

**SPECIES UTILISATION PREFERENCES AND RESOURCE POTENTIAL OF  
MIOMBO WOODLANDS: A CASE OF SELECTED VILLAGES IN TABORA,  
TANZANIA**

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## **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.**

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**Date**

## ABSTRACT

Miombo woodland occupies the greater portion of the Zambezi phytoregion where communities derive products and services for their livelihood. The managers of these resources have for many years neglected these crucial needs, which has important implications for silvicultural systems and management interventions. The overall objective of this study was to document the miombo species utilisation preferences by local communities in Tabora, Tanzania. This information was obtained using individual interviews and village meetings. A simple line transect inventory survey was carried out to assess the miombo resources adjacent to the studied villages.

The villagers in Tabora have knowledge of the importance of their woodland resources and put different species to different uses, with some overlap where a species has multiple uses. The surveyed villages differ in the utilisation of miombo resources, where the choice and quantities used depend on their proximity to urban areas. There is strong preference for suitable species for building poles and due to scarcity some people now use mud bricks for house construction. Suitable timber tree species are scarce in the Urumwa Forest Reserve and now low quality species such as *Sterculia quinqueloba* are used. For firewood live trees are cut and dried, however any combustible material is used. Not surprisingly the community's use priorities differ from the management priorities of the Forest Department. The use of miombo products for income generation in the studied villages is influenced by the proximity to urban areas and villagers do not perceive commercialisation of these products as depriving them of resources. The use of woodlands for cultural and religious purposes in Tabora, though important to the spiritual wellbeing of people, has declined over the years. The fact that the villagers choose particular miombo trees for different purposes is an indication of some kind of local knowledge and management. The Urumwa Forest Reserve is now an open access resource as villagers have depleted wood resources adjacent to their settlements. Awareness of the causes of miombo resource depletion in these villages is positively correlated with the proximity to urban areas and wood scarcity.

Community participation in management of natural resources is still new in Tabora as few villagers were aware of the new government management interventions of the Urumwa woodlands, and awareness seems to be limited largely to males and leaders. There is active management of indigenous trees protected on farms for various uses and exotic tree-planting mainly for fruits and shade, is done around homesteads, but with no *de jure* rights of ownership. Tree planting in this area is severely hindered by drought, insects and termite attack to seedlings and this has made people depend entirely on the miombo for their wood requirements.

The simple wood resource inventory survey carried out in this study has showed that the Urumwa miombo woodland is heavily utilised. This has resulted in poor tree diameter distribution and species composition. The smaller tree diameters recorded in the Urumwa Reserve indicate that the potential of this woodland for timber production is low compared to other products. The priority products documented in this study form base-line information for management plans and silvicultural systems suitable for sustainable management and utilisation of these woodlands in future.

## OPSOMMING

Miombo bosveld beslaan die grootste gedeelte van die Zambezi vegetasiestreek waarin 'n groot menslike bevolking produkte en dienste uit hierdie bioom genereer om 'n bestaan te maak. Bestuurders van hierdie bronne verwaarloos al jare hierdie kritiese behoeftes, en dit het belangrike implikasies vir boskundige sisteme en bestuurstussentredes. Die hoofdoel van hierdie studie was om die miombo spesiesbenutting-voorkeure van plaaslike gemeenskappe in Tabora, Tanzanië te bepaal. Inligting is bekom deur individuele onderhoude en dorpsvergaderings. 'n Eenvoudige lyn-transek opname is uitgevoer om die miombo-bronne langs die bestudeerde dorpies te bepaal.

Die dorpsbewoners in Tabora dra kennis van die belangrikheid van hul bosveld bronne en gebruik verskillende spesies vir verskillende doele, met oorvleueling waar spesies meervoudige gebruike het. Die dorpies wat ondersoek is verskil in die benutting van miombo bronne waar die keuses en kwantiteite wat gebruik word bepaal word deur die nabyheid aan stedelike gebiede. Daar is 'n sterk voorkeur vir spesies geskik vir boupale en as gevolg van skaarste van die spesies gebruik sommige inwoners nou klei bakstene vir huiskonstruksie. Geskikte spesies vir die produksie van hout is skaars in die Urumwa Forest Reserve en lae kwaliteit spesies soos *Sterculia quinqueloba* word gebruik. Lewende bome word gekap en gedroog vir brandhout alhoewel enige brandbare materiaal ook gebruik word. Dit is nie verbasend dat die gemeenskap se gebruiksprioriteite verskil van die bestuurs-prioriteite van die Departement Bosbou nie. Die gebruik van miombo-produkte vir inkomste-generasie in die bestudeerde dorpies word beïnvloed deur die nabyheid aan stedelike gebiede en dorpsbewoners beskou nie dat die kommersialisering van sulke produkte hul van hulpbronne ontnem nie. Die gebruik van bosveld vir kulturele en godsdienstige doeleindes in Tabora, wat belangrik is vir die geestelike gesondheid van die inwoners, het oor die jare afgeneem. Die feit dat dorpsbewoners besondere miombo-bome kies vir verskillende gebruike is 'n aanduiding van 'n mate van plaaslike kennis en bestuur. Die Urumwa Bosreserwe is nou 'n vrye toegang hulpbron omdat dorpsbewoners houtbronne na aan hul dorpies uitgeput het. Bewustheid van die oorsake van die uitputting van miombo hulpbronne naby die dorpies is positief gekorreleer met die nabyheid aan dorpsgebiede en houtskaarste.

Gemeenskapsdeelname by die bestuur van natuurlike hulpbronne is 'n nuwe konsep in Tabora omdat min dorpsbewoners bewus is van nuwe bestuursintredes deur die regering by die Urumwa bosveld en bewustheid blyk beperk te wees tot mans en leiers. Daar is aktiewe bestuur van inheemse bome wat vir spesifieke gebruike beskerm word op plase en uitheemse boomaanplantings, hoofsaaklik vir vrugte en skadu, word by huise gemaak. Daar is geen *de jure* regte in die geval nie. Boomaanplantings in die gebied word ernstig beperk deur droogte, insekte en termietaanvalle op saailinge en dit veroorsaak dat mense uitsluitlik op miombo staat maak vir hul houtbehoefte.

Die eenvoudige houthulpbron-opname wat in die studie onderneem is het bewys dat die Urumwa miombo bosveld straf benut word en dat daar geen balans tussen aanwas en hout benutting is nie. Dit veroorsaak swak boomdeursnit-verspreiding en spesies samestelling. Die kleiner boomdeursnitte wat in die Urumwa Bosreserwe aangeteken is dui daarop dat die potensiaal van hierdie bosveld vir houtproduksie laag is en slegs beperk is tot ander produkte. Die voorkeur-produkte wat in hierdie studie gedokumenteer is vorm kerninligting vir bestuursplanne en boskundige sisteme wat geskik sal wees vir die toekomstige volhoubare bestuur en benutting van hierdie bosvelde.

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## 1. INTRODUCTION

### 1.1 *The miombo woodlands of Africa*

Miombo is an informal term used to describe the indigenous woodlands of central, southern and eastern Africa which are largely characterised by the three closely related genera of *Brachystegia*, *Julbernardia* and *Isoberlinia*, from the legume family Caesalpinaceae (Jeffers and Boaler, 1966; Lawton, 1982; White, 1983). Muyombo in *Kinyamwezi* and *Kisukuma* languages in Tanzania refers to *Brachystegia spiciformis*. Twenty one species of *Brachystegia* and three species of each of the other two genera have been recorded in miombo woodlands of Zimbabwe (Campbell *et al.*, 1996). According to White (1983) 19 species of *Brachystegia* and three species of *Julbernardia globiflora*, *J. paniculata* and *Isoberlinia angolensis* occur in miombo as dominants. In addition to the dominant tree species, some canopy associates such as *Pterocarpus angolensis* and *Azelia quanzensis* are valuable timber species (Jeffers and Boaler, 1966; Lawton, 1979; Lawton, 1980; Lawton, 1982; Acres *et al.*, 1984). The diversity of canopy species is low, although the overall species richness of the flora is high (Frost, 1996).

Miombo woodlands are representative of a significant type of dry deciduous woodland ecosystem found in many tropical countries (White, 1983; Tuite and Gardiner, 1990; Dewees, 1996). The miombo ecozone covers an area of approximately 2.7 million km<sup>2</sup> (Millington *et al.*, 1986), in regions receiving more than 700 mm mean annual rainfall on nutrient poor soils. The natural range of miombo is from 5° to 25° South of the equator (Fig.1) with its main cover spreading across the central African Plateau at altitudes of 500 m to 1,500 m above sea level (White, 1983). This tropical position results in high temperatures, making precipitation a major climatic factor determining miombo ecology (Tuite and Gardiner, 1990). According to Chidumayo (1997), miombo tree species are frost sensitive and do not tolerate absolute minimum temperatures of less than -4°C, which may be the reason for their northern and southern limits of distribution.

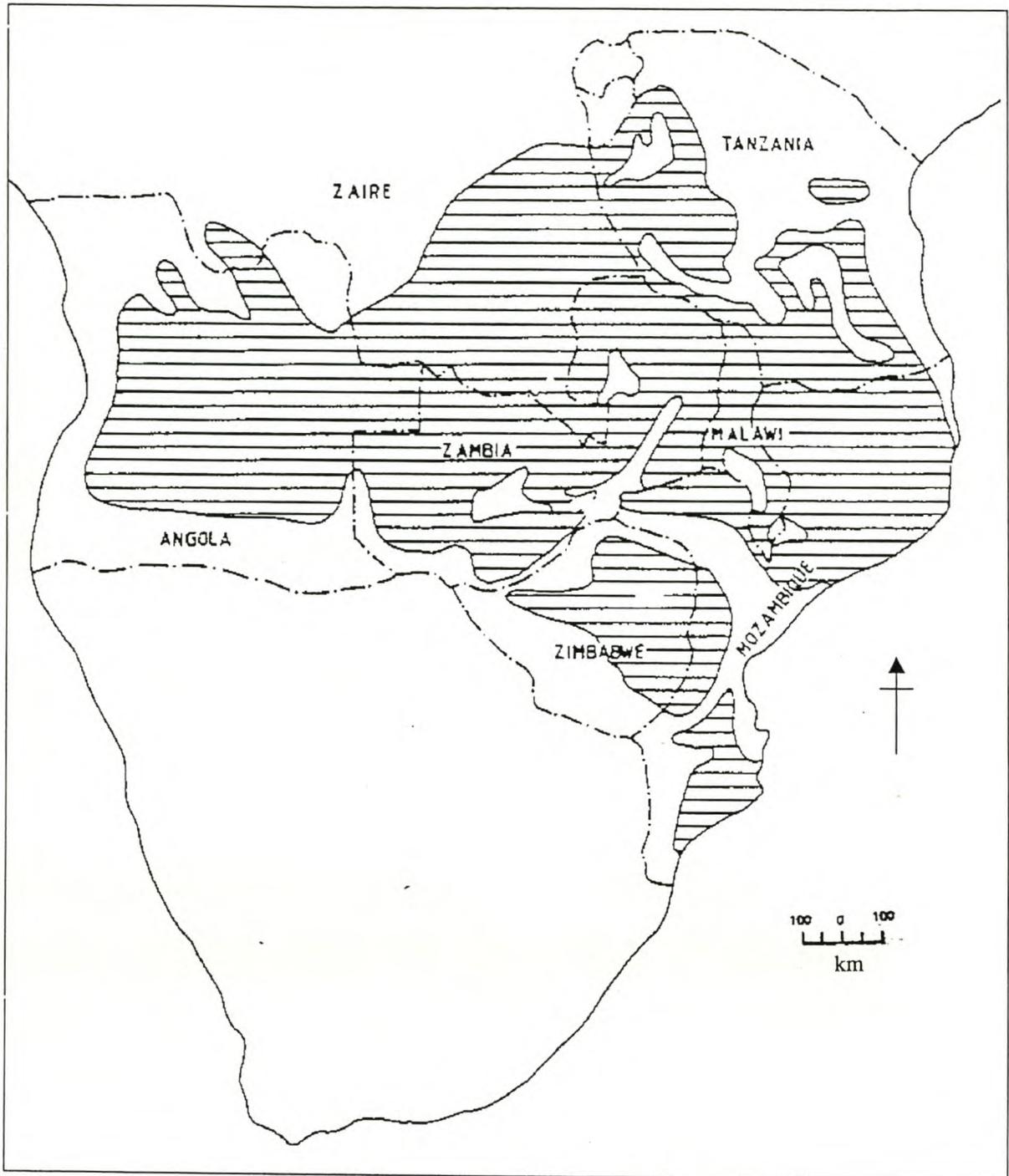


Fig. 1: The distribution of miombo woodlands in southern and central Africa.

Source: Chidumayo (1997).

Miombo represents the largest extent of savanna and contiguous woodland type in Africa, even perhaps globally (Frost, 1996), and over 75 million people are estimated to live within this biome (WRI, 1992). In regions where population pressures are high and arable land resources are limited, miombo woodlands are becoming an increasingly important

element in complex systems of rural land use which integrate woodland management with crop and livestock production (Deweese, 1996).

Two classes of miombo woodland are recognised. First is the relatively dry miombo covering huge areas of central and east Africa between 15° south and the equator with annual rainfall less than 1,000 mm. It is most extensive in northern Angola, southern Democratic Republic of Congo (DRC, the former Zaire), Zambia, Zimbabwe, Malawi, Tanzania and Mozambique (White, 1983; Millington *et al.*, 1994; Chidumayo, 1997). The canopy trees are less than 15 m tall (White, 1983). These woodlands contain growing stock estimated at 6,836 million tonnes with annual sustainable yield of nearly 138 million tonnes, representing a considerable potential for fuelwood exploitation (Millington *et al.*, 1994). It is poor floristically and only *Brachystegia spiciformis*, *B. boehmii* and *Julbernardia globiflora* are the dominant species (White, 1983). The second class is the wet miombo, covering the southern DRC, northern and central Angola, northern Zambia, south-eastern Tanzania and central Mozambique. This type of miombo is found in high rainfall areas (more than 1,000 mm) with lower seasonality than the relatively dry miombo (White, 1983; Millington *et al.*, 1994). It contains a growing stock estimated at about 2,540 million tonnes, with annual sustainable yield of around 43 million tonnes (Millington *et al.*, 1994). This type of miombo is floristically rich and includes nearly all the miombo dominants (White, 1983). However according to White (1983) it is difficult to clearly distinguish between the two miombo classes especially in areas where climate changes rapidly like the Lake Tanganyika escarpments and Lake Malawi troughs, and in the Eastern Highlands of Zimbabwe.

## **1.2 *Miombo in Tanzania***

In Tanzania miombo is the most important type of savanna woodland (Gauslaa, 1988). It occurs at altitudes from near sea level to about 1,600 m, with annual rainfall ranging from 500 mm to 1,200 mm (Jeffers and Boaler, 1966). Miombo constitutes the largest single vegetation type in the country, forming nearly 90% of the total forest area or 13% of the land area (Persson, 1975; MNRT, 1998). The relatively dry miombo woodland covers extensive areas of Shinyanga, Kigoma, Tabora, Rukwa, Mbeya and Iringa regions and wet miombo occupies the south-eastern regions (Millington *et al.*, 1994). Miombo in Tanzania consists of two main layers, the tree canopy and the herb or ground layer, plus an underwood layer of

smaller trees. In some places a shrub layer also exists (Jeffers and Boaler, 1966; Acres *et al.*, 1984). The distribution of miombo woodlands in Tanzania is shown in Figure 2.

According to Jeffers and Boaler (1966), the canopy of mature miombo stands in Tanzania reaches a height of 10 to 20 m and crowns of individual trees may touch with occasional gaps, conforming with the definition given by White, (1983). Although slightly open in some areas, the ground layer is dominated by the *Hyperrhenia* grasses with saplings of the main canopy species and they are often subject to burning (Jeffers and Boaler, 1966; Lawton, 1982; Tuite and Gardiner, 1990; O'Keefe *et al.*, 1994). These woodlands differ in the degree of canopy closure and in species composition (White, 1983; O'Kting'ati and Monela, 1990). Where canopy cover is complete, the ground layer often includes a large proportion of herbs and grasses and the height reaches 50 cm (Jeffers and Boaler, 1966). Growth ring counts of *Pterocarpus angolensis* stems in Tanzania by Boaler and Sciwale (1966) suggested that miombo trees can live to about 100 years. In Zimbabwe growth ring counts by Grundy (1995) suggest that there were older miombo trees, but in protected areas.

Of the Tanzanian woodlands, miombo contains more of the commercially exploitable timber, with an estimated 15 exploitable trees per km<sup>2</sup> (Persson, 1975; Temu, 1979a). The best miombo stands are capable of yielding 35-80 m<sup>3</sup> per ha, although the trees are generally small, rarely exceeding 60 cm diameter at breast height (dbh). The Tanzanian miombo woodlands are among the best sources of some economically important tree species, namely *Pterocarpus angolensis*, *Azelia quanzensis*, *Swartzia madagascariensis*, *Isobertinia* spp. and *Brachystegia spiciformis*. They supply logs to the sawmilling industry and small scale pitsawyers (Temu, 1979a). From a logging perspective, it appears that these open woodlands are excellent as far as manoeuvrability of logging gear is concerned, therefore minimising damage to undesired species and hence assuring future harvests (Boaler and Sciwale, 1966). These woodlands are also known for their high quality honey production in the beekeeping industry and as habitats for many wild animals and birds (Temu, 1979a).

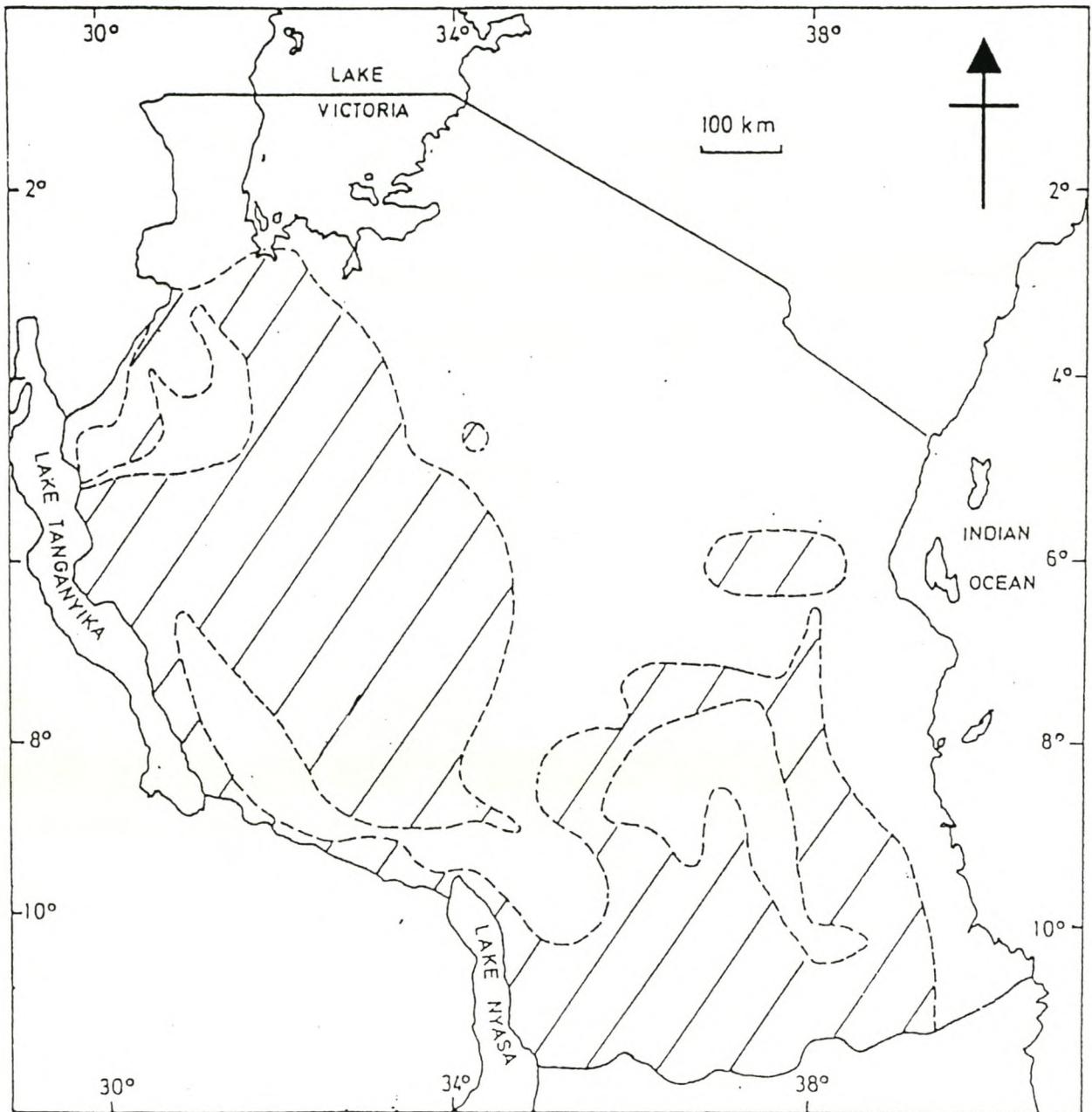


Fig. 2: The distribution of miombo woodlands in Tanzania (shaded area).

Source: Gillman (1949).

### 1.3 Ecology of the miombo woodlands

Jeffers and Boaler (1966) carried out ecological studies of miombo woodlands in Tanzania. The ecology of the miombo region is closely related to soil types and distribution pattern of rainfall (Jeffers and Boaler, 1966; Tuite and Gardiner, 1990; Abbot, 1997; Chidumayo, 1997). Soil moisture and fires are important ecological factors determining the density of trees and structure of the miombo woodlands (Gauslaa, 1988; Abbot, 1997; Chidumayo, 1997).

Miombo trees are typically deciduous (White, 1983; Gauslaa, 1988; Tuite and Gardiner, 1990; Chidumayo, 1997) but include some evergreen species, especially among those found on terminaria (anthills) (Jeffers and Boaler, 1966). The dry season temperatures mainly determine the deciduous period of the miombo species (Lawton, 1982; Tuite and Gardiner, 1990) with the length of the leafless period varying with site and from year to year (Jeffers and Boaler, 1966; Lawton, 1982). In general the higher the altitude and rainfall the shorter the leafless period. In wet years and at high altitude sites, some trees of usually deciduous species keep their leaves through the entire dry season. However there is always a marked flush of shoot growth and new leaves are produced at the end of the dry season (Jeffers and Boaler, 1966; Lawton, 1982; Chidumayo, 1997). In the Tanzanian miombo, the dry season lasts from April to October or November and the pre-rains flush takes place in September or October (Jeffers and Boaler, 1966).

