 000 - 1 500	840 - 960	19 - 21
E	1 000 - 1 600	960 - 1 050	19 - 21
G	900 - 1 500	1 050 - 1 200	19 - 21
H	475 - 1 000	1 200 - 1 600	23+
J	1 000 - 1 500	1 200 - 1 600	19 - 21
K	600 - 1 100	1 200 - 1 600	21 - 23
L	475 - 1 000	1 600+	23+
M	1 500+	1 050 - 1 600	19

[1]Altitude in metres above sea level; [2]Mean annual rainfall in mm; [3]Mean annual temperature in °C.

Source: Hardcastle (1978).

Appendix 2.1 Individual interview questionnaire on utilisation of wild fruit in the study area, Mwanza District, Malawi

INDIVIDUAL INTERVIEW QUESTIONNAIRE

Date of interview __/__/ 01 Village_____
Respondent's Number _____

DEMOGRAPHIC DATA

1. Respondent's name _____

2. Gender (Tick) 1. Male_____ 2. Female _____

3. Age (Tick)
   1. <15 years old ___
   2. 15 to 25 years old ___
   3. 26 to 35 years old. ___
   4. 36 to 45 years old. ___
   5. >45 years old ___

4. Marital status (Tick)
   1. Single ___
   2. Married ___
   3. Widowed ___
   4. Divorced ___

5. Household size (Number of individuals) (Tick)
   1. 1 to 4 ___
   2. 5 to 8 ___
   3. 9 to 12 ___
   4. > 12 ___

B. HOUSEHOLD OWNERSHIP OF RESOURCES

1. What does the main house in your household consist of? (Tick)
   a) roof
      1. iron sheets ____
      2. tin ____
      3. grass ____

   b) wall
      1. fire baked ____
      2. sun dried bricks ____
      3. wattle and daub ____

2. In your household, do you own any of the following?
   a) radio 1. Yes ___ 2. No ___
   b) bicycle 1. Yes ___ 2. No ___
   c) ox drawn cart? 1. Yes ___ 2. No ___

3. Which animals do you rear? (Tick and specify quantity)
   1. Chicken ___ _____
   2. Pigs ___ _____
   3. Goats ___ _____
   4. Sheep ___ _____
   5. Cattle ___ _____
   6. Other (Specify) ___ _____ _____
      _____ _____
      _____ _____

C. AVAILABILITY AND RANKING OF INDIGENOUS FRUIT

4. Which indigenous fruit available and utilised in your area are your important three?
   X. Most important fruit _____
   Y. More important fruit _____
   Z. Much important fruit _____

5. What was your ranking based on?
   1. Commercial purpose _____
   2. Home consumption _____
   3. Other (Specify) _____

D. OWNERSHIP OF INDIGENOUS FRUIT TREES

6. In your household, do you privately own any indigenous fruit trees? (Tick)
   1. Yes ___ 2. No ___ (If No, Go to Q.8).

7. What are the trees?

	Quantity	Location
a) _____	_____	_____
b) _____	_____	_____
c) _____	_____	_____

d) _____ _____ _____
e) _____ _____ _____
f) _____ _____ _____
g) _____ _____ _____
h) _____ _____ _____

E. COLLECTION OF WILD FRUIT

8. Do you collect any of the three ranked indigenous fruit?
   1. Yes _____ 2. No _____
   If No, Why ?_____ (Go to Q.12).

9. Which ones do you collect?
   Fruit X: ____
   Fruit Y: ____
   Fruit Z: ____

10. Each day you collect indigenous fruit, on average, how much do you collect for:

1. Snack:

		X	Y	Z
Number of fruit		____	____	____
Number of plates (Size)	1.	____	____	____
	2.	____	____	____
	3.	____	____	____

How often?	For how many months?
X:_____ times / week / month	_____
Y:_____ times / week / month	_____
Z:_____ times / week / month	_____

2. Meal:

		X	Y	Z
Number of fruit		____	____	____
Number of plates (Size)	1.	____	____	____
	2.	____	____	____
	3.	____	____	____
Number of bags (50 kg size)		____	____	____

How often?	For how many months?
X:_____ times / week / month	_____
Y:_____ times / week / month	_____
Z:_____ times / week / month	_____

3. Commercial purpose:

		X	Y	Z
Number of fruit		____	____	____
Number of plates (Size)	1.	____	____	____
	2.	____	____	____

	3.		
Number of bags	____	____	____
	____	____	____

How often?	For how many months?
X:_____ times / week / month	_____
Y:_____ times / week / month	_____
Z:_____ times / week / month	_____

11. What methods of fruit harvesting do you mainly use?

Fruit	Method
X:	_____
Y:	_____
Z:	_____

F. FRUIT PROCESSING

12. Do you do any fruit processing activities?
    1. Yes ____ 2. No. _____ (If No, Go to Q.14).

13. What processes are carried out on the fruit?

Fruit X:	Home consumption	Commercial use
	_____	_____
	_____	_____
	_____	_____

Fruit Y:	Home consumption	Commercial use
	_____	_____
	_____	_____
	_____	_____

Fruit Z:	Home consumption	Commercial use
	_____	_____
	_____	_____
	_____	_____

G. FRUIT STORAGE

14. Do you do store any of the three fruit?
    1. Yes. ___ 2. No.___ (If No, Go to Q. 17)

15. How long do you store the fruit without getting bad?
    X:_____ days /weeks / months
    Y:_____ days / weeks / months
    Z:_____ days / weeks / months