#### 1.3.1 Soil moisture

Gauslaa (1988) pointed out that the rainfall regime seems to be the overriding determinant of miombo woodlands structure, dictating the relative abundance of herbaceous and tree species. Species diversity is also dependent upon variability of soil conditions and land use history (Jeffers and Boaler, 1966; Lawton, 1982; Chidumayo, 1988; Abbot, 1997). Soil depth is important for good soil moisture holding capacity and determines miombo structure and species composition (Gauslaa, 1988; Tuite and Gardiner, 1990). Grundy (1995) claimed that soil depth is the most important factor influencing growth and regeneration of miombo trees in Zimbabwe. The pre-rains miombo flush draws water from the soil moisture reserves left from previous rains and the depth from which this water is drawn determines the extent of flush (Jeffers and Boaler, 1966). Tree species like *Brachystegia longifolia*, *B.*

*spiciformis* and *B. utilis* require at least 3 m depth of soil to grow up to maximum height of 30 m. *Isoberlinia angolensis* and *B. boehmii* reach their full height of 23 m on less than 3 m deep soil, while *Uapaca nitida*, *U. kirkiana* and *Hymenocardia acida* can attain a maximum height of 10 to 14 m on less than 1.3 m deep soil (Gauslaa, 1988). Jeffers and Boaler (1966) recorded a 3.5 m mean taproot depth of miombo trees in Tanzania with an exceptional taproot of *Brachystegia spiciformis* traced to 4.5 m. Strang (1969) observed miombo taproots in *Brachystegia* and *Julbernardia* woodland in Zimbabwe at a depth below 1.8 m. The ectomycorrhizal associations of these dominant genera in the miombo enables them to exploit porous, infertile soils more efficiently than groups lacking ectomycorrhizae (Högberg and Pearce, 1986; Frost, 1996).

### 1.3.2 Fires

Grass fires are frequent in miombo woodlands (Jeffers and Boaler, 1966), making fire an important ecological factor in most of these woodlands and ecologists agree that miombo woodlands represent either a fire or climatic climax succession stage (Tuite and Gardiner, 1990). Most fires in the miombo is reported to be caused by man when hunting or stimulating grass to provide palatable pasture for livestock grazing. Livestock herders use fire to kill ticks and tsetse flies in the miombo woodlands. Fire is also widely used in preparing land for cultivation (Pers. obs.; Jeffers and Boaler, 1966; Lawton, 1982; Kikula, 1986). Boaler and Sciwale (1966) further argued that not only the frequency but also the intensity of dry season fires is an important factor in miombo ecology. The impact of fire on miombo woodland depends on the time of burning and on the amount of fuel material, with burning during the cool dry season encouraging regeneration more than late burning (Lawton, 1982; Chidumayo, 1997).

Fire seems to maintain a higher grass to wood vegetation ratio than would otherwise exist, and shifts the ratio of fire resistant to susceptible species to favour resistant species (Stromgaard, 1985; Gauslaa, 1988). Annual plants in miombo woodlands normally escape fires through seeds buried in the soil (Chidumayo, 1997). However most of the tree species in miombo do not have soil seed banks and thus dispersed seeds on the soil surface and litter are more susceptible to burning and drought (Strang, 1966; Chidumayo, 1997). Unlike the seeds of the leguminous dominants, seeds protected by indehiscent fruits are more protected from direct effects of fire. Many herbaceous and woody plants in miombo woodlands escape fires

by remaining dormant during the dry season when the risk of fire is greatest (Chidumayo, 1997).

Studies of the effect of fire on species composition in Tanzanian miombo by Kikula (1986) showed similarities to the results obtained from fire experiments in Zambia in terms of species recorded. In Zambia fire has been reported to enhance species succession in the miombo ecosystem (Stromgaard, 1985; Chidumayo, 1988). The plant succession process starts by the fire tolerant *Chipya* woodland forming a light canopy that creates conditions favourable for establishment of semi-tolerant *Uapaca* species. The fire tolerant species further suppress grass production and fire intensity and facilitate the development of *Brachystegia* and *Julbernardia* miombo canopy species. Other miombo transitional species that survive fires as coppice in *Chipya* vegetation are *Parinari curatellifolia* and *Pterocarpus angolensis* (Stromgaard, 1985; Chidumayo, 1988; Chidumayo, 1997).

### 1.3.3 Regeneration in miombo woodlands

Flowering in miombo woodlands occurs throughout the year and reaches its peak towards the end of the dry season. Fruit production however varies from year to year and even within the same species. For most miombo trees the fruit takes at least six months to mature and seed dispersal occurs at the end of dry season (Chidumayo, 1997). Dispersed seeds of the majority of miombo tree species germinate immediately provided there is enough water (Strang, 1966). Seedlings immediately establish roots because they allocate more resources to root than shoot growth during the establishment phase, in order to survive (Chidumayo, 1997). However soils under the grass cover, on which miombo seeds depend for germination, can dry immediately at the onset of the dry season and hinder seed germination (Strang, 1966).

Due to unfavourable soil conditions in the miombo, most common species such as *Brachystegia spiciformis* and *Julbernardia globiflora* regenerate largely by root suckers or coppice shoots (Strang, 1966). Shifting cultivation destroys some but not all trees present in mature miombo (Stromgaard, 1985; Gauslaa, 1988). In old fields where the rootstock is abundant after abandonment, disturbed or cut roots are able to send up suckers (Lawton, 1982; Stromgaard, 1985; Abbot, 1997; Chidumayo, 1997). Strang (1966) claimed that the evidence of miombo establishment from suckers and coppice shoots is much clearer in

abandoned fields, where one finds a nearly uniform distribution of saplings. Establishment from seeds results in more irregular distribution of the regrowth.

#### 1.4 *Uses of miombo woodlands*

Miombo woodlands are perhaps the most obvious natural resource in southern Africa because a large number of people depend on them for a variety of purposes (Deweese, 1996; Dewees, 1999; Abbot, 1997). Various authorities mention some uses as: goods such as pasture and fodder, fruit, construction wood, firewood, medicine, rope, insects and game, and services such as soil erosion control and improvement of soil fertility (Grundy 1990; Campbell *et al.*, 1993; Cunningham, 1993; Grundy *et al.*, 1993; Hofstad 1993; Olsen *et al.*, 1999). The advantage associated with utilisation of these resources is that they are renewable if managed in sustainable manner (Cunningham, 1993).

Most miombo woodlands in southern Africa have been heavily disturbed precisely because of their great local value, measured by rural people in ways which differ from the ways natural resource managers have measured value (Deweese, 1996). In Zimbabwe, miombo provides a critical source of dry season livestock browse. Leaf litter is collected and transported to fields, and is a main source of nutrients for agriculture (Campbell *et al.*, 1993; Nyathi and Campbell, 1993). In Zimbabwe, farmers on average collected about half a tonne of litter per household annually (Nyathi and Campbell, 1993). In Malawi, miombo is a rich source of wild fruits, edible fungi and insects (Lowore *et al.*, 1995). Beekeeping and honey hunting in Tanzanian miombo woodlands can be an especially profitable enterprise (Ntenga and Mugongo, 1991).

##### 1.4.1 Shifting cultivation

Throughout the miombo ecozone, cultivation has almost certainly occurred at times in the past (Lawton, 1982; White, 1983). In the process of shifting cultivation the woodlands are normally cut over, the vegetation debris burned to produce essential nutrient inputs to the soil, and the soils cultivated for a period of 3-4 years. After this period sites are abandoned because of the decline in soil fertility of the cultivated land (Boaler and Sciwale, 1966; Stromgaard, 1985; Chidumayo, 1997). In Tanzania, shifting cultivation used to be the most widespread agricultural system (Boaler and Sciwale, 1966; Lawton, 1980). Lawton (1980)

provides evidence that cultivators have abandoned large areas of miombo in Tanzania within the last 100 years and as a result of cultivation, coppice remnants of what was formerly miombo woodland occur on shallow, sandy soils on ridge crests outside the present limits of the miombo woodland (Lawton, 1979). In Zambia small areas of open *Combretum* woodland, described by Lawton (1980) as *Chipya*, occur on uplands and appear to be a secondary formation resulting from cultivation and fires (Chidumayo, 1997).

With increasing population in the miombo, more and smaller trees are cut and regeneration is inhibited due to over-utilisation of cultivated sites (Stromgaard, 1985). As population growth puts more pressure on good agricultural land, people have started perceiving woodlands as land that could be put under agriculture. However it is not often the community living near or in the woodlands that desire the land, but rather others living some distance from the woodlands who do not appreciate the role they play in the lives of those living near them (Walubengo and Obare, 1996).

#### 1.4.2 Miombo as source of income for rural economy

Most African people live in rural areas where they subsist on agricultural produce. Woodlands provide them with food security in years of low crop yields, and can also provide a source of income for buying food (Abbot, 1997; Shackleton *et al.*, 1998). Estimating the income of people whose livelihood depends on forests is the key to understanding their wellbeing and use of the woodlands (Wollenberg and Nawir, 1998). However there are few studies which attempt to measure the overall value of miombo woodlands to rural households (Clarke *et al.*, 1996), and data on woodland peoples' income are scarce (Wollenberg and Nawir, 1998). Even less attention has been paid to the socio-economic differentiation of miombo woodland use, namely which households are dependent on what resources and for what reasons (Clarke *et al.*, 1996). Only a small portion of woodland timber and non-timber products has ever been used to estimate income, suggesting that actual woodland income is higher than reported figures (Wollenberg and Nawir, 1998). A study by Shackleton *et al.* (1998) indicated extensive use of edible wild herbs by rural communities in South Africa where certain households expended considerable effort to derive some income from these products. Local level valuation of savanna resources has reported by Campbell *et al.* (1997).

The forest resources (including woodlands) of Tanzania have been identified as vital for economic development (UNDP/World Bank, 1988; MNRT, 1998). However conventional national accounting methods in Tanzania underestimate the contribution that natural resources such as miombo woodlands make towards the national economy. Forests and woodlands appear to make a minimal contribution, mostly in the form of timber production. A large proportion of products, particularly woodfuel and poles, is not part of the monetary economy. However a significant percentage of the unrecorded woodfuel trade is monetised and an increasing number of people are becoming involved (UNDP/World Bank, 1988).

Kajembe (1994) claimed that the contribution of the forestry sector to the Tanzanian economy in 1987 represented only 1 to 2% of the Gross Domestic Product (GDP). MNRT (1998) quotes the contribution of forests and related resources in 1989 as being 2 to 3% of the GDP. This contribution does not reflect the true economic importance of the forestry sector in Tanzania, however. This is due to the inadequate management of the forests and woodlands in the country (MNRT, 1998). The only reliable data are on export trade which falls short of accounting for the domestic consumption that can exceed the quantity reported to foreign markets (Kowero and O’Kting’ati, 1990). Part of the forest and woodland produce commercialised in urban and rural centres is traded informally to evade taxes and fees. Much of the output remains unrecorded and goes to subsistence consumption to meet the basic needs of the rural population (e.g. fuelwood, fodder, fruits and medicines) (UNDP/World Bank, 1988; Kajembe, 1994).

#### 1.4.3 Increased demand for miombo products

Exploitation of forests and woodlands for timber in Tanzania started early in the 18<sup>th</sup> century when the Arabs came to Tanzania, and it continued during the German era in the 19<sup>th</sup> century. The main species exploited include *Pterocarpus angolensis* from the miombo woodlands (Kimariyo, 1990). The 1920’s campaigns to eradicate tsetse flies carrying sleeping sickness, caused destruction of the miombo woodlands in the Tabora region (Lawton, 1982; Acres *et al.*, 1984; Mtuy, 1996).

The consequence of increased demand for miombo woodlands and other forest resources in Tanzania has been the increased rate of deforestation in the country. Reported causes of deforestation in Tanzania include: charcoal production, firewood for curing tobacco, timber harvesting and clearing land for agriculture (Temu, 1979b; Ramadhani, 1989; Johnsen, 1994). The villagisation programme has also been pointed out as one of the major causes of deforestation as new villages were established in intact forests or woodlands. However Johnsen (1994) argued that there is not enough reliable quantitative evidence on the real causes of deforestation in Tanzania. Kajembe (1994) also claimed that though forests and woodlands are assumed to occupy 50% of the total land area of Tanzania, this estimate might now be too high because of unrecorded areas lost due to deforestation.

The problem of deforestation is indeed a central environmental challenge facing Tanzania like any other African country, and as a result, woodland resources are rapidly becoming scarce. Bush clearing as a management option encourages vast clearance of natural vegetation to establish rangelands. Local agropastoralists have practised this technique for centuries, especially for initiating the growth of palatable grass or forage (Mtuy, 1996). In Tabora there is increasing immigration of livestock herders from the semi-arid regions in the north and east of the region where livestock pressures on land and vegetation resources are rapidly mounting (Acres *et al.*, 1984; FRMP, 1997). Currently, there are two categories of agropastoralists moving into the area: seasonal herders in search of dry season grazing only and others who are penetrating deeper into the region for longer periods with strong prospects of settling down (FRMP, 1997). This migration into woodlands and forests is taking place throughout Tanzania (Shepherd, 1992).

### **1.5 Land and tree tenure**

Tree and woodland utilisation is affected by tenurial access (Campbell *et al.*, 1993; Abbot, 1997). Whether or not local communities are able to conserve and manage woodland resources around them depends entirely on rights of use and access. Land tenure can be expected to influence not only the ownership of woodland resources but also its sustainability (Deweese, 1999). In Zimbabwe, Campbell *et al.* (1993) found greater evidence of intensive management taking place in woodlands which were to some extent controlled by individuals rather than in communally managed areas. According to Bruce and Fortmann (1992), people only manage trees on land with some secure property rights. In agreement with this thinking,

Warner (1997) maintained that farmers would not plant or retain trees on the land if there are uncertainties as to whether they will continue to have access to their holdings. Land tenure is of central importance to this effect (Deweese, 1999), especially when proposing management interventions (Campbell *et al.*, 1993).

Most families in rural Tanzania live on village land or other land that is communally owned, which is otherwise subject to customary controls with the ultimate ownership of the land vested in the State (Acres *et al.*, 1984; Kauzeni *et al.*, 1993; Kajembe, 1994; Kessy, 1998). The general trend of customary land tenure is for a farmer to be given the land by a local authority, such as village headman or council who has authority over land distribution. The farmer then has the right to cultivate, graze, build a house, and use natural resources on the land. Rights to the trees are intertwined with rights to the land on which the trees stand (Kajembe, 1994; Warner, 1997). Recognised rights to the trees retained in the crop fields continue to be important, as do rights to trees in communal areas where they are used for specific purposes such as hanging of beehives. Customary land tenure is therefore a usufruct system, for if the land is not farmed, the rights to it ends and the land becomes available for redistribution (Warner, 1997).

Grazing land in Tanzania is communal and is normally located in areas where crops are not grown. The grazing of cultivated land can only take place after harvesting and with the permission of the owner (Acres *et al.*, 1984). However if the trees are retained in crop lands to which the rest of the community has access for grazing, the land holder usually does not have rights of exclusion in order to protect the trees (Warner, 1997), though this is changing in communities which have introduced bylaws to this effect. Traditionally, livestock owners have migrated seasonally or for longer periods to grazing lands outside their own villages (Acres *et al.*, 1984).

## **1.6 Management history of the miombo woodlands**

### **1.6.1 Pre-colonial period**

Land was owned communally in most countries in Africa before colonialism (Matose, 1994). Local people had access to and used these natural forests for pastures, farming land, fisheries and wildlife resources (IIED, 1994). Hunting was regarded as fundamental for many

cultures as it contributed significantly to the community's self-definition. These communities also relied on traditional medicine from adjacent woodlands and forests. Management of resources was based on Chieftdoms and traditional rules governed the use of sacred forests. As reported by Grundy (1990), in Zimbabwe cutting of trees was controlled by local leaders in African communities, who issued permission for trees to be cut for specific purposes.

### 1.6.2 Colonial period

Common to colonised African countries have been the policies that limit local people from benefiting from natural resources (Bell, 1987; Misana *et al.*, 1996). When national level decisions and policies dealing with common property management were made, they often ignored the traditional rules of land and tree tenure (Penzich, 1994).

The first international conservation treaty, the Convention for the Preservation of Animals, was signed in London in 1900 and became the basis for most colonial wildlife legislation in Anglophone Africa (IIED, 1994). During the colonial era most traditional land use practices were regarded as detrimental to the environment (Millington, 1987). Colonial legislation banned traditional hunting and local Africans were not given hunting licences (IIED, 1994). The effect of removing control from local level to the State has overall been one of the main factors undermining indigenous knowledge and management practices in Africa (Kajembe, 1994).

During the colonial period, land was demarcated for national parks, forest and game reserves to protect the large animal species and their habitats (IIED, 1994). Government conservation efforts took the land from the people and put it under State control which did not allow access to local people (Matose, 1994). This was done without consideration of traditional land use systems, and without the consent of the local communities whose lives would be affected. Local people found themselves deprived of access to the pastures, farming land, fisheries and wildlife resources upon which they depended for their livelihood (IIED, 1994).

### 1.6.3 Conservation and management after independence

When African countries became independent in the 1960s new governments continued expanding the protected areas. The tenure systems introduced during colonisation have been maintained despite the negative impacts upon neighbouring communities (IIED, 1994). Forest policies in most east and southern African countries until the 1970s mainly focused on the preservation of forest reserves and wild animals (Misana *et al.*, 1996) without considering the needs of local communities adjacent to conservation areas. Most research and projects in the miombo woodlands of Tanzania have not been based on rural people's knowledge. This is due to the fact that most research institutions, development agencies and government bodies still adhere to the attitude that the people living in rural areas are backward and that development must be planned for them (Barrow, 1996).

The existing body of research into the management and conservation of miombo woodlands in Tanzania, as elsewhere, has been focussed principally on ecology and silviculture. Most research initiatives have failed to recognise the enormous pressures being placed on miombo woodlands and have not considered the underlying reasons for the extensive modification of remaining miombo woodlands as a result of human impact (Deweese, 1999). The local population has often been excluded from management of miombo woodland resources and sees these resources as a form of land use in competition with the use that meets their immediate needs (Gauslaa, 1988). It is becoming increasingly clear that the public sector simply does not have the resources to effectively manage extensive woodlands areas in relation to the large human populations already dependent on them (Deweese, 1996; MNRT, 1998). Forestry services are not well established and often have limited staff and means, and the management of vast stretches of low to average productivity woodlands is difficult. Enforcement of the law is thus impracticable (Gauslaa, 1988).

The consequences of such policies have been conflicts over resource use (Matose, 1994) and conflict between short-term individual interests and long-term communal interests (Bell, 1987). There has been no incentive for local people to manage and utilise the natural resources sustainably (Misana *et al.*, 1996). This is due to the fact that, although communities bear the costs of natural resources management, they receive few tangible benefits (IIED, 1994). One of the consequences of such protectionist policies has been an increase in poaching of animals to supply a variety of products such as meat, skins and ivory.

Encroachment on national parks for grazing, wood cutting for fuelwood and farming by neighbouring local communities has also increased (Misana *et al.*, 1996). According to Pendzich (1994), growing inequality of access as well as lack of confidence in future access causes people to cut down forests and resist conservation efforts as some individuals act in their own immediate interests rather than the communities long term interests. Villagers who illegally collected honey and mushrooms from a protected area in Zimbabwe reported that they deliberately used wasteful and destructive methods of harvesting in retaliation for what they considered to be unfair harassment from forest guards (Matose, 1994).

As a result of years of exclusion from decision making, the environment in many developing countries has become degraded, forests clear cut, agricultural soils exploited, streams polluted and watershed left unprotected (Pendzich, 1994). According to Chidumayo (1989), despite the relatively small populations, much of the miombo woodlands has been and continues to be modified by the local communities principally through removal of woodland cover.

#### 1.6.4 Miombo management in Tanzania

In Tanzania miombo woodlands have for many years played an integral role in the social well being of the people, especially the rural communities (Temu, 1979a). However inventory data for indigenous forests and woodlands for management plans in Tanzania are scarce. The most extensive inventory was undertaken during 1971-1973 (Schultz and Co. 1973; Nshubemuki, 1998). Management of the miombo woodlands in Tanzania has for many years been based only on timber harvesting regulations such as the allowable cut and minimum diameters. Information on silvicultural treatments is lacking and this has led to overexploitation of commercially important tree species such as *Pterocarpus angolensis* and *Azelia quanzensis*. The total standing volume of timber and mean annual increments of other miombo species are more or less unknown (Nshubemuki, 1998). This problem covers both currently marketed and less marketable species. It also includes the distribution of woodland, the standing stock of economically exploitable volumes of standing timber and the economically sustainable yield (Ahlbäck, 1988). The problem is not confined only to Tanzania. Hofstad (1993) mentioned that although estimates of biomass or standing volume in miombo woodlands of Zimbabwe have been made, the exact figures are not available.

Indigenous forests and woodlands in Tanzania are estimated to provide some 400,000 m<sup>3</sup> of wood annually (MNRT, 1988). Little is known about annual removals for use as poles or posts or other consumptive purposes (Nshubemuki, 1998). Temu (1979a) estimated a standing volume of about 60 m<sup>3</sup> per hectare in relatively undisturbed miombo woodland in Tanzania. Generally, wood supply figures concern solid wood of trees with diameter at breast height of at least 10 cm. Additional biomass including branches, tops, residues, small trees, brushes and shrubs that are possible to use, is normally neglected (Nshubemuki, 1998). According to Temu (1979b), for most miombo species, the mature tree has more volume in the branches than in the stem.

#### 1.6.5 Existing land tenure and its impact on natural resource management

The villagisation programme in Tanzania, where entire communities were moved from one area to another, had a marked impact on the traditional systems of land tenure within which the present farming systems have developed (Banyikwa, 1991). Until the 1973 Villagisation Act, the allocation of land for cultivation was the responsibility of the Chief or was delegated to the headman of the village concerned. This responsibility now lies with the village Chairman as head of the village Economic Planning Committee (Acres *et al.*, 1984; Banyikwa, 1991). A case study carried out in Tanzania by Warner (1997) revealed that some tribes like the *Sukuma* farmers expressed uneasiness about their tenure. The fact that people did not own land and were moved from one place to another caused the village natural resources in Tanzania to be neglected (Banyikwa, 1991). Most villages do not have title deeds and are not yet demarcated, a situation which also increases the insecurity over access to resources. According to Kessy (1998), this insecurity of tenure has resulted in a number of environmental problems including promotion of open access, particularly in forests and woodlands. Already there is uncontrolled migration of people in the miombo woodlands that has led to serious encroachments. The major problem facing the State is that it does not have enough human and financial resources to manage and control the natural resources it claims to own (MNRT, 1998).

Although some government regulations prohibiting misuse of woodland resources already exist in Tanzania (Temu, 1979a), their management has been poor to the extent of rapid deterioration (O’Kting’ati and Monela, 1990). In Tanzania, people are not allowed to cut down good stems of valuable tree species like *Pterocarpus angolensis* for fuelwood

(Gauslaa, 1988). However farmers do not spare any particular tree species when they need to use it (Temu, 1979a). Most activities taking place in miombo woodlands of Tanzania are unplanned and often uncontrolled. All products extracted from these woodlands by villagers are regarded as “free goods” (O’Kting’ati and Monela, 1990).

### ***1.7 New approaches to miombo management***

Most projects in the miombo focus only on the physical management of these woodlands rather than the reasons for management and by whom (Deweese, 1996). The important role that local communities can play in the management and conservation of biological diversity has recently been recognised (Howell, 1987; Little and Brokensha, 1987; Kajembe, 1994; Pendzich, 1994) and is of considerable importance to land use strategies (Bell, 1987). There is therefore a need to revisit the current management systems in thinking and practice (Deweese, 1996). When rural people are not involved as partners in the design and implementation of forest projects, the government efforts to address both local and national objectives are likely to fail (Pendzich, 1994). To bring about any meaningful change, however, these new approaches to miombo management must incorporate the social and economic factors which influence the way in which these woodlands are utilised by communities (Deweese, 1996).

#### **1.7.1 Community participation in miombo management**

Much that may prove useful for community forestry and conservation development efforts can be learned from local people (Gumbo, 1993; Kajembe, 1994). IUCN (1980) reported that the most effective way of convincing people of the merits of conservation is to enable them to participate in the decisions concerning living resources. The disappearance of miombo woodlands have been reported in southern Africa, and according to Deweese (1999), the only way of preventing the complete loss of these woodlands is to empower local people to manage them. Social and economic approaches must be seen as mechanisms for informing the policy process in a way which can help to bring about management change (Deweese, 1996).

Participation begins with identifying a problem and planning how to solve it, and ends with monitoring and evaluating the completed activity leading to enablement and

empowerment. It is a process designed to develop and strengthen the capacities of rural people to gain responsibility for, and authority over local natural resources and effectively contribute to all decisions on how these resources are used (Oakley, 1991). Each community is different and therefore will have different priorities, income levels, life qualities and traditions, and a variety of skills are required to deal with such diversified communities. Real participation must lead to a definition of who the people are, how they are organised and what options they have for managing their natural resources (Barrow, 1996).

### 1.7.2 Indigenous knowledge and miombo management

Local communities are more knowledgeable about their environment and natural resources than outsiders (Chambers, 1983; Kajembe, 1994; Barrow, 1996). Indigenous knowledge and practice has come to be taken more seriously by foresters recently with initiation of social forestry programmes (Shepherd, 1992). Local communities are often aware of the importance of managing their natural resources in a sustainable manner (Kajembe, 1994; Pendzich 1994; Barrow, 1996; Clarke *et al.*, 1996). Much of this knowledge is reflected in ethnobotanical studies (Clarke *et al.*, 1996). It is essential therefore that their knowledge and customs remain the basis of how their lives and land are managed (Barrow, 1996). It is clear that people actively protect and plant useful tree species (Kajembe, 1994). In areas where pressure for resources is not yet extreme, valuable tree species are rarely cut down and only the "useless" bush trees are utilised (Kajembe, 1994). In Zimbabwe the majority of farmers were found to leave trees on farms, most of which were fruit trees (Grundy *et al.*, 1993).

Rules and agreements ensuring the judicious use of important woodland resources are commonly found amongst miombo dwellers and adherence to these indicates a form of management (Grundy, 1990; Gumbo, 1993). In some areas cutting of trees is controlled by local leaders who give permission for trees to be cut for specific purposes. They will also monitor where and how the trees are cut to ensure minimum impact (Grundy, 1990). These indigenous management systems empower local people to develop their own initiatives and rules on how wildlife and other natural resources should be used (IIED, 1994). This indicates that local communities can be instrumental in contributing to natural resources management.

### 1.7.3 Resource sharing

There is a growing recognition of the potential antagonism between the goals of natural preservation and the right of indigenous people to land tenure and use. Due to this some conservationists have proposed that the human neighbours of nature protection areas should receive direct, compensatory benefits from the reserves (IUCN, 1980; Lindsay, 1987). Zimbabwe has carried this concept further with its Communal Area Management Plan for Indigenous Resources (CAMPFIRE) proposal (Bell, 1987; IIED, 1994). It is envisaged in this plan that residents in communal areas may form companies owning and controlling the use of all natural resources on a communal basis, within limits laid down by the government (Bell, 1987). CAMPFIRE represents one of the most exciting recent developments in African conservation and has demonstrated that wildlife can be integrated with people in such a way as to forge a conservation initiative that is socially, economically and environmentally sustainable. The basic principle behind CAMPFIRE is the re-empowerment of local communities through providing them with access to, control over, and responsibility for natural resources. Local communities should have the right to make decisions regarding those natural resources and any activities that affect them. In addition the local communities should receive the benefits from the exploitation of natural resources (IIED, 1994). In another example of benefit sharing, a programme was initiated in 1977 to involve the Maasai in direct benefits from a National Park in Amboseli, Kenya which was created in their critical grazing lands. Benefits from the management of wildlife including meat for the community and revenue from safaris and trophy hunting are received directly at grass roots level (Lindsay, 1987).

### 1.8 *Context of this study*

The importance of miombo woodlands is obvious from the role they play in providing products and services to the ever-increasing populations in this ecozone. Despite this importance however, foresters and forest managers have perceptual difficulties in assessing the uses of miombo woodlands by local communities (Deweese, 1999). This is due to the fact that even the most economically productive miombo has been heavily modified by intensive use and no longer resembles a typical woodland (Temu, 1979b; White, 1983; Gauslaa, 1989; Dewees, 1996; Misana *et al.*, 1996). These ruined woodlands are of little importance to foresters trained to manage miombo for timber production (Deweese, 1996). Miombo

woodlands in Tanzania however are important for many different products and services they offer to local communities inhabiting this ecosystem (Temu, 1979b; Gauslaa, 1989; O’Kting’ati and Monela, 1990; Tuite and Gardiner, 1990).

Despite the wide spread nature of the miombo biome, its long history of exploitation and increasing human pressure and needs, documentation of miombo woodland resource use by local people in Tanzania remains scarce (Tuite and Gardiner, 1990). Misana *et al.*, (1996) have given an account on the historical perspective utilisation of the miombo woodlands in southern Africa. It is claimed that changes in the miombo woodland ecozone are a response of this biome to various factors and have taken place in phases. Major factors known to have had great influence on the use of these woodlands are, among others, the pre-colonial long distance caravan trade and the Ngoni penetration from South Africa (see Lawton, 1982; Misana *et al.*, 1996).

Few studies have documented the indigenous knowledge and use of miombo trees in Tanzania (Tuite and Gardiner, 1990; Katambo, 1999; Munyanziza and Wiersum, 1999; Olsen *et al.*, 1999). Most studies in the Tanzanian miombo, especially Tabora, have focussed on ecology and management and have ignored the woodlands and people interactions that have crucial implications on management of this resource. Some studies of Tanzanian miombo have been done (Jeffers and Boaler, 1966; Boaler, 1966a; Boaler, 1966b; Boaler and Sciwale, 1966; Lawton, 1979; Temu, 1979a; Temu, 1979b; Kikula, 1986; O’Kting’ati and Monela, 1990), but with little or no emphasis at all on the socio-economic forces behind the utilisation of these woodlands.

Reduction in quantity and quality of tree and woodland resources is a major concern of the current Forest Policy in Tanzania (MNRT, 1998; Olsen *et al.*, 1999). The rate of deforestation in Tanzania as a result of clearing for agriculture, overgrazing, wildfires, charcoal making and overexploitation of wood resources, is broadly estimated at 130,000 to 500,000 ha per year (MNRT, 1998). The Tabora Forest Resources Management Project (FRMP) has reported severe encroachment in most of the reserved woodlands in the region, including the Urumwa Reserve (FRMP, 1997). The national Forest Policy in Tanzania is currently undergoing a re-orientation which, according to Dewees (1996), is expected to bring about a convergence between silvicultural management practices and the social and economic factors which largely influence the use of miombo woodlands. Tanzania’s new Forest Policy

aims at involving local communities and the private sector in the management of natural resources because the budget allocated to forestry is less than 1% of the total national budget, making sustainable management of these resources difficult (MNRT, 1998). The Forest Resources Management Project has started implementing this objective and a Joint Forest Management Programme is underway. Baseline information on socio-economic and local institutional arrangements is lacking, however.

Community needs and priority products expected from the miombo woodlands will determine the silvicultural systems to be applied for sustainable management (Grundy, 1995). Dewees (1996) argued that despite the heavy dependence of rural people on products from these woodlands, most national forest departments' management approaches have not been able to increase production of such products. This research seeks to broaden the scope of silvicultural research more effectively, to consider local utility and management of miombo woodlands in Tabora and Tanzania at large.

#### 1.8.1 Objectives of the study

The following are the objectives of this particular study.

#### 1.8.2 General Objective

The overall objective of this study is to document the tree species utilisation preferences by local communities in the Urumwa miombo woodland reserve in the Tabora region of Tanzania.

#### 1.8.3 Specific Objectives

Specific objectives for this study are threefold:

1. To investigate whether and how people value the miombo resources for their various uses.
2. To determine which woodland resources are used and for which purposes.
3. To undertake resource inventory survey in the woodlands adjacent to the study area.

### **1.9 Study questions**

This research attempts to answer the following questions:

1. Do the local people understand the value of the miombo resources around them?
2. What alternatives do local people have to fulfil their wood requirements?
3. Which miombo woodland resources are preferred for various purposes?
4. What is the tree species abundance in the woodlands of the area?

### **1.10 Hypotheses**

1. Local communities around Urumwa depend on miombo woodland for their tree products.
2. Local communities understand the importance of conserving miombo woodlands.
3. The Urumwa miombo woodland has enough wood resources for local communities' needs in terms of species preferences.

### **1.11 Thesis structure**

This thesis is divided into four chapters: The Introduction in Chapter 1 presents a literature review on the miombo woodlands, its distribution, ecology, importance to local communities, land and tree tenure, management, context of the study, study objectives, research questions and hypotheses. In Chapter 2 the study area, methods and data analysis are described. Chapter 3 presents results on miombo resource use surveys and a simple miombo resource assessment. Discussion, conclusions and recommendations are presented in Chapter 4.

## 2. STUDY AREA AND METHODS

### 2.1 *Overview of Tanzania*

Tanzania is situated in the eastern part of Africa, south of the equator between 1° and 12°S and 30° and 41°E (Fig.3). It lies between three great lakes (Victoria in the north, Tanganyika in the west and Nyasa in the south in the Western Rift Valley) and the Indian Ocean to the east (UNDP/World Bank 1988). Tanzania is the largest country in east Africa, covering an area of about 945,000 km<sup>2</sup> of which 53,000 km<sup>2</sup> are inundated by water (Ahlbäck 1988; UNDP/World Bank 1988). The coastline extends for about 800 km. It shares common borders with Kenya and Uganda in the north, Rwanda, Burundi, and Democratic Republic of Congo (former Zaire) in the west and Zambia, Malawi and Mozambique in the south. The country embraces the mainland and the islands of Zanzibar, Pemba and Mafia in the Indian Ocean (UNDP/World Bank 1988; Kauzeni *et al.*, 1993).

#### 2.1.1 Topography

Tanzania has four distinct topographical regions known as (1) the coastal plain which rises from the sea to 200 m; (2) the central plateau with elevations up to 1,000 m; (3) the river complex and (4) the volcanic and massif mountains, the highest being the northern highlands (UNDP/World Bank, 1988). Tanzania includes both the highest and lowest places in Africa; the summit of Mount Kilimanjaro 5,950 m above sea level and the floor of Lake Tanganyika 358 m below sea level. Except for the coastal belt, most of the country is located on the Central African Plateau, at 1,000 to 1,500 m above sea level (UNDP/World Bank 1988; Kauzeni *et al.*, 1993; Berry, 1995).

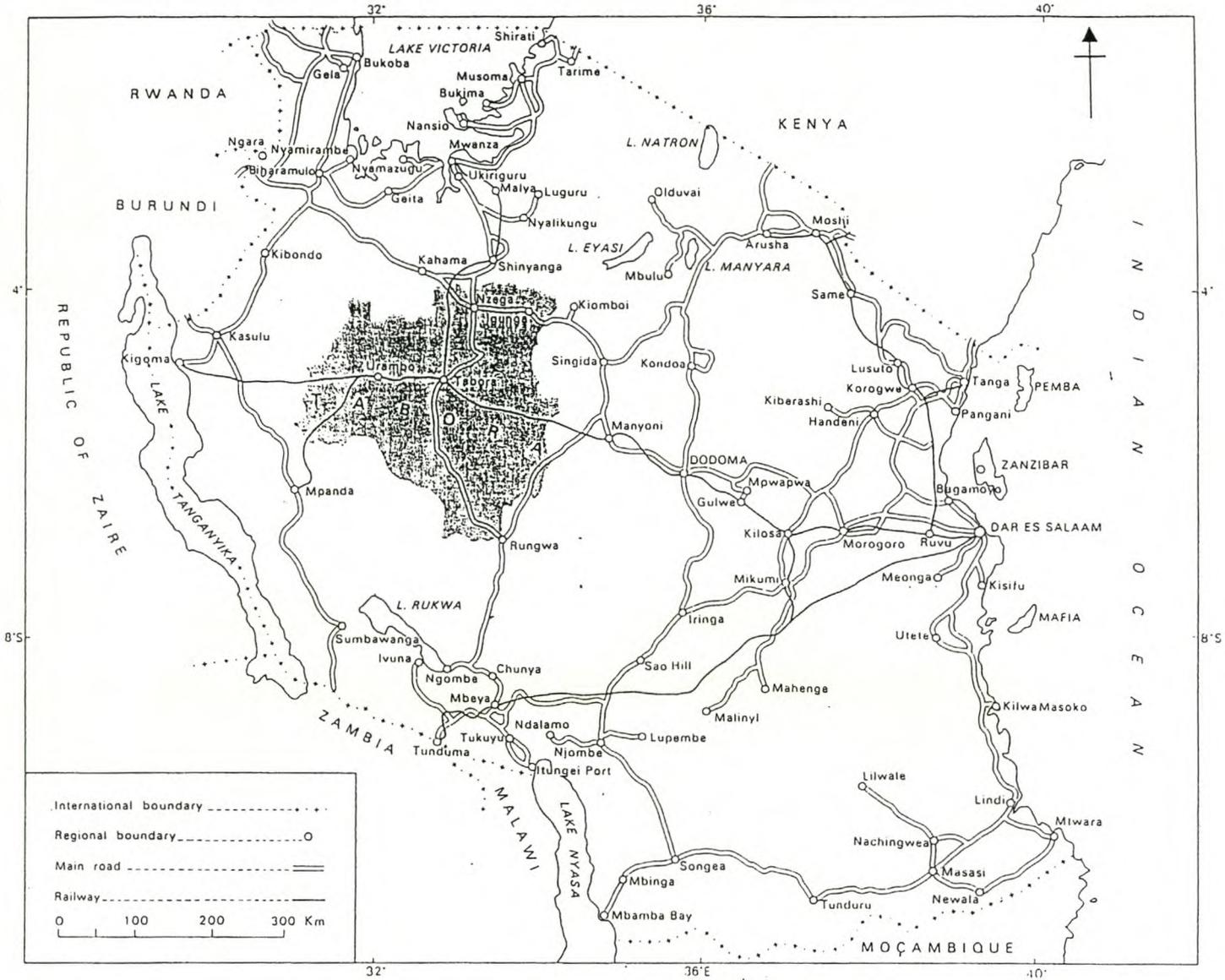


Fig. 3: Tanzania ,showing political borders and the location of Tabora.

Source: Acres *et al.* (1984).

### 2.1.2 Climate

Tanzania experiences a wide range of temperature regions, ranging from tropical to temperate. Rainfall is variable, both from place to place and time to time (Berry, 1995). A greater part of the country experiences rainfall in a single rainy season from November to May; though two rainfall peaks occur in some areas referred to as short and long rain seasons. Short rains normally occur from mid November to mid December, and long rains normally from mid March to end of May (Kauzeni *et al.*, 1993; Berry, 1995; Nshubemuki, 1998). About 3% of Tanzania receives annual rainfalls exceeding 1,250 mm while 21% of the country can expect with 90% probability more than 750 mm of annual rainfall (Persson, 1975; Berry, 1995). The central third of the country which is semi-arid receive less than 500 mm rainfall with evaporation normally exceeding rainfall in nine months of the year (Berry, 1995).

### 2.1.3 Soils

The coastal zone is mainly covered with deep, sandy to heavy texture soils with moderate to high moisture availability. Most of the central and western plateau areas are mantled by sandy loam soils of low nutrient content and low water holding capacity. Eroded land and deeply weathered soil susceptible to erosion occur on hill or mountain slopes and in the central highlands (Kauzeni *et al.*, 1993). The most fertile soils in Tanzania are the reddish-brown soils derived from volcanic rocks although *mbuga* (lowland) and other alluvial soils have good potential elsewhere in the country. These well drained, volcanic soils of high ash content are found in the northern rift zone and the volcanic areas of the northern and southern highlands. Generally these are heavy-textured, moderately to well drained, with moderate to high moisture storing properties. The soils of the western highlands are developed from basaltic rocks and are well drained with good moisture holding properties (Kauzeni *et al.*, 1993; Berry, 1995).

### 2.1.4 Population

The current population of Tanzania is estimated to be 28 million with an annual growth rate of about 3.4 per cent (Nshubemuki, 1998). Tanzania has a low overall population density, averaging about 19 persons per km<sup>2</sup>. However some areas such as Kilimanjaro,

Mwanza and Dar es Salaam are more densely populated with over 200 persons per km<sup>2</sup>. Other areas are more sparsely populated (e.g. Lindi, Rukwa, Ruvuma, and Tabora regions) mainly because of their low and unreliable rainfall and infertile soils. About 89% of the total population live in rural areas, mostly in about 8,000 villages (Kauzeni *et al.*, 1993; Berry, 1995).

#### 2.1.5 Forests and woodlands

Tanzania is one of the countries in southern Africa with the major proportion of its landscape under forests and woodlands. However most of the Tanzanian natural vegetation has over the years been considerably modified by human occupation (Berry, 1995). Forests and woodlands in Tanzania are estimated to occupy 38-50% of Tanzania's mainland area (approximately 40 million ha) (Kajembe, 1994; MNRT, 1998). These include high or closed tropical and afro-montane forests in the uplands, woodlands in the south and central western areas, and mangrove forests in the coastal belt along the Indian Ocean (Berry, 1995; MNRT, 1998). According to Kimariyo (1990), legally reserved forests and woodlands on State land account for about 15% of the total land area of Tanzania.

#### 2.1.6 Agriculture

Agriculture is the mainstay of the economy of Tanzania, providing 40 to 50% of the Gross National Product (GNP), 80% of exports and 90% of the employment (Kauzeni *et al.*, 1993; Kajembe, 1994). Tanzania is a country of varying agricultural potential, ranging from semi-desert to fertile and highly productive land under rain-fed agriculture. Thus there is potential to grow a wide range of temperate and tropical crops. The main crops cultivated include coffee, tea, cotton, sisal, tobacco, wheat, maize, rice, beans, and cashew. However there are growing conflicts between agriculture and other land uses. Much of the productive land is already densely settled and as population pressure continues to rise, more and more people are settling and cultivating in the marginal areas, often encroaching into grazing areas or forest and wildlife reserves (Kauzeni *et al.*, 1993).

## 2.2 Overview of Tabora

### 2.2.1 Location

The Tabora region forms part of the vast central plateau of Tanzania (Fig. 3), an area of generally low relief most of which lies between 1,100 and 1,300 m above sea level (Acres *et al.*, 1984). This region lies between 4° and 7° south of the equator and between 31° and 34° east of Greenwich. It shares borders with the Shinyanga region in the north, Singida region in the east, Rukwa and Mbeya regions in the south while the western border is shared with Kigoma region. The region has a gross land area of 73,500 km<sup>2</sup>, representing 9% of the land area of Tanzania's mainland.

### 2.2.2 Climate

The climate of Tabora is generally warm. Temperatures reach their peak in September to October just before the onset of the rainy season. The mean maximum monthly temperatures vary between 27.6°C and 30°C while the mean minimum monthly temperatures range between 15.1°C and 18.3°C. The rate of evapotranspiration in the miombo woodlands of Tabora exceeds the monthly rainfall every month which may result in consistent water deficit depending on the moisture holding capacity of the soil (Acres *et al.*, 1984).

Rainfall is markedly seasonal and ranges from an annual average of 1,000 mm in the west part to 700 mm in the north-east. The rainfall pattern is characteristically extremely variable and unpredictable, both spatially and temporally, with a risk of long dry spells at any time during the rainy season. Rains normally start in October or November, reaching a peak in December, after which a slight dry spell follows in January or February. A second lower peak occurs in February or March, and the rains then tail off in April, sometimes extending into May. Thus, although the rainfall is broadly monomodal, there is a trend towards a bimodal pattern (Acres *et al.*, 1984).

### 2.2.3 Soils

The soils of Tabora, like other miombo soils, are generally poor in terms of fertility (Boaler and Sciwale, 1966; Lawton, 1982; Stromgaard, 1985). They vary widely, ranging from sandy loam in the south and west to heavy (black/dark brown) soils in poorly drained areas especially in the north of the region (Acres *et al.*, 1984; Berry, 1995). The soil organic matter content is low or very low throughout the region and the content of total Nitrogen, available Phosphorus, exchangeable Potassium and other cations is also low (Acres *et al.*, 1984; see also Lawton, 1982; Stromgaard, 1985 on Zambian miombo soils). Local farmers recognise the different soils in their village areas, and have developed a good working knowledge of how these soils differ and which crops will do best on them in any year. Local names for the soils vary between villages, but those of the most important soils are sufficiently consistent to be understood over the region as a whole (Acres *et al.*, 1984).

### 2.2.4 Population

The total population of Tabora in the 1978 census was 818,049 (Acres *et al.*, 1984). In the national population census of 1988 Tabora supported about 1,036,000 people, representing an increase of about 217,951 people in a period of 10 years. Data obtained from the Tabora regional hospital indicated that in 1997 this region had 1,286,375 people living in about 418 villages. Compared to other regions in Tanzania, the regional population density of 14 people per km<sup>2</sup> is low. However the growth rate is above the national average of 3.4%, which is accounted for by immigration, particularly from more densely populated areas to the north. It was estimated that by the year 2000 the region will accommodate 1.4 million people (Acres *et al.*, 1984).

### 2.2.5 Land use

The breakdown of the total land area of Tabora in terms of use is shown in Table 1. Three main land use categories are recognised in Tabora namely, agriculture (crop cultivation), livestock production and forest utilisation.

The rural people in Tabora are essentially subsistence farmers growing mainly food crops and a few cash crops. The most important food crops are maize, sorghum, groundnuts,

cassava, sweet potato and rice. Cash crops contributing to the rural economy in the region are tobacco, cotton and sunflower. Most crops are grown on uplands under dry land cultivation. Rice is cultivated in *mbugas* (lowlands) and on lower slopes where seepage or runoff can be ponded (Acres *et al.*, 1984).

**Table 1:** The land use pattern of Tabora.

Land use	Area in km <sup>2</sup>
<b>Crop cultivation</b>	
Upland cultivation (fallow inclusive)	8,026
Low land cultivation	1,070
<b>Livestock grazing</b>	
Low land and swamp suitable for dry season grazing	10,100
Bush land and grass available for grazing	2,770
<b>Forestry</b>	
Thicket and woodland available for timber and fuel	18,560
Forest and game reserves	33,830
Cultivation within forest reserves	285
<b>Water bodies</b>	215
<b>Total</b>	<b>74,856</b>

Source: Acres *et al.* (1984).

All areas not in the cultivation cycle are assumed to be available for grazing by either domestic stock or wildlife. During the rains the uplands, including fallow land in cultivation areas, are grazed. The *mbugas* and crop residues on cropland are grazed during the dry season (Acres *et al.*, 1984). However tsetse flies exclude much of the region from grazing by domestic animals. Tsetse infestation occurs mainly in thicket and woodland, and associated *mbugas* (Lawton, 1982; Acres *et al.*, 1984).

#### 2.2.6 Vegetation types

Vegetation of Tabora is divided into two main categories namely the upland and lowland or *mbugas*. The upland vegetation is made up of miombo woodland and a number of vegetation communities in the drier north-eastern area that include *Acacia/Combretum* woodland, bushland and bushed grassland (Acres *et al.*, 1984).