16. What materials do you use to store the fruit?
    Fruit X: a) _____ b) _____ c) _____
    Fruit Y: a) _____ b) _____ c) _____
    Fruit Z: a) _____ b) _____ c) _____

H. MARKET STRUCTURES

17. Which indigenous fruit do you sell?
    Fruit X: 1. Yes _____ 2. No. _____
    Fruit Y: 1. Yes _____ 2. No. _____
    Fruit Z: 1. Yes _____ 2. No. _____
    If none, why? _____(Go to Q.22)

18. Where do you sell them?
    1. Market place ____ (Distance _____ km)
    2. Along the road ____
    3. At home / in the village ____
    4. Other (specify) ____ _____

19. For how much do you sell;
    Fruit X: MK_____ per _____
    Fruit Y: MK_____ per _____
    Fruit Z: MK_____ per _____

20. On average, how much do you get in a season as your profit from wild fruit sales?
    Fruit X: MK _____
    Fruit Y: MK _____
    Fruit Z: MK _____

21. What problems do you face in selling indigenous fruit?
    i. _____
    ii. _____
    iii. _____
    iv. _____

I. SALE OF EXOTIC FRUIT

22. Do you sell any exotic fruit?
    1. Yes _____ 2. No. _____ (If No, Go to Q.26).

23. Which ones do you sell?
    a) _____ b) _____ c) _____ d) _____

24. How do you obtain them?
    1. Buy ___ 2. Own _____ 3. Other (specify) _____

25. Which months do you sell them?

Fruit	Months sold	Profit per year
_____	_____	MK_____
_____	_____	MK_____
_____	_____	MK_____
_____	_____	MK_____

26. Which fruit do you buy more often?
    1. Exotic ____ 2. Indigenous ____ 3. None ____

Appendix 2.2. Questionnaire on wild fruit market survey conducted in selected five districts, Malawi

WILD FRUIT MARKET SURVEY

Date of interview ___/__/ 01. District _____
Respondent's Number _____ Place of interview_____

A. DEMOGRAPHIC DATA

1. Respondent's name _____

2. Gender 1. Male ___
   2. Female ___

3. Age
   1. <15 years old ____
   2. 15 to 25 years old ____
   3. 26 to 35 years old ____
   4. 36 to 45 years old ____
   5. > 45 years old ____

4. Category of respondent
   1. Retailer _____
   2. Wholesaler _____
   3. Both _____

5. Marital status
   1. Single ____
   2. Married ____
   3. Widowed ____
   4. Divorced ____

B. SALE OF WILD FRUIT

6. Fruit selling ? 1.*Adansonia digitata* (Baobab) _____
   2.*Tamarindus indica* (Tamarind) _____
   3. *Ziziphus mauritiana* _____
   4. Other (specify) _____

7. How do you get the fruit you are selling?
   1. Buying _____
   2. Harvesting from forest _____
   3. Both _____

8. How do you transport them to the selling place?
   1. Own transport _____ (Specify) _____
   2. Hiring _____ (Specify) _____
   3. Both _____ (Specify) _____

9. What expenses do you incur on (If none, indicate)?
    1. Harvesting MK_____
    2. Buying MK_____
    3. Transport MK_____
    4. Processing MK_____
    5. Storage MK_____
    6. Selling MK_____
    7. Food MK_____
    8. Selling MK_____
    9. Other (specify) _____ MK_____
       _____ MK_____

10. For how long (Seasons) have you been selling indigenous fruit?
    1. 1 to 3 ___
    2. 4 to 6 ___
    3. 7 to 9 ___
    4. 10 to 10+ ___

11. On average, what fruit quantity do you sell?
    (Quantity)_____ per month / season
    For _____months
    (Convert to kg) _____

12. For how much do you sell the fruit?
    MK_____per _____ (Convert to standard amount).

13. How do you compare the current price with that of last season?
    1. Decreased _____
    2. Constant _____
    3. Increased _____
    4. Other (specify) _____

14. On average, how much profit do you get?
    MK _____per month.
    For_____months
    (Calculate per season).

15. How much do you have for home consumption as compared to the amount you sell per season?
    1. Less ____
    2. Almost the same ____
    3. More ____

16. What problems do you face with selling indigenous fruit?

    _____
    _____
    _____
    _____
    _____
    _____
    _____

Appendix 3.1 Household sizes and marital status of respondents interviewed in the sampled villages

Variable	Category	Frequency	Percentage
Household wealth	Rich[1]	7	6.1
	Upper medium[2]	8	7
	Medium[3]	33	28.7
	Lower medium[4]	23	20
	Poor[5]	44	38.3
Total		115	100
Marital status	Single	37	32.2
	Married	61	53
	Widowed	5	4.3
	Divorced	12	10.4
Total		115	100

[1]The rich had at least houses with iron sheets, fire or sun baked bricks and reared cattle and other animals. Those without iron sheets had at least 20 cattle and some goats.