Tabora contains a greater area of natural woodlands than any other region in Tanzania. Miombo woodlands in Tabora cover an area of about 38,160 km<sup>2</sup>, which is almost 51% of the total land area. About half of the woodlands are in designated reserves in State land and the rest are in land allocated to villages or on public land. These woodlands are exploited for

commercial timber production and a number of non-timber products including honey and beeswax, gum arabic, building poles, firewood, charcoal and game (Temu, 1979a; Acres *et al.*, 1984).

### 2.3 *Location of the study area*

This study was carried out in the Urumwa miombo woodland reserve situated between 5° and 5.2°S and 32.7° and 33°E, about 15 km south of Tabora Municipality (Fig. 4). This woodland, which is situated in the high rainfall zone of the region, covers an area of about 13,000 ha. Like most of the miombo areas, the soils of this study area are poor in nutrients and are formed above the old land underlain by granite parent rock (Acres *et al.*, 1984). The uplands are dominated by the broad out-washed plain of old colluvial soil deposits while the lowlands have well drained sandy soils and seasonally flooded clay and sandy-loam soils (Acres *et al.*, 1984). There are 12 villages surrounding Urumwa miombo woodland with an estimated population of about 22,500 inhabitants. Historically the *Nyamwezi* people have been settled in Tabora since the 17<sup>th</sup> century and until the 19<sup>th</sup> century the country was ruled under a Chieftdom. The famous chief of *Wanyamwezi* was Mtemi Milambo who ruled from 1840 to 1884. Most of the people are subsistence agriculturists and pastoralists. Other socio-economic activities include timber harvesting, mainly from pit-sawing, charcoal making and beekeeping. There is no electricity in these villages, so wood is the only source of energy. The vegetation is relatively dry miombo with a canopy layer dominated by the common miombo species of *Brachystegia* and *Julbernardia* (in upland) with some *Acacia/Combretum* woodland in the lowlands. The herb layer is dominated by *Hyperrhenia* grass with a shrub layer of canopy trees saplings. The Urumwa reserve is regenerated woodland after people were evacuated in the early 1950's on the gazetting of the government Forest Reserve. Most mature miombo woodland in the Tabora region is secondary regrowth especially after massive deforestation in the 20<sup>th</sup> century following an outbreak of sleeping sickness (Lawton, 1982). The Tabora Forest Resources Management Project has identified the Urumwa miombo woodland reserve as one of the most depleted woodlands in Tabora as a result of increased open access (FRMP, 1997).

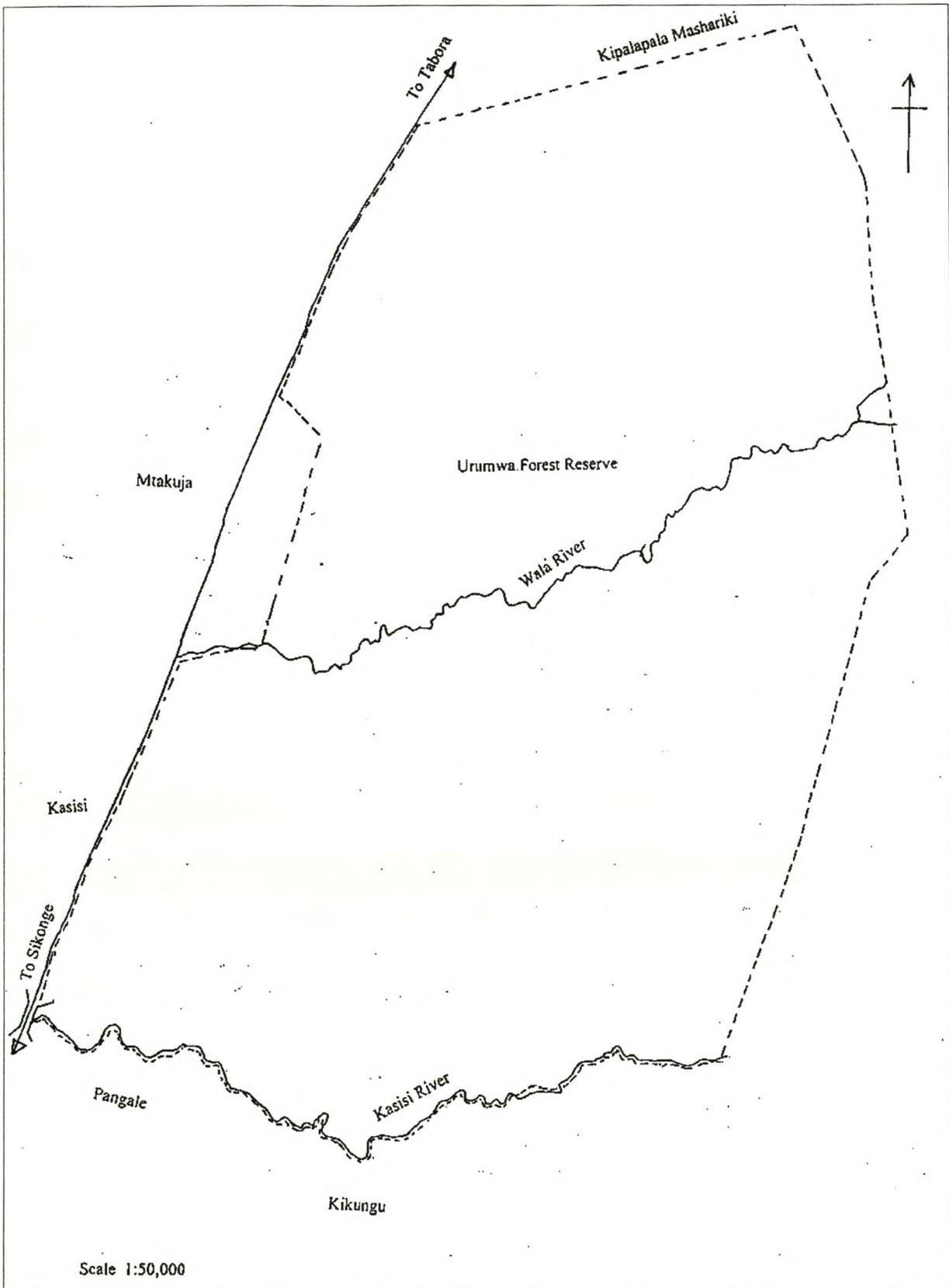


Fig. 4: Urumwa Forest Reserve showing the location of studied villages in Tabora, Tanzania.

Source: The Tabora Forest Resources Management Project.

## 2.4 *Methods*

This study was carried out using a range of research techniques which included individual interviews and village meetings. A simple miombo resource assessment was carried out using a line transect survey technique.

### 2.4.1 Individual interviews

Five villages surrounding this reserve were selected systematically along the main road that connects the southern part of Tabora with Tabora town where most of the miombo woodland products are sold and transported to neighbouring regions. Selected villages are located in the north, west and southern part of the reserve. It was not possible to cover the eastern side of the reserve because of logistical reasons. The villages surveyed were Kipalapala Mashariki, Mtakuja, Kasisi, Pangale and Kikungu (see Fig. 4).

After village selection, a representative sample of respondents was selected from each village, based on random sampling procedures. Normally village leaders keep reliable records of the village population, thus it was easy to obtain the data from the Village Executive Officers. A household is normally identified by the name of the household head who might be male or female. To facilitate this study a list of all household heads was obtained from the village authorities and from this list a random sample was drawn. The sample size for each village was 30% of the total number of households. The sample was then stratified in an attempt to obtain approximately equal representation of both males and females. In this case, every alternate household selected was male. In cases where no female respondent was available, a male respondent was substituted instead. In total, 154 households were surveyed in the five selected case study villages in which 92 respondents were males and 62 were females. The information on the utilisation of miombo woodland resources in this study was obtained from the people who use them for their daily requirements, using a questionnaire survey (Appendix 1).

According to Chambers (1983) the most common method of formal rural research is the questionnaire survey. Questionnaires can be used for descriptive, explanatory and exploratory research purposes, and are also an excellent vehicle for measuring attitudes and

orientations in a large population. This method is chiefly used in studies that have individual people as the units of analysis, and is advocated as the best method available to the social scientist interested in collecting original data for describing a population too large to observe directly (see Babbie, 1995).

The technique used to collect information in this particular study was a semi-structured interview (Babbie, 1995). Chambers (1983) stated that the best way to learn from local people is to sit down, ask questions and listen. Rather than asking respondents to read questionnaires and enter their own answers, researchers send interviewers to ask the questions orally and record respondents' answers (Babbie, 1995).

In conducting the interviews, assistance was given by a team of research assistants from the Miombo Woodlands Research Centre, Tabora. Most of these people were conversant with the most important local languages of *Wanyamwezi* and *Wasukuma*, spoken by the dominant ethnic groups in the study area. Since the questions were semi-structured, the respondents were given an opportunity to include more explanations wherever necessary. Sometimes an interviewee could call a husband or a wife to help in answering some questions related to indigenous knowledge such as specific names for medicinal and sacred trees. The questionnaire covered values and benefits, availability, management, use, trees protected on farms and preferences of priority species in the surrounding miombo woodland areas. The questions were formulated in English and *Kiswahili*, but in most cases they were asked in *Kinyamwezi* and *Kisukuma*, and the responses were written in *Kiswahili* and later translated into English.

In order to estimate the value of the miombo woodland resources to local users, each respondent was asked to mention products and services they obtained from the miombo woodlands around their village and these were noted on the ground where possible, or on pieces of paper. The respondent was then asked to prioritise them depending on their importance in their daily lives. By providing respondents with about 30-40 maize grains (which represented money) and asking them to "buy" the resource by putting the money values against each product, it was possible to come up with priority products. The products with highest priority scored the highest, which gave a good indication of how the local people valued the woodlands around them.

#### 2.4.2 Village meetings and group discussions

To complement the information gathered from individual interviews, village meetings were conducted. Meetings in the selected villages were conducted under the guidance of the Village Executive Officers who called general meetings for all villagers. Normally venues were in primary schools where facilities like classrooms and desks to sit on were available. This followed the Participatory Rural Appraisal (PRA) procedure where the villagers were given several topics to discuss among themselves and asked to write down their results and conclusions (Chambers, 1983; Anon., 1993; Slocum and Thomas-Slayter, 1998). Participatory Rural Appraisal is a cross-disciplinary and cross-sectoral approach to engaging communities in development projects through interactive and participatory processes (Thomas-Slayter, 1998). Before people could be divided into groups, they were introduced to the study objectives which covered issues related to analysis of woodland resources in terms of values obtained. Tenure rights and management of the woodlands around them, historical events, the extent of utilisation for daily needs and the availability of these resources were among issues raised. As a research tool, PRA serves the purpose of opening up discussions with villagers on a particular topic of interest (Slocum and Thomas-Slayter, 1998).

Participatory Rural Appraisal makes use of various techniques such as resource mapping, venn diagrams, time line and matrix scoring to achieve a desired purpose, all of which can be handled by villagers with a minimum level of education and yet provide useful information (Anon., 1993; Slocum and Klaver, 1998; Slocum, 1998; Wichhart, 1998). The choice of any one of these techniques depends on the information one wants to generate. These methods ensure that participants in the discussion are relaxed and thus co-operative, but they also demand substantial explanations by the research team so that the methods are well understood by the participants. Participatory Rural Appraisal allows sharing of information and ideas between rural people and researchers (Slocum and Thomas-Slayter, 1998). In this study, time lines (flow of events), matrix scoring for valuing and prioritising the miombo benefits and transect walks (during resource assessment) were used.

In the general meetings the villagers were asked to discuss a range of issues pertaining to woodland use and management. First they were requested to mention the benefits they obtained from the woodland and to prioritise them. They were also asked if they knew how the miombo woodlands around them were managed and if the community had formed

miombo woodland management committees. Community participation in the management and conservation of the miombo woodland resources was explored. The participants were also asked to list any existing bylaws in their villages and how they were executed. They went on to discuss which miombo products were used daily and whether they were also used for income generation. Where estimates could be obtained, villagers gave prices for various products sold. The participants were given time to express their feelings on the changes in the availability of resources that may have occurred in recent years, including the distance from which they were obtained. Then they identified tree species which they normally protected on farms.

The time line technique was used to obtain information on the most important events in the area which had occurred over a long period in the past. In this case villagers were asked to recall events which occurred as far back as 1950 up to 1999. Participants discussed this together and then recorded major events with approximate dates. Events that had influence on miombo woodland resources such as ownership, management and utilisation by local communities were given most emphasis in this study.

#### 2.4.3 Validity and reliability of results

Reliability and validity of the results from this kind of research depends on the truthfulness of the interviewees and their perception of the interviewer (Grundy, 1990). According to Chambers (1983), rural people can provide false information for a variety of reasons such as fear, prudence, ignorance, exhaustion, hostility, and hope of benefits. Involvement of village leaders and local interpreters in the study were strategies used to minimise the error in responses. Questionnaire pre-testing, training of interviewers, use of local people who spoke local languages and follow-up village meetings were steps taken to increase reliability and validity of the answers.

#### 2.4.4 Resource assessment

A simple survey of tree species richness and diameter distribution was carried out in the Urumwa reserve using the line transect method (Sutherland, 1996). This survey is referred to as “simple” because an in-depth inventory of the woodland was beyond the scope of this study. There was no reconnaissance survey done for general assessment to check for

variation in the woodland, as soils, slope and disturbance may lead to species variation in the area (see Högberg and Pearce, 1986; Grundy, 1995). The data gathered from this exercise is not expected to give any viable biological statistical inference for the distribution of species in the area, but an indication of the degree of availability as compared to the responses from the questionnaire. This resource assessment was done after the questionnaire survey because some information from the interviews such as where miombo products were harvested and distance travelled determined the location and length of the transects. In each village one transect running from the village, starting at the edge of settlements in the direction of the forest reserve, was established. The direction of the walk was decided by looking at the map and the position of the village and, using a compass, the bearing was selected. The maximum length of the transects was 2 km, and this was obtained from the responses on the average distance travelled by the majority of villagers in searching for wood products in woodlands adjacent to their villages. Circular plots of size 100 m<sup>2</sup> were laid out after every 100 m along the transect. No assessment was made at the starting point, as this was a borderline between the woodlands and the village settlement land. A string of length 5.64 m pegged at the centre of each plot was used as radius to mark the boundary of the plot. A total of 58 plots were laid out in woodlands adjacent to the five selected villages. All tree species with diameter at breast height (dbh) >5 cm in each plot were enumerated and the names were written in *Kinyamwezi* and *Kisukuma*. Trees with diameters at breast height >5 cm were recorded and measured to determine changes in species diameter class distribution and composition at increasing distance from the village. Corresponding scientific names for trees were later obtained from checklists (Brenan and Greenway, 1949; Mbuya *et al.*, 1994). No measurements were made for trees with diameter at breast height <5 cm. The transects established at each village served also as PRA transect walk to gather more information on miombo use. Although it was not possible to organise a group of villagers to walk with, some members of various village committees were willing to join the research team. These people assisted in naming the trees in local languages and gave explanations on various activities related to miombo use as observed along the transects.

## 2.5 *Data analysis*

The data were systematically analysed to provide answers to the study questions and achieve the objectives presented in Chapter 1. Data obtained from questionnaires were coded and fed into a Microsoft Excel and STATISTICA Computer Programme (STATISTICA 5.1, 1998) to generate some descriptive statistics. Coding refers to systematic organisation of data into categories and in this case numerical codes were assigned to responses (see Babbie, 1995). For questions that had single answers, the responses were analysed without any coding. According to Babbie (1995), one disadvantage of questionnaire surveys is that a wide variety of responses are difficult to code. In such cases, the responses were treated as variables and their frequencies entered case wise for analysis. Grouping (independent) variables were village, location and gender, and each question formed a dependent variable. Analysis for the questionnaire was mainly descriptive as only chi-square ( $\chi^2$ ) statistics, tables and associated graphs were used in interpretation of the results. No data transformation was performed as detection of more complex relationships amongst the tested variables was beyond the scope of this study. Information obtained from village meetings was analysed on the spot by recording consensus conclusions from the participants. The purpose of these meetings was to support the validity of the information obtained from the analysis of questionnaires.

Data recorded from the transect survey was organised into tables with villages, distance from the village, diameter at breast height and number of stems per hectare as variables. Diameter at breast height and number of stems per hectare were tested across the five villages using a one-way analysis of variance (ANOVA). The Spearman Rank Order Correlations was used to determine the relationship between the number of stems per hectare and the mean stem diameter at breast height. Regression analysis was also used to test the effect of village proximity to the Urumwa reserve on mean diameter distribution and number of stems per hectare. Graphs were used for interpretation of significant test statistics. Individual miombo tree species contributions to the species composition of the woodlands adjacent to the studied villages were determined using the correspondence analysis.

### 3. RESULTS

This chapter presents results obtained from a questionnaire survey on utilisation of miombo resources by communities (section 3.1) and a simple inventory survey on miombo resources (section 3.8) in the five selected villages of Tabora.

#### 3.1 *Utilisation preferences survey*

Although effort was made to have a balance between gender classes during sampling, it was later found to be impossible as few women appeared for interviews. In some cases women were not ready to answer questions, giving reasons that only men dealt with woodland activities and not them. These results are therefore based on a questionnaire survey that involved 154 households in five villages around Urumwa in Tabora, out of which 60% were men and 40% were women. The main socio-economic activities of the people in this study area were agriculture (73%), pastoralism (13%), tobacco farming (13%) and beekeeping (1%). A distinction is made here between agriculture and tobacco farming simply because tobacco curing requires wood and has implications for utilisation of miombo in the area. However this is not a strict categorisation of socio-economic activities in these villages as one household could be involved in more than one of them.

Communities in the miombo woodlands of Tabora are knowledgeable and understand the values and benefits which accrue from utilising these resources. The most frequently mentioned values and benefits from the miombo throughout this survey included firewood, charcoal, building poles, medicinal plants, food (mushrooms, fruits, honey, insects, game meat, and vegetables), timber, fodder, thatching grass, fibres, and services such as soil fertility improvement and water (catchments). About 97% of the respondents said that the miombo woodlands around their villages have values in their daily livelihood. There was no significant difference between the villages ( $\chi^2=7.085$ ,  $p>0.05$ ) in understanding the values of miombo woodlands for the community's daily life.

### 3.1.1 Firewood and charcoal

Firewood and charcoal are the major sources of energy in most rural areas in Tabora. In this study firewood was mentioned by 93% of all respondents as being one of the major products obtained from the miombo woodlands of Tabora. Charcoal was mentioned by 40% of the respondents. There was a significant difference ( $\chi^2 = 31.26$ ,  $p < 0.05$ ) between the studied villages as shown in Table 2.

**Table 2:** Differences on the use of charcoal in the five studied villages of Tabora, Tanzania.

Village	Percentage response
Kipalapala Mashariki	73
Mtakuja	34
Kasisi	14
Pangale	39
Kikungu	29

Interviewees explained that they were no longer able to choose particular tree species for firewood in the area and others had to resort to using crop residues such as maize cobs for cooking and heating. However, when available, local communities have strong preferences for certain tree species when it comes to utilisation for firewood and charcoal. Wood properties were mentioned as being the most important factors determining species suitability for these uses. Most interviewed people said that the best firewood must burn very well and for a long time but with no irritating smoke, produce hot coals and not too many ashes and it should not be too heavy or difficult to split. The most frequently mentioned tree species for firewood and charcoal making in this study include: *Albizia amara*, *Brachystegia boehmii*, *B. spiciformis*, *Combretum collium*, *C. molle*, *C. zeyheri*, *Julbernardia globiflora*, *Pericopsis angolensis*, *Pterocarpus tinctorius* and *Terminalia sericea*.

In the group meetings it was explained that most villagers had plentiful wood resources when settled there until the villagisation programme in the 1970s. People in that time collected wood from dead fallen trees only and they did not need to cut any live trees. As populations have grown after the villagisation programme in Tanzania, wood resources have gradually been depleted and now people must cut live trees and dry them for firewood.

### 3.1.2 Building poles

Most houses in the study area were built from wood, where poles were used to construct walls and were later plastered with mud. Poles are also used to make the roof on which the bundles of thatch are tied. It was observed in this study area that few houses were built from mud bricks. This was an indication of people's heavy dependence on the miombo woodlands for building materials. About 84% of respondents obtained their building materials from the miombo around their villages.

Local communities within the study area have preferences for tree species used for poles in house construction. The most preferred species include: *Albizia antunesiana*, *Combretum collium*, *C. molle*, *C. zeyheri*, *Dalbergia melanoxylon*, *D. nitidula*, *Erythrophloeum africanum*, *Pericopsis angolensis*, *Pterocarpus tinctorius* and *Terminalia sericea*. However some of these species, such as *Combretum collium*, *C. molle*, *C. zeyheri* and *Terminalia sericea*, although said to be most preferred, were also most abundant in the woodlands around the surveyed villages (Table 12).

### 3.1.3 Medicinal plants

Fifty six percent of respondents mentioned the importance of miombo woodlands as a source of medicinal products. There are both traditional healers and midwives in the villages who offer health services to the communities. According to the responses collected from the group meetings, almost every miombo species has medicinal properties. The villagers also explained that the harvesting of medicines, especially roots, required the collector to bury the tree stumps as this allowed new root growth. Although the government of Tanzania has tried to bring modern health services closer to the people in the villages, problems in availability of medicines have persisted, and not all people can afford the prices when medicines are available. This situation has forced most of the rural people to heavily depend on naturally obtained medicines from the woodlands and forests. The study area had only two dispensaries, one in Kipalapala Mashariki and another one in Pangale village. However villagers explained that some diseases could not be cured in ordinary hospitals and dispensaries but were cured by traditional medicines only.

Tree species preferences for medicinal use depend on the knowledge of the user and the number of cures each species offers. Miombo tree species mentioned by respondents to have medicinal properties were; *Azelia quanzensis*, *Cassia abbreviata*, *Cassipourea insignis*, *Combretum collium*, *C. molle*, *C. zeyheri*, *Dichrostachys cinerea*, *Erythrina abyssinica*, *Fagara mekeri*, *Ozoroa insignis*, *Popowia obovata*, *Pterocarpus angolensis*, *P. tinctorius*, *Schrebera koiloneura*, *Securidaca longipedunculata*, *Tamarindus indica*, *Terminalia sericea*, *Vitex mombassae* and *Xylopiya antunesii*.

#### 3.1.4 Food from miombo

Miombo woodlands are sources of various foods such as mushrooms, fruits, honey, insects, game meat, and wild vegetables. Most respondents said that these products are very important, especially in low rainfall years when crop yields were low. Foods from the miombo woodlands in the study area were mentioned by 43% of the respondents irrespective of village or gender ( $\chi^2=3.6$ ,  $p=0.05$ ) ( $\chi^2=0.65$ ,  $p>0.05$ ) respectively.

Wild fruits were the major focus of this study among other foods obtained from the woodlands. Fruit tree species mentioned by respondents throughout this study included: *Annona senegalensis*, *Berchemia bicolor*, *Flacourtia indica*, *Grewia bicolor*, *Grewia* sp., *Hexalobus monopetalus*, *Parinari curatellifolia*, *Phyllanthus engleri*, *Popowia obovata*, *Strychnos cocculoides*, *S. spinosa*, *Tamarindus indica*, *Vangueriopsis lansiflora*, *Vitex doniana*, *V. mombassae*, *Ximenia africana* and *X. americana*.

#### 3.1.5 Timber

Timber from the miombo surrounding the study area is normally produced by pitsawyers on a small scale. Timber was mentioned by 38% of the respondents as an important product from the miombo. There was a significant difference ( $\chi^2=23.99$ ,  $p<0.05$ ) in responses from the different villages. Of those who valued timber as a product, 64% came from Kipalapala Mashariki, 39% from Pangale, 36% from Mtakuja, 29% from Kikungu and 11% came from Kasisi. There was also a significant difference ( $\chi^2=6.21$ ,  $p<0.05$ ) between gender groups where more males (54%) than females (26%) saw timber as being a valuable product. The most preferred miombo tree species for timber are *Azelia quanzensis*,

*Brachystegia spiciformis*, *Pterocarpus angolensis* and *P. tinctorius*, and two alternative species *Albizia antunesiana* and *Sterculia quinqueloba* which were said to be used when the best ones are not easily available.

### 3.1.6 Thatching grass

Most of the houses in the study area had thatched roofs. Houses are re-thatched once every two years on average, depending on the quality of the grass and the thatching style. About 19% of the respondents said they obtained their thatching grass from the miombo woodlands. There was no significant difference ( $\chi^2=6.31$ ,  $p>0.05$ ) in collection of grass from the woodlands by inhabitants of the five different villages. However a chi-square test showed significant difference ( $\chi^2=7.87$ ,  $p<0.05$ ) between gender groups with 26% of males and 8% of females mentioning that they obtained thatching grass from the miombo.

### 3.1.7 Fibre

Traditional ropes from forests and woodlands are widely used as tying materials for house construction in rural areas of Tabora. Some respondents said that they normally used traditional ropes more frequently than alternatives such as nails. In this study 27% of the respondents mentioned fibres as one of the values and benefits obtained from the miombo. There was a significant difference ( $\chi^2=15.2$ ,  $p<0.05$ ) between use of rope in the five villages, whereby of those who said they used traditional ropes, 47% came from Kasisi, 36% from Kikungu, 28% from Mtakuja, 23% from Pangale and 9% from Kipalapala Mashariki. There was also a significant difference ( $\chi^2=13.4$ ,  $p<0.05$ ) between men (38% of male respondents) and women (11% of female respondents) in mentioning fibre as a product from the miombo.

Tree species frequently used for traditional ropes include *Brachystegia boehmii*, *B. microphylla*, *B. spiciformis*, *Commiphora* sp., *Julbernardia globiflora* and *Lannea schimperi*. *Brachystegia boehmii* and *B. spiciformis* are also used for making bark hives.

### 3.1.8 Fodder

Miombo is an important source of fodder throughout the study area (19% of the respondents). There was no significant difference between villages ( $\chi^2 = 4.87$ ,  $p > 0.05$ ) and gender groups ( $\chi^2 = 3.86$ ,  $p = 0.05$ ) in recognising miombo as a source of fodder. Pastoralists mainly from neighbouring dry regions have invaded the woodlands in search of grazing, and it was explained that the Tabora population was growing fast as a result of the influx of cattle herders into the miombo areas. Most of respondents blamed cattle herders for the depletion of the woodlands through cutting down trees to favour grass growth. The Urumwa miombo is heavily grazed and the number of cattle herders is likely to increase in future.

Trees in the miombo said to have palatable browse were *Annona* sp., *Brachystegia spiciformis*, *Combretum obovatum*, *Dichrostachys cinerea*, *Julbernardia globiflora*, *Parinari curatellifolia*, *Phyllanthus discoides* and *Tamarindus indica*.

### 3.1.9 Soil improvement and catchments

Only 7% of the respondents mentioned miombo as important for soil improvement. Although this sounds very low, most miombo dwellers in this area have used land under miombo for agricultural production. Only one farmer in Kipalapala Mashariki village explained to the researcher that he broadcast *Julbernardia* and *Brachystegia* species seeds on his farm to get regeneration that improves the soils of his crop fields, most probably from litter decomposition. There were no significant differences between villages ( $\chi^2 = 0.52$ ,  $p > 0.05$ ) and gender ( $\chi^2 = 1.8$ ,  $p > 0.05$ ) in mentioning the importance of miombo for soil improvement.

Miombo woodlands in the study area form seasonal catchment areas for the Wala and Kasisi rivers feeding into the Ugalla river and Malagarasi swamps to the west. These seasonal rivers crossing the Urumwa miombo woodland reserve are important sources of water for humans, livestock and wild animals in the area especially immediately after the rains. The people also believe that forests and woodlands have influence on rainfall. Some of the respondents said that there have been differences in rainfall intensity and seasonality between now and about thirty years ago when most of the hilltop areas were closed canopy

woodlands. Water was mentioned by 14% of respondents as one of the products obtained from the miombo woodlands in this study area. There were no significant differences between villages ( $\chi^2=3.5$ ,  $p>0.05$ ) and gender ( $\chi^2=0.76$ ,  $p>0.05$ ) in mentioning water as an important benefit obtained from the miombo woodlands.

### 3.1.10 Communities' priority products obtained from the Tabora miombo

People in the studied villages indicated to have different priorities in products they expected from the miombo woodlands adjacent to their villages. Trees for poles were the highest priority of all (35%), even more than firewood and charcoal. The main reason given by most respondents was that, a house was most important because it provided shelter and that other products like firewood could be stored in it during the rainy season. Surprisingly only 12% of all the respondents indicated that timber from the miombo was their first priority product and is third on the overall priority list. Medicine and food from the miombo were equally important products to the majority of respondents. Fodder received less attention, perhaps because only 13% of respondents were cattle herders and the fact that most of *Wanyamwezi* people are not pastoralists. Tree fibre was not considered by any of the respondents to be a priority product, however the reason given was that in many cases the same trees could produce both poles and fibre for tying. In addition fibre is not harvested from mature trees and young trees are easily available in the area. The majority of respondents put services from the miombo such as soil fertility improvement and water conservation at low priority level. A smaller proportion of the respondents also put thatching grass as their first priority product, because grass can be obtained not only from the woodlands but also from the cultivated lands. Priority products according to most of the respondents are shown in Table 3.

**Table 3:** The overall priority miombo products as mentioned by respondents in the five studied villages in Tabora, Tanzania.

Product	Percent response	Priority
Poles	35	1
Firewood	18	2
Timber	12	3
Medicine	10	4
Food	10	4
Charcoal	5	6
Fodder	3	7
Soil improvement	3	7
Water	3	7
Thatching grass	1	10

There was a significant difference ( $\chi^2=10.72$ ,  $p<0.05$ ) between villages in mentioning priority products from the miombo woodlands of Tabora. Whether the respondent was a male or female, however, did not significantly influence the choice of the priority products from the woodlands ( $\chi^2=0.28$ ,  $p>0.05$ ). The village priority products are presented in Table 4.

**Table 4:** Village responses in mentioning priority products obtained from the woodlands of Tabora, Tanzania.

Products	Village (%)				
	K-Mashariki	Mtakuja	Kasisi	Pangale	Kikungu
Charcoal	7	6	0	8	0
Firewood	9	19	25	15	29
Fodder	4	3	0	8	0
Food	16	6	8	0	21
Medicine	9	11	6	15	14
Poles	30	32	50	31	36
Soil fertility	0	2	6	8	0
Thatching grass	0	2	0	0	0
Timber	25	13	0	15	0
Water	0	4	5	0	0
None	0	2	0	0	0

### 3.2 Use of miombo for income generation

A number of tree and woodland products are traded to generate income in the studied area. However only 32% of the respondents said that they used miombo products for income generation, the remainder claiming not to do so. There was a significant difference ( $\chi^2=10.8$ ,  $p<0.05$ ) between villages in this regard, with Mtakuja village having more positive responses (47% of respondents) for income generation than Kipalapala Mashariki (34%), Kikungu (29%), Pangale (23%) and Kasisi (14%). Significantly more men (44% of male respondents) than women (15% of female respondents) traded miombo products ( $\chi^2=14.3$ ,  $p<0.05$ ).

The most commercialised products, according to those respondents who said they obtained income from miombo, were firewood, timber (mainly from pit-sawing), charcoal, poles, thatching grass, bees honey, wild meat (from small scale hunting), medicinal plants and indigenous fruits. Table 5 indicates miombo products sold to the markets by communities around Urumwa for income generation. In general, hunting and fruit gathering did not feature as very important economic activities in this study area. Villagers may have been hesitant to admit to selling miombo products, hence the low positive response to this question. Most

activities carried out in the Urumwa woodlands are considered to be illegal by the Forest Department as most villagers harvest products without permits.

**Table 5:** Commercialised products from the miombo in the five villages of Tabora, Tanzania (n=154).

Product	Percent response
Building poles	8
Charcoal	22
Firewood	39
Fruits	1
Honey	12
Medicines	2
Thatch grasses	4
Timber	12
Wild meat	1

Commercialisation of miombo products is regarded as a complementary source of income especially during years of low crop yields in rural areas of Tabora. Although there were no specific prices for commercialised miombo woodland products in the studied villages, it was possible to get average prices during the village meetings. It was learnt that all prices were negotiable but there was always a minimum price in each village below which a product was not sold. Prices for various products as mentioned by the respondents are presented in Table 6. However, not all products mentioned in Table 5 above appear in Table 6 simply because their prices were not obtained in the village meetings.

**Table 6:** Average prices for commercialised miombo woodland products in the five villages of Tabora, Tanzania.

Product	Unit	Price (USD <sup>1</sup> )
Building poles	1 piece	0.40
Charcoal	1 sack	1.10
Firewood	Head load	0.34
Fruits	1 litre container	0.27
Honey	20 litre container	14.00
Thatching grass	Head load	0.40
Timber	1 piece (any size)	2.00

<sup>1</sup> The exchange rate as at June, 1999 was 1 USD=737 Tanzanian Shillings

Most respondents (55%) in the study area considered that commercialisation of miombo products did not necessarily deplete the resource. The reasons given were that people do not work in the woodlands for the whole year, and that the resource is given enough

time to regenerate, as most miombo tree species are capable of regenerating after cutting. The rest of respondents (45%) said that increased commercialisation of the miombo woodlands in the area, especially due to increased pressure from Tabora town (about 7 km away from the first village) deprived the communities of the use of the resources. According to group discussions, charcoal-making was seen to be the most destructive commercial activity. When asked whether those who sold woodland products should compensate those who did not, in terms of service provision at the village level, 51% of the respondents said no and 49% found the idea viable. Many people argued that traders already pay a royalty to the government, so they should not have to pay the village as well.

About 68% of the respondents did not know whether there were people from outside their villages who harvest products from the miombo in their area. There appeared to be no clear boundaries over the resources or defined user rights in the villages studied. The woodlands in Tabora, being on State land, are considered to be an open access resource and no single community has the right to exclude others from utilising them. This is due to meagre funding from the government for management and control of the Urumwa woodland reserve.

### **3.3 Use of miombo for cultural and religious values**

The Tabora miombo woodlands have both cultural and religious values for the local communities. Of the respondents interviewed, 58% mentioned that some sacred trees were found in their villages. Twenty two percent said there were no sacred trees and the rest (20%) said they didn't know any trees used for cultural and religious purposes. Although there has been much influence from Christianity and Islam on traditions and culture in this study area, some communities like the *Wanyamwezi* and *Wasukuma* tribes still practice their traditions and cultures to some extent. Villagers could identify specific areas in the woodlands that used to be ritual areas. However very few such places still exist in Tabora, and only one important area known as *Nshepa* was identified during this survey. This area used to be the State House and was the area where the Chiefs of the *Wanyamwezi* were buried. This is where big rituals called *Tambiko* were conducted. Few small ritual houses called *Ihanga* for family rituals known as *Maswezi*, *Migabho* or *Midimi* are also found around the village settlements.

There are specific tree preferences associated with rituals in the miombo woodlands of Tabora. Tree species mentioned in this study as being important for the traditional rituals and religions in this study area are presented in Table 7. Of 14 tree species mentioned as important for rituals, the most frequently used were *Combretum molle*, *Ficus thonningii* and *Sterculia africana*. Construction of the ritual house (*Ihanga*) was done using poles from *Combretum molle*. Ropes for tying the poles and thatch were obtained from *Sterculia africana*. *Ficus thonningii* was planted on top of the Chief's grave to demarcate the ritual area (*Tambiko*). There are associated beliefs attached to these trees whereby *Combretum molle*, locally known in *Kinyamwezi* as *mlama*, is believed to bring everlasting blessings from the forefathers. *Sterculia africana* on the other hand protects people from bad spirits and brings grace and cleansing to an affected community (the local name *mhozya* refers to calming). *Ficus thonningii*, or *mlumba* in *Kinyamwezi*, is a tree believed to house the gods, and prayers can be made under it.

**Table 7:** Tree species used for spiritual purposes in the five surveyed villages adjacent to Urumwa Forest Reserve (n=154).

Species	Percent response <sup>2</sup>
<i>Azelia quanzensis</i>	15
<i>Cassia abbreviata</i>	3
<i>Combretum molle</i>	20
<i>Cussonia arborea</i>	7
<i>Erythrina abyssinica</i>	5
<i>Ficus spp</i>	8
<i>Ficus thonningii</i>	21
<i>Lonchocarpus capassa</i>	5
<i>Markamia obtusifolia</i>	4
Msingisa (unidentified)	1
<i>Pterocarpus angolensis</i>	7
<i>Sclerocarya birrea</i>	2
<i>Sterculia africana</i>	9
<i>Tamarindus indica</i>	1

<sup>2</sup> The reported percentage of trees species uses for spiritual purposes in Table 7 does not sum up to 100% because a species was either used alone or together with some other species.

Religious and other cultural activities in these areas included rainmaking rituals conducted by members of the Chief's clan, but only at the Chief's State house where ritual facilities were available. Normally, whenever there were problems such as drought, the current Chief instructed his assistants called the *Wanangwa* to convene meetings for ritual ceremonies. A cow, usually a black one, would be slaughtered on top of the previous Chief's

grave to allow the blood to flow onto it after which every participant was given a piece of skin to wear as a bracelet. A successful ritual was indicated by the speed with which the cow's blood flowed over the grave, the faster the flow the greater the success. The internal parts of the animal such as the intestines also provided information on the outcome of the ritual and this was based on their position inside the stomach, each position having a particular meaning. Other cultural activities that took place in the woodland according to the respondents included circumcision of young boys and girls, and training of the youths on traditional norms.

In this particular study area it was observed that the traditional religious and cultural values of the miombo woodlands to the local communities have declined over years. The contributing factors as mentioned by the respondents included the ever-increasing ethnic heterogeneity in the area as a result of human immigrations, pressures from Christianity and Islamic ideologies, urbanisation and the fact that young generations regard traditional practices as backward due to modernisation. Another contributing factor was the abolishment of the Chiefdoms soon after independence in Tanzania and the introduction of the villagisation programme whereby all powers were vested in elected village councils. Observations made in this area, especially in Kipalapala Mashariki village where the State House of the Chief and *Nshepa*, the main ritual areas, used to be located, suggested that traditional leaders have abandoned these areas and no rehabilitation efforts have been made.

### **3.4 *Where people harvest miombo resources***

On the question of where communities obtained their wood resources, very few people (9% of the respondents) admitted to have obtained their wood products from the government reserve, the majority (49%) said that they harvested from their private woodlands and the rest (42%) harvested in the public and village lands. The majority of respondents travelled between half and two kilometres in search of miombo products. Most respondents said that they did not enter the Urumwa reserve because they were harassed, fined or arrested by foresters if found inside the boundary. However observations made during the transect survey revealed that wood harvesting was going on in the reserve and was done by the villagers from surrounding villages. Conflicts between foresters and villagers were bitterly described by some of the respondents.

### 3.4.1 Availability of most preferred miombo species

The majority of respondents (55%) said that they were still able to find the tree species they preferred most for various uses. The rest (45%) of the respondents said that the most preferred tree species in the miombo woodlands around their villages were not easily available in required sizes for various uses. The preferred tree species that were said to be unavailable in required sizes for various uses are presented in Table 8.

There are a number of reasons for the depletion of the mentioned miombo tree species. About 45% of the respondents could explain why most important trees have disappeared in their villages while 55% said that they did not know the underlying causes. Among the 45% respondents who understood the underlying causes of miombo depletion, there was a significant difference ( $\chi^2 = 30.75$ ,  $p < 0.05$ ) between villages (Table 9) but there was no significant difference ( $\chi^2 = 0.13$ ,  $p > 0.05$ ) in the main causes mentioned by men and women. Understanding of the causes of miombo depletion was significantly positively correlated with the village proximity to Tabora town ( $r = 0.3$ ;  $p < 0.05$ ;  $n = 154$ ) in the study area.

**Table 8:** Preferred miombo tree species but not easily available in the five villages of Tabora, Tanzania.

Tree species	Percent of responses <sup>3</sup>	Uses
<i>Azelia quanzensis</i>	5	Timber
<i>Albizia</i> spp.	2	Timber, poles
<i>Brachystegia boehmii</i>	12	Making hives, fibres, firewood
<i>Brachystegia spiciformis</i>	14	Timber, fibres, firewood
<i>Combretum collium</i>	8	Firewood, poles, medicine
<i>Combretum zeyheri</i>	8	Firewood, poles
<i>Julbernardia globiflora</i>	14	Hive making, fibres, firewood
<i>Pericopsis angolensis</i>	10	Poles
<i>Pterocarpus angolensis</i>	16	Timber
<i>Pterocarpus tinctorius</i>	12	Timber
<i>Swartzia madagascariensis</i>	2	Poles,
<i>Terminalia sericea</i>	7	Poles, medicine

<sup>3</sup> Most respondents mentioned more than one preferred but unavailable tree species, thus the total percentage in this table does not sum up to 100%.

Major causes of miombo depletion in the studied villages were illegal harvesting for timber, charcoal, firewood and poles (21% of respondents); population growth (20%) due to immigrations of pastoralists from neighbouring regions. Agricultural expansion and fires

accounted for only 2% each. Of these, charcoal making was said to be more devastating than any other activity. Respondents said that where a charcoal kiln was established, it took a longer time for that patch to recover, compared to other activities which allowed more rapid regeneration after cutting.

**Table 9:** Differences between villages in understanding the causes of miombo depletion in Tabora, Tanzania.

Village	Percent response
Kipalapala Mashariki	60
Mtakuja	55
Kasisi	20
Pangale	47
Kikungu	28

### 3.4.2 Currently utilised miombo tree species

It is evident from the results that some communities have changed their species preferences from most preferred to easily available tree species in these villages (Table 10). Of all respondents, 36% said that they use alternative tree species to replace the unavailable preferred species. However 55% of respondents still use and get preferred tree species from regenerating woodlands. The rest (9%) said that their preferences have changed to any available tree species because of scarcity.

**Table 10:** Currently utilised miombo tree species as mentioned by 36% of respondents in the five villages around the Urumwa Forest Reserve of Tabora, Tanzania.

Species	Uses
<i>Azelia quanzensis</i>	Timber
<i>Albizia antunesiana</i>	Timber
<i>Brachystegia microphylla</i>	Firewood
<i>Burkea africana</i>	Poles
<i>Combretum collium</i>	Poles, firewood, medicine
<i>Combretum fragransi</i>	Firewood, poles
<i>Combretum zeyheri</i>	Poles, firewood
<i>Sterculia quinqueloba</i>	Timber
<i>Terminalia sericea</i>	Poles, medicine
<i>Terminalia torullosa</i>	Poles, firewood

Three tree species, *Combretum collium*, *C. zeyheri* and *Terminalia sericea*, were mentioned as being preferred but unavailable and also appear in the list of currently utilised species. The reason may be the variability in distribution of the species in the woodland, the

preferred sizes for various uses, and the fact that some respondents said they use regenerating preferred species in the woodland.

It was learnt in this study however that apart from preferences, some taboos allowed people to use only certain tree species for specific purposes. One respondent in Kasisi village told the researcher that they used only *Combretum collium* and *Combretum zeyheri* for firewood and are not allowed by taboos to use *Azelia quanzensis*.

### **3.5 Community awareness of miombo management**

On probing the community awareness of miombo management interventions in the study area, 52% of the respondents said that they knew how the Urumwa woodlands were managed. The village from where the respondents came had a significant effect ( $\chi^2 = 12.9$ ,  $p < 0.05$ ) on the answers. In Kikungu village understanding of management was low (29%) compared to 36% at Kipalapala Mashariki, 56% at Kasisi, 62% at Pangale and 68% at Mtakuja. Whether a respondent was male or female also significantly influenced a respondent's knowledge of Urumwa management ( $\chi^2 = 7.28$ ,  $p < 0.05$ ), with more male respondents (61%) claiming to know how Urumwa miombo was managed, compared to only 38% of female respondents.

Fifty five percent of respondents claimed that the Urumwa miombo woodlands were under management of the government only as it is a government reserve, while 21% said that communities around the reserve were involved in the management decisions. Twenty four percent of the respondents were not aware of who managed these woodlands and to them Urumwa was an open access resource. In the group meetings village leaders and a few villagers appeared to be better informed on management of the woodland than the majority of respondents. It was learnt in the group meetings that some villages (Kipalapala Mashariki, Mtakuja and Pangale) were already involved in a Joint Forest Management (JFM) programme and had been allocated coupes of sizes ranging from 5 to 12 ha. Although most of the respondents were not well informed on the coupe system, some respondents explained that permission to cut trees for various uses was granted by the chairperson of a woodland management committee. Any villager who wanted wood was shown an area from where to harvest and was only allowed to use hand or cross cut saws provided to the village by the

Forest Resources Management Project to cut trees at a recommended height from the ground. Most women could not tell where their village coupe was located in the reserve.

Only 39% of respondents claimed to have heard about the existence of village miombo woodlands management committees but they said that the committees were not functional. This was confirmed by the majority of respondents (69%) who did not know the role played by the communities in the management of the Urumwa miombo woodland reserve and only 31% claimed to know. Out of those who claimed to know the role of villagers in the management of the Urumwa miombo, 29% said that their role was to guard and protect and 2% said their role was to utilise the woodlands.

The villages surveyed lacked clear bylaws on land and tree ownership, utilisation and management of trees and woodlands. Fifty two percent of the respondents did not know the existence of any bylaws in their villages and only 48% said that they knew they existed. When questioned further as to what kind of rules and regulations existed, the respondents mentioned fines for being found with illegal woodland produce or confiscation of the produce. In these cases however, they were referring to laws enforced by the foresters, not bylaws governing ownership, use and management of trees and woodlands within their communities.

### **3.6 Trees left on farms**

Eighty six percent of respondents said that they left some tree species uncut on their crop fields (Table 11). There was no significant difference between villages ( $\chi^2=8.69$ ,  $p>0.05$ ) and gender groups ( $\chi^2=2.88$ ,  $p>0.05$ ) in responding to this question.

Twenty two different tree species were mentioned, the most common being *Pterocarpus angolensis*, *Vitex mombassae*, *Brachystegia spiciformis*, *Terminalia sericea*, *Azelia quanzensis*, *Strychnos cocculoides*, *Brachystegia boehmii*, *Pterocarpus tinctorius* and *Julbernardia globiflora*, in that order. Various reasons were given by the respondents for leaving trees uncut in their farms, and these included: trees protected by law, for shade, fruits, timber and poles, medicines, spiritual trees and for soil improvement. Some trees were left on farms simply because they were too big or hard to cut down. Thirty three percent of mentioned trees were edible fruit trees. Participants in the group meetings explained that

normally trees left on farms belonged to the person cultivating the land even though they did not have title deeds to the land. The fact that other people could not cut a tree from neighbours was a matter of respect in the community, but they had no formal right of exclusion.