[2]The upper medium group's houses had iron sheets. Some reared animals and owned radios.

[3]The medium group reared some animals, had decent houses but without iron sheets, some had radios.

[4]The lower medium group had no radios in most cases and houses made of thatching grass and wattle and daub but more improved than those for the poor. They had at least six chickens or a goat.

[5]The poor group had no radios, reared no animals or had less than six chickens and their houses were of the lowest standard.

Appendix 3.2 Availability of other indigenous tree species in the study area

Other indigenous tree species	Vernacular name	Villages				
		Kanselu	Limani	Mathotho	Mkoka	Ndelema
Acacia karroo	mfungo			*		*
Acacia nigrescens	mkunkhu	*				*
Acacia nilotica	chisiyo	*				
Albizia harveyi	njenjete		*			
Antidesma venosum	mdyapumbwa	*	*			
Bauhinia petersiana	mphando	*				*
Brachystegia floribunda	tsamba		*			
Burkea africana	mkalati		*			
Combretum collinum	chinama	*	*			*
Combretum sp.	kakunguni		*			*
Commiphora africana	khobo					*
Commiphora sp.	thindiri		*			*
Dalbergia melanoxylon	phingo					*
Dichrostachys cinerea	kapangale	*				*
Diospyros quiloensis	msinja					*
Diplorhynchus condylocarpon	thombozi		*			
Ehretia amoena	bwamoto					*
Holarrhena pubescens	mpotolozi					*
Kirkia acuminata	mtumbu	*				
Lannea discolor	chiumbu		*			
Lannea stuhlmanni	chilusa		*		*	
Lonchocarpus capassa	mswaswa	*			*	
Markhamia acuminata	katsongole					*
Maytenus senegalensis	mphabulu			*		
Ozoroa insignis	m'mbewe		*			*
Pseudolachnostylis maprouneifolia	msolo	*	*			
Sterculia africana	mgoza			*	*	*
Sterculia quinqeloba	msetanyani		*			
Stereospermum kunthianum	mlakanjovu		*			*
Terminalia sericea	tsatsake		*			
Trichilia capitata	mdyakhope	*		*		
Turraea robusta	mtunda		*			
Vernonia amygdalina	futsa		*			
Vitex sp.	mdyankhandwe	*				
Xeromphobis obovata.	chipembere		*			

Appendix 3.3. Results of Analysis of Variance (ANOVA) on numbers of fruit and non-fruit trees sampled in the plots in the study area

General Linear Models Procedure

Dependent Variable: LEVAL

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	15	11.76390015	0.78426001	2.94	0.1534
Error	4	1.06742560	0.26685640		
Corrected Total	19	12.83132574			

R-Square	C.V.	Root MSE	LEVAL Mean
0.916811	21.88347	0.5165815	2.3606008

Source	DF	Type I SS	Mean Square	F Value	Pr > F
PLOT	1	0.62006033	0.62006033	2.32	0.2021
SPECIES[1]	1	0.03333955	0.03333955	0.12	0.7416
VILL[2]	4	5.97937725	1.49484431	5.60	0.0619
PLOT*SPECIES	1	0.16833552	0.16833552	0.63	0.4715
PLOT*VILL	4	3.14512245	0.78628061	2.95	0.1601
SPECIES*VILL	4	1.81766505	0.45441626	1.70	0.3094

[1]Type of tree whether fruit or non fruit species

[2]Sampled villages

Appendix 3.4. Numbers of fruit trees available in the combined 1st plots (0.1 ha each) and 2nd plots (0.1 ha each) according to diameter size classes (cm)

Combined Plots 1 (n=5)										
Indigenous fruit tree species	**Diameter size classes (cm)**									
	1-10	11-20	21-30	31-40	41-50	61-70	71-80	81-90	91-100	>100
Adansonia digitata					2					7
Azanza garckeana	1									
Berchemia discolor				1		1				
Cordyla africana						1				
Diospyros kirkii	9	3		4						
Dovyalis macrocalyx				1						
Flacourtia indica	6	1								
Grewia flavescens	3									
Lecaniodiscus flaxinifolius		3	2							
Sclerocarya birrea	2	1								
Sterculia appendiculata				1						
Strychnos spinosa				2						
Tamarindus indica	2			1	2	2	1	1	1	
Totals	23	8	2	10	4	4	1	1	1	7

Combined Plots 2 (n=5)										
Indigenous fruit tree species	**Diameter size classes (cm)**									
	1-10	11-20	21-30	31-40	41-50	61-70	71-80	81-90	91-100	>100
Adansonia digitata										1
Cordyla africana				1						
Diospyros kirkii	17	5	1							
Diospyros squarrosa	2	1								
Flacourtia indica	14	1								
Grewia flavescens	12	2								
Grewia monticola	3									
Lecaniodiscus flaxinifolius	1		1		1					
Tamarindus indica					1					
Vangueria infausta	5	2								
Ximenia caffra	3	1								
Totals	57	12	2	1	2	0	0	0	0	1