**Table 11:** Trees left on farms in the five villages surveyed in Tabora, Tanzania (n=154).

Species	Percent of responses <sup>4</sup>	Tree uses
<i>Azelia quanzensis</i>	19	Timber
<i>Albizia amara</i>	5	Fuelwood
<i>Berchemia discolor</i>	5	Fruits
<i>Brachystegia boehmii</i>	18	Fibres, beehives
<i>Brachystegia spiciformis</i>	27	Fuelwood, shade, soil fertility
<i>Cassia abbreviata</i>	2	Medicine
<i>Dalbergia melanoxylon</i>	8	Protected tree, poles
<i>Erythrophloeum africanum</i>	5	Timber, poles
<i>Ficus</i> spp.	2	Spiritual
<i>Julbernardia globiflora</i>	14	Fibres, fuelwood, shade
<i>Parinari curatellifolia</i>	10	Fruits
<i>Pericopsis angolensis</i>	10	Poles
<i>Pterocarpus angolensis</i>	49	Timber, protected tree
<i>Pterocarpus tinctorius</i>	15	Timber, shade
<i>Sterculia quinqueloba</i>	8	Timber
<i>Strychnos cocculoides</i>	19	Fruits
<i>Strychnos innocua</i>	2	Fruits
<i>Swartzia madagascariensis</i>	1	Timber, poles
<i>Tamarindus indica</i>	4	Fruits, shade
<i>Terminalia sericea</i>	21	Poles, medicine, shade
<i>Vitex doniana</i>	10	Fruits
<i>Vitex mombassae</i>	39	Fruits, medicine

<sup>4</sup> Percentages in Table 11 do not sum up to 100% because the responses were not mutually exclusive. As such the reported percentages indicate that a species is either protected on farm alone or with some other species.

### 3.7 Tree planting by households

In this study 69% of the respondents planted trees of various species. Fruit trees were planted by 32% of the respondents, mainly *Carica papaya* (papaya), *Citrus sinensis* (orange), *Mangifera indica* (mango) and *Psidium guajava* (guava). Other trees planted mainly for fuelwood, building poles and shade were *Acacia crassicarpa* (2% of responses), *Eucalyptus* spp. (33%) and *Senna* spp. (27%). Timber trees such as *Azelia quanzensis*, *Grevillea robusta* and *Pterocarpus angolensis* were planted by 4% and fodder trees were planted by 5% of respondents. Thirty one percent of the people interviewed did not plant any trees. There was no significant difference between villages in respondents' involvement in tree planting ( $\chi^2 = 9.06$ ,  $p > 0.05$ ). Gender had a significant effect ( $\chi^2 = 5.6$ ,  $p < 0.05$ ) on tree planting however,

with more men (76% of male respondents) than women (58% of female respondents) planting trees.

Tree planting in semi-arid areas such as Tabora is hampered by a number of climatic and ecological factors but most of the people who planted trees (67%) experienced no major problems. The other 33% of tree planting households had difficulties with the survival of the trees where planted, due to drought, insects, fire, lack of expertise, termites. Seed unavailability was also mentioned as one of problems hindering tree planting in the studied villages (Fig. 5). Of these drought stress, insects and termite attack were the major problems. Termites were mentioned separately from other insects due to their predominance in the miombo woodlands and also the villagers were distinguishing them from other insects which attack seedlings.

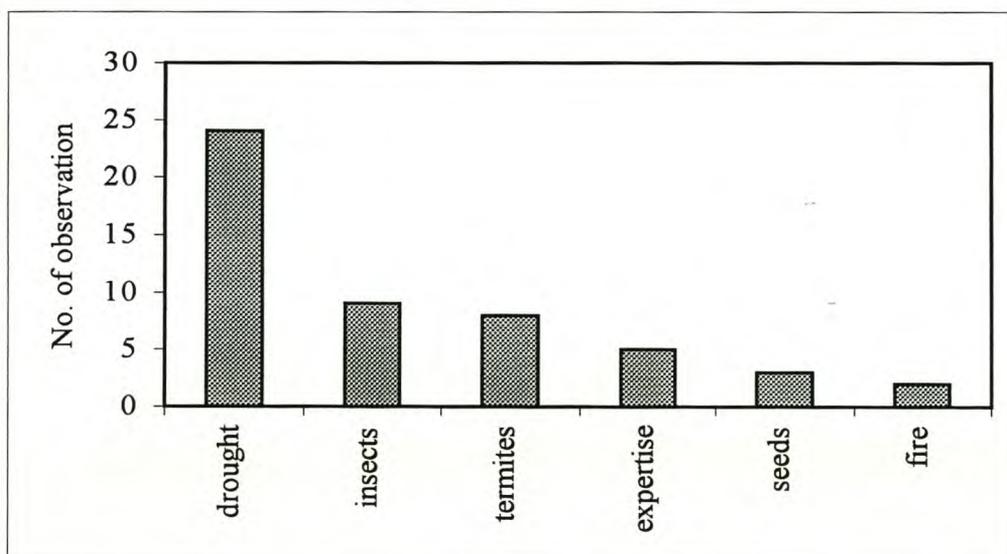


Fig. 5: Problems with tree planting in the five studied villages of Tabora, Tanzania.

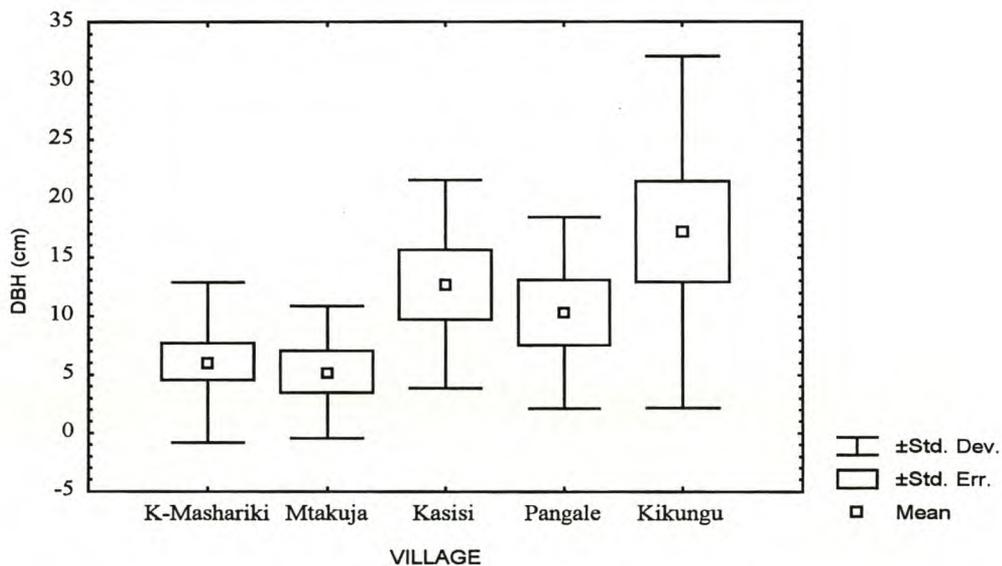
### 3.8 *Assessment of the miombo resources*

This section presents results based on the simple inventory survey of species diameter distribution, number of stems per hectare and species composition in the studied villages. The results presented here only give an indication of the availability of the miombo resources in the studied area. The number of transects and sample plots per village were not enough to give any valid statistical inferences and a detailed inventory was beyond the scope of this study. Village location and distance from the miombo were assumed to be independent

variables affecting the number of stems per hectare, mean diameter of stems and miombo tree species composition in the studied villages.

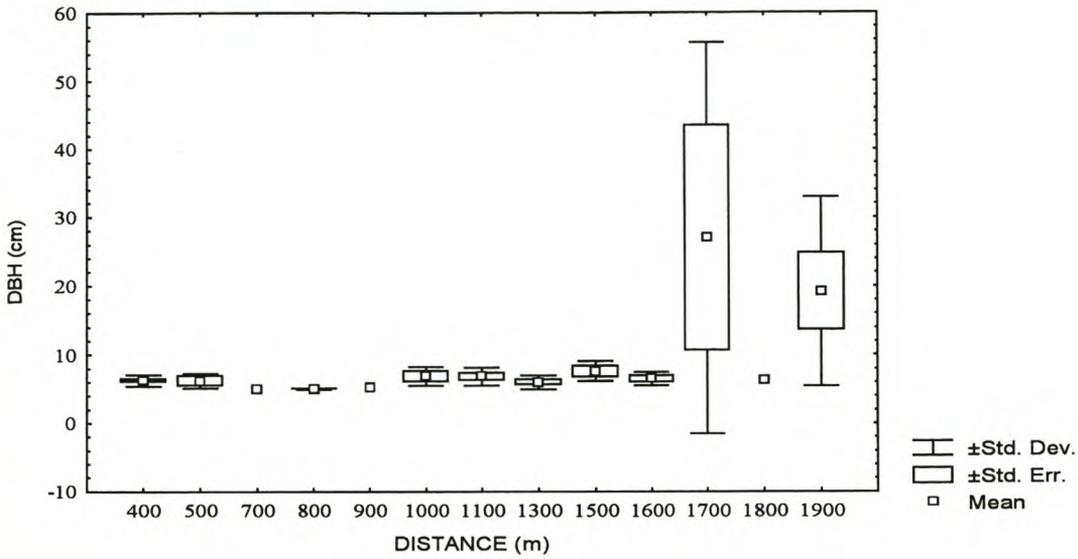
### 3.8.1 Diameter distribution

Mean diameter of trees was significantly different ( $F=3.39$ ;  $df= 4$  and  $53$ ;  $p<0.05$ ) between village transects. Larger mean diameters (17.1 cm) were found next to Kikungu village compared to the rest of the villages (Fig. 6). Stem size generally increased as distance increased from Tabora town. In determining resource availability relative to proximity to the village, proximity had significant effect on mean diameter distribution in woodlands next to Kipalapala Mashariki ( $F=9.8$ ;  $df=1$  and  $50$ ;  $p<0.05$ ). Generally trees were smaller within 1.6 km towards the Urumwa Reserve, and the change was irregular there after (Fig. 7).

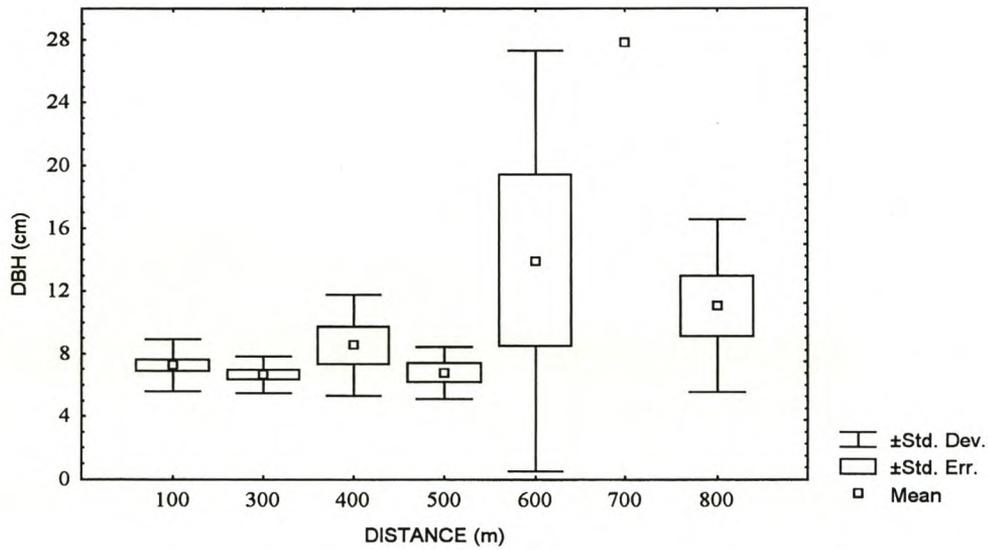


**Fig. 6:** Mean diameter at breast height (DBH) distribution in the five studied villages of Tabora, Tanzania

Distance had no significant effect on diameter distribution in woodlands adjacent to Mtakuja village ( $F=2.53$ ;  $df=1$  and  $22$ ;  $p>0.05$ ). Mean tree diameter changed significantly in woodlands close to Kasisi village as distance increased towards the Urumwa Reserve ( $F=8.84$ ;  $df=1$  and  $61$ ;  $p<0.05$ ). Figure 8 presents diameter distribution along the Kasisi village transect. There was no significant difference in mean diameter distribution as one moved from Pangale and Kikungu villages towards the Urumwa Reserve ( $F=0.83$ ;  $df=1$  and  $19$ ;  $p>0.05$ ) ( $F=3.2$ ;  $df=1$  and  $37$ ;  $p>0.05$ ) respectively.



**Fig. 7:** Mean diameter (DBH) change relative to woodland proximity to Kipalapala Mashariki village in Tabora, Tanzania.



**Fig. 8:** Mean diameter (DBH) change relative to woodland proximity to Kasisi village in Tabora, Tanzania.

### 3.8.2 Mean number of stems per hectare

The mean numbers of stems per hectare in the five studied villages are presented in Fig. 9. The mean number of stems per hectare was significantly affected by the location of a village ( $F=4.41$ ;  $df= 4$  and  $53$ ;  $p<0.05$ ). The first three villages, Kipalapala Mashariki (7 km from Tabora), Mtakuja (12 km) and Kasisi (23 km) had the lowest mean numbers of stems

per hectare. The two villages furthest from Tabora (Pangale and Kikungu), located at 35 km and 43 km respectively had a relatively high mean number of stems per hectare. In Kikungu village, a larger area has been cultivated and grazed for the past 20 years resulting in scattered big trees at low density but still higher than the first three villages. Regenerating *Combretum* woodland covered a large part of the area next to Pangale village.

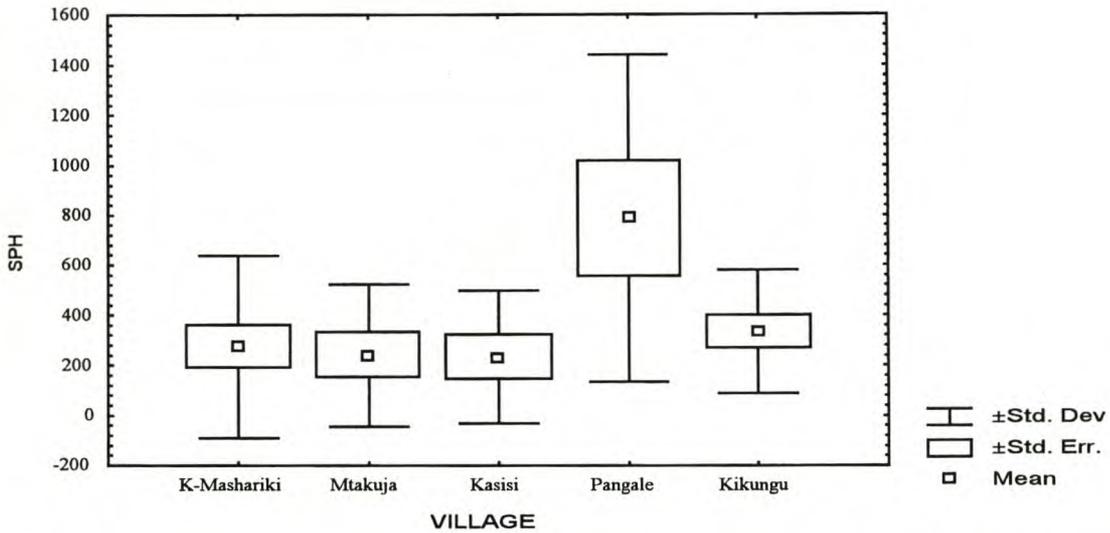


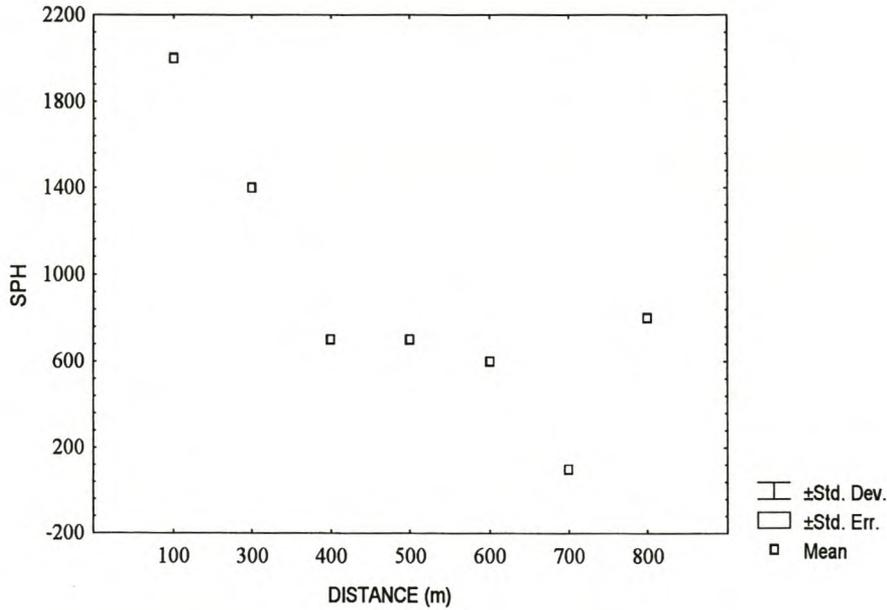
Fig. 9: The mean number of stems per hectare (SPH) in the five studied villages of Tabora, Tanzania.

Woodland proximity to the village location did not have any significant effect on the number of stems per hectare in woodlands next to Kipalapala Mashariki and Mtakuja ( $F=0.65$ ;  $df=1$  and  $11$ ;  $p>0.05$ ) ( $F=0.19$ ;  $df=1$  and  $3$ ;  $p>0.05$ ) respectively. Likewise, the number of stems per hectare in woodlands adjacent to Kasisi village was not significantly affected by the distance towards the Urumwa Forest Reserve ( $F=0.91$ ;  $df=1$  and  $6$ ;  $p>0.05$ ). While distance from Pangale village towards the Urumwa Reserve had significant effect on the number of stems per hectare ( $F=11.08$ ;  $df=1$  and  $5$ ;  $p<0.05$ ), there was none in woodlands adjacent to Kikungu village ( $F=0.81$ ;  $df=1$  and  $9$ ;  $p>0.05$ ). The change in number of stems per hectare relative to woodland proximity to Pangale village is shown in Figure 10. There were more stems per hectare close to this village than there were with increase in distance towards the Urumwa Reserve.

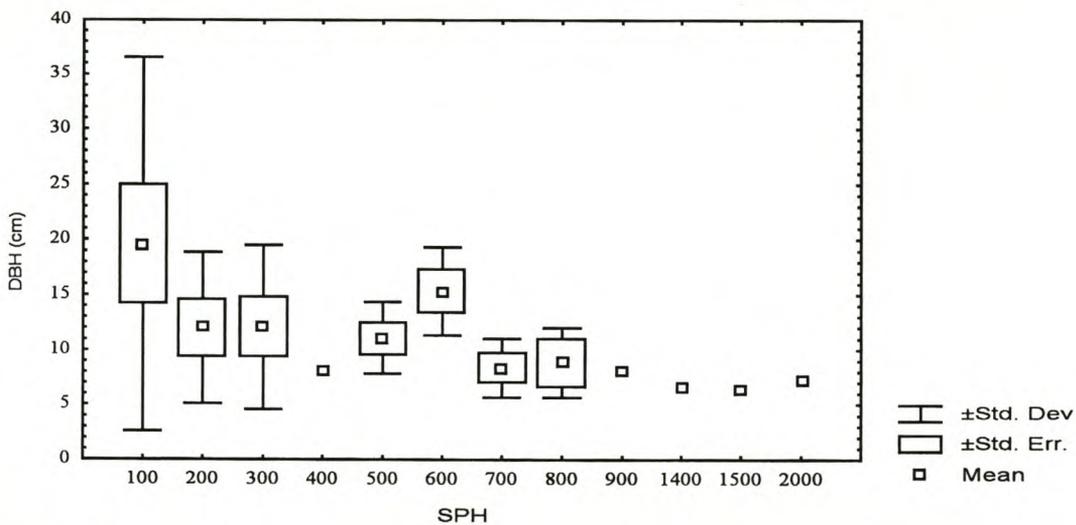
### 3.8.3 Relationship between the number of stems per hectare and stem diameter distribution

The number of stems per hectare were significantly positively correlated with the stem diameters at breast height ( $r=0.47$ ;  $p<0.05$ ;  $n=58$ ) in the studied villages. There were fewer

larger trees per hectare in old regrowth and many small stems in young regenerating miombo (Fig. 11). Most of stems in the woodlands adjacent to the studied villages had diameters ranging from 5-10 cm (Fig. 12). Where tree cutting was intense, only a few big scattered trees were recorded. Very little regeneration was observed under big crowns, but no crown diameter measurements were made in this study to determine the relationship between crown diameter and regeneration.



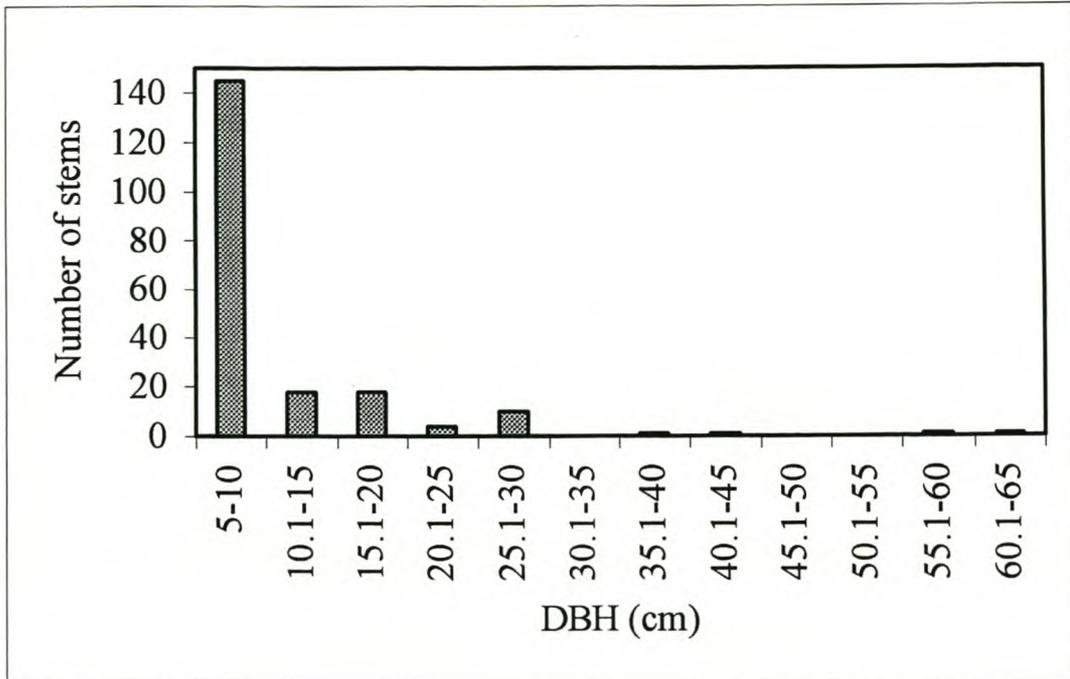
**Fig. 10:** Change in number of stems per hectare (SPH) relative to woodland proximity to Pangale village in Tabora, Tanzania.



**Fig. 11:** The mean number of stems per hectare (SPH) and mean stem diameter (DBH) distribution in the five villages of Tabora, Tanzania.

**Table 12:** Miombo species percentage composition in the five villages of Tabora, Tanzania.

SPECIES	VILLAGE				
	K_MASHARIKI	MTAKUJA	KASISI	PANGALE	KIKUNGU
<i>Acacia nilotica</i>	-	-	-	-	3
<i>Acacia polyacantha</i>	-	-	-	-	3
<i>Albizia amara</i>	6	-	-	-	-
<i>Albizia antunesiana</i>	4	-	-	-	-
<i>Albizia brachycalyx</i>	-	-	5	-	3
<i>Brachystegia boehmii</i>	4	-	5	2	3
<i>Brachystegia spiciformis</i>	-	-	5	2	3
<i>Combretum collium</i>	6	-	5	2	5
<i>Combretum fragransi</i>	-	-	-	23	3
<i>Combretum molle</i>	-	9	-	6	2
<i>Combretum zeyheri</i>	2	9	60	19	38
<i>Commiphora eminii</i>	2	9	-	-	-
<i>Commiphora sp.</i>	2	-	-	2	3
<i>Crossopterix febrifuga</i>	-	18	-	-	-
<i>Dalbergia melanoxylon</i>	-	-	-	-	5
<i>Dalbergia nitidula</i>	-	-	-	-	5
<i>Dichrostachys cinerea</i>	-	5	-	15	-
<i>Diplorhynchus condylocarpon</i>	2	31	5	7	7
<i>Hymenocardia mollis</i>	-	5	-	-	-
<i>Julbernardia globiflora</i>	23	-	10	-	10
<i>Lannea schimperi</i>	2	-	-	-	3
<i>Lonchocarpus capassa</i>	2	-	5	2	-
<i>Ostryoderis stuhlmanii</i>	2	-	-	-	-
<i>Ozoroa insignis</i>	2	-	-	-	-
<i>Pericopsis angolensis</i>	-	-	-	6	-
<i>Phyllanthus discoides</i>	-	-	-	3	-
<i>Pseudolachnostylis maprouneifolia</i>	-	-	-	5	-
<i>Pterocarpus angolensis</i>	2	4	-	-	2
<i>Pterocarpus tinctorius</i>	-	-	-	2	-
<i>Strychnos innocua</i>	-	9	-	-	-
<i>Strychnos pungensi</i>	4	-	-	-	-
<i>Terminalia sericea</i>	29	-	-	2	2
<i>Terminalia tollurosa</i>	4	-	-	2	-
<i>Vitex doniana</i>	2	-	-	-	-



**Fig. 12:** The relationship between absolute number of stems and diameter in the woodlands adjacent to the five villages of Tabora, Tanzania.

#### 3.8.4 Tree species composition

Tree species composition in the study area is presented in Table 12. A total of 34 different miombo species were recorded in this study, with composition varying significantly between the five villages surveyed ( $\chi^2=309.56$ ,  $p<0.05$ ). The woodlands were most diverse next to Kipalapala Mashariki village where 18 different species were recorded. The most abundant tree species in this village were *Terminalia sericea* (29%) and *Julbernardia globiflora* (23%). There were 17 miombo tree species recorded in Kikungu village with most abundant tree species being *Combretum zeyheri* (38%) and *Julbernardia globiflora* (10%). Sixteen different tree species were recorded in Pangale village. Tree species with high composition in this village were *Combretum fragransi* (23%), *C. zeyheri* (19%) and *Dichrostachys cinerea* (15%). There were only nine different tree species encountered in the Mtakuja transect survey and of these, *Diplorhynchus condylocarpon* (31%) and *Crossopterix febrifuga* (18%) were the most common. Kasisi village was found to have only eight different tree species and here *Combretum zeyheri* (60%) and *Julbernardia globiflora* (10%) were the most abundant.

## 4. DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

### 4.1 *Miombo uses*

#### 4.1.1 Products and services

The villagers in the surveyed area are aware of the importance of the miombo woodlands adjacent to their villages. People in these villages depend entirely on miombo woodlands for their wood and some non-wood product requirements. Researchers elsewhere agree that, throughout the miombo region the woodlands supply many products and services essential to the wellbeing of rural communities (Grundy, 1990; Tuite and Gardiner, 1990; Clarke *et al.*, 1996; Dewees, 1996). Communities in the studied area have used miombo for firewood, charcoal, building poles, medicines, food (fruits, mushrooms, wild vegetables, honey, insects and wild game), timber, fodder, thatching grass, fibre and for cropping. Similar uses have been reported by other authorities in the miombo ecozone and other savanna woodlands (Campbell, 1987; Chidumayo and Siwela, 1988; Campbell *et al.*, 1993; Grundy *et al.*, 1993; Clarke *et al.*, 1996; Shackleton *et al.*, 1998; Olsen *et al.*, 1999). Local communities in Tabora assign different uses to different species but with some overlap, especially when a species has multiple uses. Campbell *et al.* (1993) showed that farmers in communal areas of Zimbabwe, like those in the study area, also had a broad knowledge of trees and their products. Similarly a study by Munyanziza and Wiersum (1999) on indigenous knowledge of miombo trees elsewhere in Tanzania revealed that although local communities had little knowledge of identifying miombo seedlings, they had a broad knowledge of utilisation.

Miombo woodland in Tanzania is estimated to contribute 60-70% of the annual amount of wood consumed as firewood (Brigham *et al.*, 1996). Firewood and charcoal are the main sources of energy in Tabora rural and urban areas. Firewood in the studied villages is used for cooking and heating, tobacco curing, brick burning (Plate 1), fish smoking, local beer brewing and metal works. Depending on availability, local people have their own selection criteria for the best tree species for firewood. Favoured characteristics by respondents, who still had strong preferences for best firewood in this study, were good burning and heating qualities, producing hot coals, no irritating smoke, and not too much ash.

Wood should not be too heavy or difficult to split. Hot flame, minimal smoke and long-lasting coals were also the most favoured characteristics by communities for preferred tree species for firewood in Malawi (Lowore *et al.*, 1995).



**Plate 1:** Brick burning near Pangale village adjacent to Urumwa Forest Reserve in Tabora, Tanzania.

It was found in this study that the use of charcoal in rural areas of Tabora was low compared to suburban areas. The main reason might be the long process required in making charcoal as well as labour requirement for cutting wood, piling, burning and packing as opposed to firewood collection. In addition the use of charcoal requires special stoves which are an added cost to rural life. People closer to Tabora town in Kipalapala Mashariki therefore used charcoal more; a village that is more influenced by urban life style than the other villages studied. Although a number of charcoal earth kilns were seen during the transect survey (Plate 2), it was learnt that most of the charcoal produced in the Urumwa miombo woodlands was sold to Tabora town where it was also transported to neighbouring regions of Shinyanga and Mwanza. Transport of these products, normally by trucks, was done at night to avoid the foresters who patrolled during the day along the Tabora to Sikonge road (Pers. obs.).



**Plate 2:** A charcoal kiln near Kikungu village adjacent to Urumwa Forest Reserve in Tabora, Tanzania.

House construction materials recorded in this study included poles, traditional ropes and thatching grass, making their supply an important function of miombo woodlands in Tabora rural areas. People throughout the miombo region select tree species for poles which are of different dimensions, durability and resistance to decay (see Grundy, 1990; Cunningham, 1993; Lowore *et al.*, 1995; Clarke *et al.*, 1996). Due to scarcity of suitable trees for poles in the study area, some people reported to prefer using mud bricks for house construction and used wood only for roofing. Building poles were the first priority product from the woodlands adjacent to the studied villages and this confirms a claim by Olsen *et al.* (1999) that local communities will only put a product as their first priority if it is the immediate option for solving their problems. Only four species: *Combretum collium*, *C. molle*, *C. zeyheri* and *Terminalia sericea*, out of ten miombo tree species that were mentioned to be the best for poles, were found to be abundant in the inventory survey however. Most of

suitable trees for building poles were not easily available in woodlands close to these villages. Traditional ropes are used frequently and almost every day by communities in the study area for house construction and tying of firewood head loads. More men harvested bark for ropes than women. Kessy (1998) reported that although local people in the Usambara Mountains of Tanzania used traditional ropes frequently, there were changes to using alternative tying materials such as nails and sisal fibres due to strict access rules for the forests. Local people in the miombo of Tabora harvest ropes when trees have new shoots and these ropes can be stored for future use. Stored dry ropes must be soaked in water if they are to be used (Pers. obs.). Traditional ropes were used more in other villages than Kipalapala Mashariki, whose respondents showed least dependence on traditional ropes. This indicates a greater influence of the town and the use of alternative tying materials in this village. Villagers in Mutanda area of Zimbabwe were seen to manage the use of trees for rope by lopping the ends of branches rather than cutting the whole tree (Grundy *et al.*, 1993) but this was not observed in the study area.

Thatching grass is an important roofing material in the rural areas of Tabora, perhaps because corrugated iron sheets are expensive. However another reason may be because it is easily obtained in the miombo and has a cooling effect in the hot dry season. While there was no significant difference between villages in thatching grass collection in the studied area, more men collected thatching grass than women in the Urumwa woodlands. The fact that more men claimed to obtain traditional ropes and thatching grass from the woodlands adjacent to the studied villages indicates that house construction in Tabora rural areas is normally done by men rather than women.

The majority of respondents in this study claimed to use miombo tree species for medicinal purposes. Traditional medicine collection from the woodland and forest reserves in Tanzania is one of the activities for which the Forest and Bee-keeping Division does not charge any royalty fees. In the rural areas of Tanzania the reliance on traditional medicines compared to modern treatments is substantial due to scarcity of hospitals and dispensaries, lack of medicines and the associated costs (Kessy, 1998). Katambo (1999) estimated that about 60% of miombo trees and other plant species in the Tabora woodlands have medicinal value. Respondents in this study however claimed that almost all miombo trees have medicinal properties and that their use and preference depends on the knowledge of the user of the particular species as well as the number of diseases it cures. In addition, apart from

modern medicine being expensive, certain diseases were only cured by using traditional medicine. A need for these latter medicines is likely to continue even though scarcity of miombo resources may in future force villagers to rely more heavily on modern medicines. A total of about 19 miombo tree species were frequently used for medicine in the surveyed villages of Tabora. Some attempts at sustainable harvesting of medicinal plants were encountered where the villagers explained that, after digging roots for medicine, they buried the tree stump to allow new root growth. Katambo (1999) recorded some rules observed by medicinal plant collectors in Tabora, whereby only one piece of bark was harvested from either east, west, south or north side of the tree. The collectors also believed that by leaving the dug roots uncovered it was like making a grave for the patient they were going to attend so the soil must be returned to cover the roots. Similar protocols governing the harvesting of medicinal plants exist in communal areas of Zimbabwe where, to promote sustainability, bark was collected from the east or west side of a tree only (Campbell *et al.*, 1993).

Miombo woodlands adjacent to the studied villages are important sources of various foods. One of the food products obtained from these woodlands is wild fruit and 17 different species were mentioned throughout this survey. Wild fruits have been reported to form an important part of the human diet elsewhere in the miombo region (Campbell, 1987; Chidumayo and Siwela, 1988; Saka and Msonthi, 1994). At least 33 fruit tree species were reported to be used by local communities in Zambia, mainly from wetter miombo (Chidumayo and Siwela, 1988). An account on the nutritional value of edible wild fruits of the miombo has been given by Saka and Msonthi (1994) in Malawi, where highest levels of protein, fat, fibre, ash and carbohydrates were obtained from *Trichilia emetica*, *Strychnos spinosa*, *Azanza garckeana*, *Ximenia caffra* and *Parinari curatellifolia* species. Two of the fruit tree species reported from Malawi, *Strychnos spinosa* and *Parinari curatellifolia*, were recorded in the present study as well.

Timber production has always been the Department of Forestry's main objective of miombo management in Tanzania, but communities in this study area put it as third priority. Olsen *et al.* (1999) in their survey of some villages in Iringa, Tanzania also found that to the rural people the distinction between timber and non-timber products is of minor importance. As found in this study, timber was ranked very close to medicine and food. Another reason for putting timber as low priority perhaps is the fact that extraction of these products from the protected woodlands has always been illegal, and most people have operated without licenses.

In Tanzania harvesting of commercial timber tree species is controlled by the government and the Forest Department issues all licences. Most rural people however are not benefiting from timber harvesting as the conditions attached to a harvesting licence are that the minimum volume of wood must be 10 m<sup>3</sup> which costs an equivalent to USD 270. This high cost tends to exclude the majority of the rural poor from timber trade and it is only rich people from outside these villages who benefit from timber trade in Tabora. However this study showed that more people in Kipalapala Mashariki village used the miombo woodlands of Urumwa for timber harvesting than the rest of studied villages perhaps due to the closeness to Tabora town. According to most respondents, important timber tree species in the area have been depleted, indicating that the potential of the Urumwa woodland as a source of timber has been reduced. However timber is still important for making doors, windows and furniture in houses. Of the species mentioned by villagers as best for timber, only *Pterocarpus angolensis* (2.7% average composition) and *Brachystegia spiciformis* (3%) were encountered in the transect surveys, suggesting low availability of these species. There is a clear indication of depletion of important timber species in the miombo woodlands of Tabora compared to about four decades ago, when Boaler (1966b) estimated the composition of *P. angolensis* at 8% in 16 miombo sites in Tanzania. Due to scarcity of *P. angolensis* and other preferred species for timber in these villages, alternative tree species such as *Sterculia quinqueloba* and *Albizia antunesiana* are now being used. It was surprising to find that people used *S. quinqueloba* species for timber despite the fact that it is soft wood, and this requires further research. Suitable management and silvicultural techniques to promote regeneration of *P. angolensis* and other important timber species in the miombo of Tabora are of paramount importance. The distribution of absolute number of stems and diameter of all live trees recorded in this survey has shown that most of the trees are smaller than the normal recommended minimum diameter of 30 cm by the Department of Forestry for any tree to be harvested for timber processing. Earlier observations in Tabora had shown that most of the confiscated timber in the Forest Department was of small sizes with large portions of sapwood (Pers. Obs.). These results confirm earlier findings by Temu (1979b) that the Tabora miombo woodlands have become more important as a source of fuelwood than of timber.

Miombo is the best source of fodder during the dry season and local communities in the region understand which miombo species are suitable for livestock (Tuite and Gardiner, 1990; Campbell *et al.*, 1993). In Zimbabwe, the older leaves of *Brachystegia spiciformis* are reported to be unpalatable to cattle but leaves are often eaten when the trees have a new flush

or when the animals have no alternatives (Grundy, 1995). Respondents in this study also mentioned *Brachystegia spiciformis* as a source of browse for livestock. The inventory survey indicated a low percentage composition of this species, which might be as a result of grazing among other factors. However the *Nyamwezi* people, who are the dominating ethnic group in Tabora, are not traditionally cattle herders but rather beekeepers (see Lawton, 1982). Most cattle herders in the studied area belong to the *Sukuma* tribe who came from the northern region of Shinyanga and settled in the miombo woodlands of Tabora in search of pastures. Much of the deforestation and encroachment for settlements and agriculture in the region is reported to have been done by pastoralists (FRMP, 1997). The effect of animal browse on the miombo of Tabora has not yet been studied. However it seems important to incorporate grazing in the management of Urumwa miombo as it may have the same effect on species composition as frequent fires (see Chidumayo, 1988; Grundy, 1995).

The value of miombo woodlands to agricultural production cannot be over-emphasised. These woodlands are dominated by the tree species of the legume family Caesalpiniaceae, most of which form mycorrhizal associations and fix soil nitrogen (Högberg and Pearce, 1986). Traditionally the farming systems in the miombo have been dominated by shifting cultivation as a strategy to obtain fertile soils under miombo cover but this system has become practically impossible under the village system (see Lawton, 1982). Few respondents mentioned miombo as important in soil improvement and this confirms results obtained in Zimbabwe where local people were also found not to perceive a role for miombo trees in soil fertility improvement (Campbell *et al.*, 1991; Grundy *et al.*, 1993). At present in Tanzania, farmers use livestock manure and chemical fertilisers to improve crop yields, while for tobacco cultivation they practice the fallow system as well. Only one farmer in Kipalapala Mashariki village said that the regeneration of *Brachystegia* and *Julbernardia* on his farm improved soil fertility through litter decomposition. Like Zimbabwe (see Grundy *et al.*, 1993), the importance of miombo trees in soil improvement was not one of the major reasons for protecting trees on farms in the villages of Tabora. Transfer of miombo litter to cultivation areas was also not observed in this study. Here villagers differ from their counterparts in Zimbabwe where local communities have been reported to use miombo litter for soil fertility improvement (Nyathi and Campbell, 1993).

There is some ecological knowledge within the local communities of Tabora on the role of miombo woodlands on climate amelioration. Some respondents explained that about

three decades ago when most of the hilltops were still covered by thick miombo, rainfall was not a problem in their villages. Recently there have been severe drought periods in these areas, thought to be due to severe reduction in vegetation cover. This kind of knowledge was also recorded by Olsen *et al.* (1999) in villages of Iringa region of Tanzania, where people had rainfall as their first priority benefit obtained from the miombo.

#### 4.1.2 Use of miombo products for income generation

All miombo products mentioned by the respondents in this study have been traded in one way or another, both in the village and urban markets. However few respondents claimed to use miombo for income generation, with more positive responses from Mtakuja and Kipalapala Mashariki, villages which are much closer to Tabora town than the rest of surveyed villages. Most interviewed people may have been hesitant to say if they earned income from sales of miombo products because the Forest Department regards most activities in the Urumwa woodlands as illegal since most villagers harvest wood products without permits. According to Brigham *et al.* (1996), the sale of woodland products for the majority of people in the miombo ecozone is one of the strategies to meet specific cash needs, as a contingency in case of crop failure. Like in this study, those who traded miombo products explained that they depended on income from the miombo especially during years of low crop yields, and observations indicated that people were busy harvesting woodland products during the dry season when they were not involved in agriculture. The woodland products trade supports large and small-scale enterprises and has been reported to be a major employer in some African countries (Brigham *et al.*, 1996). Use of woodland products by communities for income generation has been reported elsewhere (Campbell, 1987; Chidumayo and Siwela, 1988; Shackleton *et al.*, 1998; Olsen *et al.*, 1999) but depends on the proximity to the market. Grundy *et al.* (1993), working in a remote area of Zimbabwe, recorded no evidence of trade in fuelwood or construction wood and no household mentioned sale or purchase of wood.

Despite the fact that people claimed to earn income from selling miombo woodland products, most prices mentioned by the respondents were quite low and there is no doubt that the income obtained cannot sustain rural livelihoods. There is a need to carry out marketing research on these products so that the extraction and trading of the miombo products in Tabora is both economical and sustainable in alleviating the problem of poverty in rural areas.

#### 4.1.3 Cultural and religious uses of miombo woodlands of Tabora

It has been observed in this study that the use of miombo woodlands for cultural and religious purposes has declined over the years. The influence of external cultures and changing policies are major causes of this decline. These influences included mainly the ever-increasing heterogeneity due to human immigration to Tabora, the abolishment of Chiefdoms soon after independence and increased urbanisation. Unless efforts are made to preserve these traditions, the value of miombo for cultural and spiritual uses will disappear within the *Nyamwezi* communities. Clarke *et al.* (1996) observed that religious and cultural customs related to the use of woodland areas and some tree species are vital to the spiritual wellbeing and functioning of the rural people in Zimbabwe. Traditional rules and taboos can be instrumental in biodiversity conservation, as sacred forests have been seen to remain untouched outside government forest reserves (Pers. obs.). Likewise, Gumbo (1993) reported that enforcement of traditional rules led to conservation of miombo fruit trees in communal areas of Zimbabwe.

#### 4.2 *Where people harvest miombo resources*

The majority of respondents obtained their wood resources from the miombo woodlands. Most respondents denied entering the Urumwa Forest Reserve although it was clearly observed during resource assessment transect walks. They claimed to have obtained their wood resources from village and private woodlands only. Local people bitterly described the conflicts existing with the foresters in the area over the use and access to the Urumwa protected miombo reserve. Most villagers have been caught with produce which was obtained illegally from the woodland, and some of them fined or had their produce confiscated, while others complained of being harassed when found inside the reserve. This type of conflict can provide an ideal opportunity for the introduction of a Joint Forest Management (JFM) project in the studied villages. The miombo reserve of Urumwa is still a State reserve and the management is purely for protection, but this woodland has turned into an open access resource because people outside the reserve do not have enough wood resources left on the public land. This is a similar situation to other miombo areas: Campbell *et al.* (1993) claimed that with increased depletion of resources, trees in the communal areas also became an open access resource in Zimbabwe.

### 4.3 *Miombo woodland species utilisation preferences and availability*

Communities in the miombo woodlands of Tabora have species preferences for various uses. Some respondents reported to have changed their preferences towards easily available tree species especially for firewood but they still had strong preferences for building poles despite the scarcity. Tree sizes influence the choice of trees harvested for various uses. Although this study did not record tree sizes used by the respondents, studies in Zimbabwe have shown that people preferred stems with diameters of 2-10 cm for construction poles (Grundy *et al.*, 1993). In Malawi, people preferred poles from trees with diameters greater than 5 cm (Lowore *et al.*, 1995). In this study however no measurements were made of the used wood at the villages. The most preferred tree species for various uses are scarce in the studied villages, and although other communities have changed their preferences to easily available species, those who maintain their preferences utilise trees of smaller sizes from regenerating coppices. As shortages of suitable building poles have persisted in the studied villages, some respondents said that they now use mud bricks for house construction and this indicates strong preferences for building materials compared to other products. For firewood, some villagers claimed to use any combustible materials, indicating that some communities are no longer actively selecting species for firewood, due to scarcity. It was also observed that in some areas people must now cut live trees and dry them for firewood. Taboos and beliefs governing use and preferences for miombo trees for firewood have been reported by some respondents in this study area where only specific species were used in some households; rarely spiritual and fruit trees were mentioned for this purpose. In this study some respondents explained that they used only *Combretum collium* and *C. zeyheri* for firewood and were not allowed by taboo to use *Azelia quanzensis*, for fear of serious consequences. Katambo (1999) reported that some medicinal plants in Tabora were protected from threats of being used as firewood through beliefs and taboos, where the use of such species was thought to bring serious problems to the responsible family. Taboos on use of certain tree species for firewood have been reported to exist also in Malawi (Lowore *et al.*, 1995).

Although some respondents explained that they were still finding species they preferred, others showed concern over the depletion of miombo resources in their villages. However for unknown reasons most respondents were hesitant to describe devastating activities in the miombo woodlands adjacent to their villages. The major causes of the

depletion of miombo resources in the studied villages were said to be illegal harvesting of resources, especially by people from Tabora town making charcoal in the woodlands, and population growth due to the influx of cattle herders. However most respondents did not know whether people from outside their villages were harvesting woodland products from the miombo adjacent to their villages. According to the local communities, commercialisation of miombo resources does not necessarily deplete the resource and the harvesters need not pay a levy at the village level since they pay taxes to the Forest Department. Agricultural expansion and forest fires were mentioned as minor causes of woodland depletion because communities in the studied villages have changed their farming systems from the old shifting cultivation to a more permanent type of agriculture, with fallow systems practised to some extent (see Lawton, 1982). A study by Olsen *et al.* (1999) in the Iringa region of Tanzania reported causes of reduction in quality and quantity of tree and woodland resources as being population growth, expansion of cultivation and the growing demand for land and woodland products. Like in Tanzania, Grundy *et al.*, (1993) reported that opening up of woodlands for agriculture was a major cause of reduction in vegetation cover in Zimbabwe's communal areas.

The studied villages have different levels of understanding of the causes of miombo woodland depletion adjacent to their villages, with villagers closer to Tabora town having more understanding than the rest. It was found in the transect survey that woodland in the vicinity of these villages had smaller diameter distributions and fewer numbers of stems per hectare, an indication of wood resource scarcity. Awareness seems to be linked with increased demand for resources. Apart from resource availability, low response to this question in other villages may be due to an unwillingness to show any interest in the reserve for fear of being implicated in its destruction.

#### **4.4 *Community participation in woodland management***

Communities which depend on forest and woodland resources for their livelihood have fought for their right to participate in decisions concerning the use of their resources (Misana *et al.*, 1996). This study has shown the importance of miombo woodlands of Tabora in supplying a variety of products for the welfare of the rural people. As the recognition of this importance has increased, it has become clear that the conventional management approaches to these woodlands can no longer work (Chidumayo *et al.*, 1996). It was found in

this study that rural people valued miombo products and services differently from the way foresters would when drawing up management plans for the woodlands (see Dewees, 1996). Timber production has always been the major focus of the Urumwa Forest Reserve management. In this study building poles were the most important products obtained from the miombo, suggesting that changes are needed for setting management objectives of these woodlands. The fact that local communities make use of miombo around these villages indicates some indigenous knowledge and management. These findings concur with research elsewhere in Africa which has shown that local communities actively manage their miombo resources next to their villages (Grundy, 1990; Campbell *et al.*, 1993; Grundy *et al.*, 1993; Gumbo, 1993; Grundy, 1995; Lowore *et al.*, 1995). There is a growing need to involve local communities in the development and protection of the woodlands from which they derive benefits (Pendzich, 1994). This clearly must include the people living near the woodlands, who have the greatest interest in the sustainable management of their resources (Pendzich, 1994; Dewees, 1999).

Currently there is a growing belief that the Tanzanian village is a unique and viable institutional basis for the locally based management of resources (see Wily, 1997). The Tabora Forest Resources Management Project for almost six years since 1993 has been addressing this issue through its extension services. The current Forest Policy of Tanzania aims at empowering local communities to manage their natural resources (MNRT, 1998) with focus on using and strengthening indigenous knowledge (Dewees, 1996). According to Wily (1997), management of woodlands by local communities has proved to be cost effective from a government viewpoint in Duru-Haitemba and Mgori areas of Tanzania. It has at the same time liberated local foresters from their coercive role and failure to protect the woodlands and they are therefore able to provide better technical advice. Village meetings to create awareness of tree planting, registration of individual woodlands, establishment of village woodland management committees and introduction of Joint Forest Management programmes in this study area have already been initiated. However the concept of community participation in woodland management in the studied villages of Tabora still seems to be new. It was clear from the results that few respondents had any idea about the woodland management interventions in the area, since the only recognised institution managing the woodlands was still the government. Although some respondents have heard about community participation in woodland management in their villages, they were not yet involved in any decision-making. Participation of the local communities in the planning

process for a conservation activity is of great importance and all interested parties must be represented (Bell, 1987; Wily, 1997).

There is a clear indication from the results of this study that earlier efforts to introduce JFM in villages around Urumwa have involved village leaders rather than entire communities. It was learnt in this present study that the village woodland management committees were not functional. Few respondents were aware of the introduction of JFM in their villages and this shows that more extension work is required to make sure each and every stakeholder is involved in decisions regarding the use and management of the woodlands. The Forest Department needs to be keen in introducing community based management of the Urumwa miombo resources by fully empowering the local communities while only providing technical support.

Clear gender roles in woodland use and management were identified in this study. Women's knowledge of the management and utilisation of the miombo resources around their villages was lower than that of men. For women, activities such as tree cutting in the woodlands are associated with men, as women will only collect medicine, fruits, vegetables, mushrooms and firewood. Where firewood collection required felling of live trees, only men cut and piled the wood and women and children carried it to the homestead. As a result, women throughout this study tended to avoid many questions regarding the use of miombo woodlands close to their villages by saying that only men knew about these issues. It was learnt that some villages had been allocated coupes for their wood requirements, however most women were not aware where their village coupe was located in the Reserve.

Participation in resource management and utilisation is not a new paradigm in Tanzania. People have been participating since the *Ujamaa* village programme, which pooled people together to share the resources, but perhaps because of deficiencies in property rights and access to resources, those efforts largely failed. Community forestry and village afforestation programmes have been introduced in the country for the past three decades. The question of equity in benefit sharing is very important, and must be made clear as one proposes community participation in resource management. According to Olsen *et al.* (1999), meeting human basic needs is one of the crucial aspects of welfare and survival, and must be incorporated in the development of any sustainable management programme. Although efforts have been made to demarcate village boundaries in Tanzania, most of them are yet to

be demarcated and this leaves villages with no clear borders so that other people cannot be excluded from utilising the resources around them (Banyikwa, 1991).

In empowering the communities to manage the woodlands adjacent to their villages foresters must ensure that the villagers are given the right of ownership and exclusion of outsiders. Failure to do this will mean that the Urumwa woodland will continue to be overexploited. The differences in socio-economic activities among the communities in the studied villages may complicate the process of involvement and empowerment. Attempts to achieve sustainable management of such diverse resources and interests require careful consideration of the stakeholders (Olsen *et al.*, 1999). Identification of target groups that may successfully undertake the new management strategies is therefore important for introduction of a pilot project and this requires a clear definition of the communities at the beginning (Grundy, 1990). According to Dewees (1996) the necessary re-orientation of miombo management calls for a deeper understanding of the impacts of past measures and practices, combined with equitable devolution of responsibility for natural resources to locally based management groups. These steps together with information on household requirements and improved operation of markets will help to assure the future of the miombo, which will otherwise continue to be degraded and destroyed. Building poles, firewood, timber, medicinal plants and food have been found to be the most important products from the miombo for the rural people in this study area and the management of the Urumwa woodlands must aim at increasing productivity of these products. Grundy (1990) pointed out that for any management scheme to be successful, the needs of the woodland users must be considered first.

#### **4.5 *Trees protected on farm***

Most interviewed people left some trees on their cultivated lands for various purposes despite the lack of clear bylaws and legal land and tree tenure rights. Although this might have created insecurity over tree resources on farms, this did not appear to be the case as trees protected on cultivated areas belonged to the cultivator and people could not cut trees from neighbours due to respect in their villages over other people's resources. Trees were left for shade, fruits, timber, poles, medicine, spiritual and for soil improvement purposes, others were left because the law protects them (e.g. *Pterocarpus angolensis*), or because they were too big and hard to cut. Kajembe (1994) claimed that some tree species were traditionally

protected from cutting in the Dodoma District of Tanzania. In Zimbabwe fruit tree species associated with ancestral spirits and rituals are traditionally protected from cutting (Gumbo, 1993). It has been reported elsewhere in southern Africa that local people have knowledge of the use of numerous tree species and select trees to be left uncut when clearing land for agriculture (Campbell, 1987; Chidumayo and Siwela, 1988; Campbell *et al.*, 1993; Grundy *et al.*, 1993). A total of 22 different tree species were reported to have been protected on crop fields by local communities in Tabora, of which 33% bore edible fruits. Local communities attach substantial value to wild fruit trees in the miombo woodlands (Chidumayo and Siwela, 1988; Gumbo, 1993) to the extent that the availability of some fruit species may not be affected by deforestation (Campbell, 1987). The list of tree species protected on farms as presented in this study may not necessarily provide a full picture of what people said they leave and what they actually practise on the ground. Grundy *et al.* (1993) in their study in Mutanda Resettlement area of Zimbabwe found that *Sclerocarya birrea* was often recorded in cultivated lands, but was not said to be left by respondents. In this present study however no surveys were done in crop fields and this calls for future research.

#### 4.6 Tree planting

The majority of respondents in this study planted trees for various uses. Exotic species like *Eucalyptus*, *Senna* spp. and exotic fruit trees were planted by more households than indigenous species like *Azelia quanzensis* and *Pterocarpus angolensis*. Of the planted exotic tree species, more fruit trees were planted than trees for other purposes. *Eucalyptus* and *Senna* species were planted for construction poles and firewood. These results differ from Grundy *et al.* (1993), who found that their Zimbabwean respondents did not plant even exotic trees for poles or construction purposes. In this study a few households planted Australian Acacias (mainly for firewood) and *Sesbania sesban* for fodder, species which were introduced to these areas during on-farm research trials. Fruit trees like *Mangifera indica*, apart from providing fruit, also provided cool shade in these areas during the hot days of the dry season.

Trees take a long time to deliver benefits and so tree planting represents an act of faith on behalf of the planter (Grundy, 1990). This might explain why people are reluctant to invest in tree planting for other purposes than they do for fruit trees, given the harsh conditions in the miombo. Another reason, although there is no empirical evidence, might be

that the people in these villages plant trees only because of government directives, but they have no culture of tree planting. Most miombo woodland tree species also regenerate profusely after cutting which may contribute to the reluctance to plant trees. Because of this, it is not surprising to find that farmers actively protect indigenous trees rather than planting them. Munyanziza and Wiersum (1999) observed that in Tanzania local people could easily identify mature miombo trees compared to regenerating seedlings, suggesting high indigenous knowledge on utilisation rather than regenerative features of the species. In this study, few respondents claimed to have planted miombo trees. In Zambia, Chidumayo and Siwela (1988) hardly recorded any cultivation of edible wild fruit trees by local communities. According to Grundy (1990), people in Zimbabwe planted indigenous trees but only on a small scale.

Throughout the miombo area drought is one of major problems hindering tree planting (Campbell *et al.*, 1993). The most important tree planting problems reported in this study include drought, insects and termite attack. Termites were mentioned separately from other insects because of their widespread activity in the miombo and the major problems they cause to crops and trees. In semi-arid areas like Tabora, tree planting is an expensive undertaking in terms of watering and protection of the trees from livestock and fires. In addition, drought-stressed trees are likely to be more susceptible to attack by other pests: a survey of widespread death of miombo trees in north-western Zimbabwe showed that the dead trees were infested with scale insects. The scale attack was secondary to moisture stress, thus accelerating their death (Mazodze, 1995).

#### **4.7 *Resource potential of miombo woodlands***

The recorded mean diameters and number of stems per hectare in the present study indicated significant differences in the intensity of utilisation of the woodlands adjacent to the studied villages. According to Geldenhuys (1993), the use of diameter measurements from woodland inventories provides useful information on the woodland population structures. The relationship between diameter and number of stems per hectare describes the size depletion rates and can be used to identify stable woodlands and predict past and future changes caused by various disturbances. Depending on proximity, it was expected that the diameter distribution and the number of stems would increase along these villages as one moved away from Tabora town. However this trend was not true for Pangale village where

the mean diameter was smaller than at the previous village and the number of stems increased sharply from the previous village. The smaller tree sizes at Pangale village may largely reflect the past disturbance to and uses of this regenerating *Combretum* woodland. In the past, Pangale village was a refugee camp and this part of the woodland was under cultivation until the villagisation programme in the 1970s when the refugees were removed in to establish a village settlement. The people who settled in Kasisi before the villagisation programme were ordered by the government to move to Pangale to form one village but most of them have now gone back. This temporal movement seems to have reduced pressure on the woodlands around Kasisi and exerted it on Pangale village woodlands. The woodland adjacent to Pangale village is now regenerating *Combretum* woodland and because of its ruined structure and composition, it seems to be neglected from any wood harvesting. During the transect survey which was done near the Pangale primary school, originally the refugee camp buildings, no intensive woodland use was observed apart from cattle grazing. Kikungu village, which was the furthest from Tabora, had larger diameters but with fewer stems per hectare compared to Pangale. This village was established about 20 years ago by the pastoralists who migrated with their livestock from the northern drier region of Shinyanga and settled there. The woodland around this village though now under high pressure for grazing, charcoal making and cultivation, has scattered bigger trees than other surveyed villages. There is also the possibility that most people harvest their wood products from the woodlands adjacent to Kikungu, rather than in Pangale where the most important species are not obtainable. The relationship between the mean diameter and number of stems per hectare in the miombo woodlands adjacent to the five studied villages of Tabora showed that the more stems per hectare there are, the smaller the diameters.

Lack of detailed inventory data in this study limits the argument on the observed species diameter distribution and composition differences in the five studied villages of Tabora. The fact that only one transect was surveyed per village means that other species in the different habitats in the woodlands may have been missed. Grundy (1995) stated that disturbance by human activities, animals and fires had caused variations in growth of miombo species in Zimbabwe. Similarly, Chidumayo (1988) and Geldenhuys (1993) maintain that, disturbance such as fire has influence on species diameter distribution and composition as it affects regeneration from both seedlings and saplings. Browsing has been reported to affect growth of young seedlings and saplings more than old regrowth of miombo in Zimbabwe (Grundy, 1995). In this study, the effect of human and livestock disturbance is obvious from

the presented results on diameter distribution and species composition, however this requires further research in the miombo woodlands of Tabora. This study has shown that intensive use of the Urumwa woodland products is high within 1 km distance from the surveyed villages. There is a progressive increase in utilisation pressure towards the Urumwa Reserve. The characteristic distribution of species diameter and number of stems per hectare observed in this study will help the foresters to apply appropriate silvicultural systems for sustained-use and management of the Urumwa woodlands (see Geldenhuys, 1993).

Different miombo species have been reported to grow better in different soil types and depth (Gauslaa, 1988; Grundy, 1990; Grundy, 1995) which may contribute to the observed species distribution differences in this study. Although there is no empirical evidence for the observed differences in species diameter distribution and composition, site characteristics such as soil depth, fertility and moisture are likely to have strongly influenced the tree growth and distribution in the studied area. Most *Combretum* species were recorded in lowlands (*mbugas*) associated with seasonal flooding and *Brachystegia* and *Julbernardia* were recorded in uplands. In Zimbabwe Grundy (1995) observed slow growth of *Brachystegia* and *Julbernardia* species under waterlogged conditions, indicating species site specificity. Further research is important to characterise species distribution along the landscape gradient and soil catena around these villages.

#### **4.8 Conclusions and Recommendations**

##### **4.8.1 Conclusions**

It can be concluded from the present study that the local communities in villages adjacent to the Urumwa reserve understand the importance of various products and services obtained from these woodlands for their daily livelihood well. This study has shown that communities in rural areas of Tabora use and depend heavily on miombo woodlands for many of their requirements. However surveyed villages differ in their levels of utilisation of the various products obtained from the nearby Urumwa Forest Reserve, the choice and quantities used depending on their proximity to urban areas. The use of miombo woodland products in the studied villages indicated some indigenous knowledge where wood properties were mentioned as major determinants of tree species suitability for building poles, firewood and charcoal. Most important miombo tree species for construction poles are no longer easily

obtainable in the studied villages and because of strong preferences for construction poles, some communities now use mud bricks for house construction. Important timber tree species have become scarce in the rural areas of Tabora due to over-exploitation and the communities frequently use less durable alternative species such as *Sterculia quinqueloba*. The use of miombo for medicinal purposes is likely to increase not only because modern medicines are expensive but also because certain diseases are only cured by traditional medicines. Almost all miombo species have medicinal values and their uses depend on the knowledge of the user on the tree and the number of cures. The reported sustainable harvesting of roots for medicine in the studied villages shows that local people try not to be destructive of their own resources. Local communities in Tabora also harvest and use wild fruits from the miombo woodlands.

The importance of the woodlands in Tabora as a source of fodder and browse is indicated by the presence of cattle herders who move to this region in large numbers. Although miombo woodlands have been used in the past for shifting cultivation, agricultural expansion does not seem at present to threaten the miombo woodlands of Tabora under the village system, but immigration of cattle herders to these woodlands needs to be controlled. Communities in Tabora villages do not perceive a role of miombo trees on soil fertility improvement. The local people in this study showed an understanding of the problems related to continued depletion of woodlands through intensive use for various products, as they observed decrease in rainfall over years in their areas.

Not surprisingly, in this study the villagers had building poles as their first priority product rather than timber, which is the main objective on which the Forest Department manages the Urumwa Reserve. This difference in prioritising miombo woodland products that exist between communities and foresters is an indication of the importance for participatory planning and decision-making for sustained use and management of these resources. This also indicates that the potential of these woodlands as a source of timber species is now low.

Income generation from the miombo woodlands adjacent to the studied villages appears to be important for the people's livelihood, the proximity of the village to urban areas having a major influence on this activity. Local communities need money to subsidise their household economy especially in years of low crop yields and villagers do not perceive

commercialisation of miombo products as depriving them of enough wood resources for various uses.

The utilisation of miombo woodlands for cultural and traditional religious purposes in the villages of Tabora has declined over years due to changing policies and modern religions. Increased ethnic heterogeneity, the abolishment of Chiefdoms after the villagisation programme in Tanzania and the fact that young generations see traditions as backward contributed largely to this decline. The respondents have reported taboos on the use of certain miombo tree species and these traditional norms can be instrumental in biodiversity conservation, as people tend to observe them more than government rules.

The majority of villagers obtained their wood resources from both the woodlands in public and private lands as well as from the Urumwa Reserve. People were hesitant to admit to use of the Forest Reserve for fear of penalties. However this study has found that the Urumwa Forest Reserve is now an open access resource as villagers have depleted the wood resources adjacent to their settlements. The studied villages showed different levels of understanding the causes of miombo resource depletion adjacent to their settlements, again depending on their proximity to urban areas. It was learnt in this study that wood scarcity seems to be positively related to awareness on causes of resource depletion.

Community participation in woodland management is still new in the study area as few villagers were aware of government interventions in the management of Urumwa woodlands, and awareness seems to be limited largely to males and leaders. Villagers have not seen the Joint Forest Management programme in this area as an empowering process. The woodland is still owned by the State and the local communities have not gained ownership rights and access to the resources. The Forest Department must be seen to be more transparent in empowering and transferring responsibilities of managing Urumwa woodlands to the local communities and must assure their land and tree tenure rights.

For any successful tree planting programme in Tabora the problems of ownership, drought, insect and termite attack must be well addressed. As a result of unfavourable conditions for tree planting, the utilisation of woodlands in Tabora villages will intensify, as people have no alternative sources of wood products, especially for building poles and

energy. Under these conditions sustainable management of the woodland resources can be difficult.

The simple inventory survey carried out in this study indicates that the Urumwa miombo woodland is heavily disturbed, resulting in poor diameter distribution and species composition. This was confirmed by the present use of small size trees for poles and timber and any combustible material for firewood. The use of mud bricks for house construction was an indication of scarcity for poles of suitable sizes and durable tree species. The small diameters recorded in the transect surveys show that the woodlands in this area have been poorly managed. The distribution of miombo tree species in the villages adjacent to Urumwa indicated that these woodlands have been under intensive use once the villages were settled. It can be concluded therefore that the Urumwa miombo woodlands do not have enough resources to sustain the ever-increasing population in Tabora region. Relatively small diameters recorded in this study indicate that the Urumwa potential for timber production is low compared to other products.

#### 4.8.2 Recommendations

- The villagers have indicated their priorities in terms of products they expect from miombo woodland management and these should form the basis for silvicultural and management systems in these woodlands.
- Studies of the silviculture of the most preferred tree species in the woodlands adjacent to the studied villages are recommended for promoting production of the desired products.
- Research is required to determine effective methods of assisting natural regeneration and also artificially establish the important indigenous tree species.
- It is recommended that the alternative timber tree species recorded in this study, especially *Sterculia quinqueloba*, be studied for wood durability and resistance to various decaying agents.
- Marketing research for the commercialised products will be important for sustainable management of these woodlands.
- Promotion of cultural uses of miombo in Tabora can be instrumental in biodiversity conservation, as people seem to adhere to the traditional rules more strongly than they would to government rules.

- As seen in this study, area the Forest Department has the task of ensuring that proper identification of participating communities is done and that all stakeholders are involved in any decisions regarding the use and management of the Urumwa woodlands.
- Research is required on the effect of various types of disturbance in the Urumwa woodlands on the tree species diameter distribution and composition in order to define appropriate management options.
- Drought and termite attack are the major tree planting problems in the studied villages so it is recommended that drought resistant exotic trees species and methods to control termites are introduced.
- To minimise the ever-increasing depletion of the Urumwa miombo woodland reserve it is recommended that wood saving stoves are introduced to adjacent villages.
- Villagers protect indigenous trees and plant exotic trees for various uses but they lack the legal rights of ownership. Thus it is recommended that villages in rural areas of Tabora are demarcated and legal title deeds issued for the security of their land and tree resources. This is envisaged to be an incentive for people to invest more in tree planting and conservation of their woodlands.
- To minimise pressure on the miombo woodlands of Tabora, communities should be encouraged to conserve and manage individual woodlands for the supply of wood products.
- Research is required on the sustainability of community participation in natural resource management and conservation under the current government policies.

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**APPENDICES**

**Appendix 1**

**The structure of the questionnaire**

A. Background information of the respondent.

Name of the village.....Respondent No (Namba ya mwanakijiji) .....

Male (Me) [ ] Female (Ke) [ ] Date of birth/age (Tarehe ya kuzaliwa /umri [ ] years (miaka)

Remarks (Maoni); [ ] Tobacco farmer (Mkulima wa tumbaku) [ ] Non-tobacco farmer (Mkulima wa mazao mengine [ ] Pastoralist (Mfugaji) [ ] other (Nyingine) .....

B. The main questionnaire.

Each question is preceded by the relevant specific objective of this study (Kila swali linatanguliwa na madhumuni halisi ya utafiti huu)

1. Peoples’ understanding of the value of the miombo resources around them (Watu wanavyoelewa thamani ya rasilimali za Miombo katika maeneo yao).

(I) Are the miombo woodlands around your village important for your daily life? (Misitu ya miombo ina thamani gani katika maisha yako ya kila siku?)

1 Yes (Ndiyo) [ ]

2 No (Hapana) [ ]

3 Don’t know (Sijui) [ ]

If yes, which are the values? Kama Ndiyo thamani gani?

Thamani (value)	Priority (umuhimu)

(ii) Do you leave any trees uncut in your crop fields? [ ] Yes [ ] No [Je unaacha miti katika shamba lako? Ndiyo [ ] Hapana [ ]

If yes, which tree species [Kama Ndiyo miti gani?]

Species (Jamii)	Why not cut? (Kwa nini haukatwi?)

(iii) Do you know how are the Urumwa miombo woodlands surrounding this village managed? (Je unaelewa jinsi gani msitu wa Urumwa unavyoendelezwa na kuhifadhiwa?)

Yes (Ndiyo) [ ] No (Hapana) [ ] Don’t know (Sijui) [ ]

(iv) If the answer is yes in (ii) above, what type of management is applied?

[Kama jibu lako la hapana juu (iii) ni ndiyo unaendelezwaje?]

1 Government only [Serikali]

2 Community participation [Kushirikishwa jamii]

3 I don't know [Sijui].

(v) Does your village have a woodland management committee? [ ] Yes [ ] No [ ] I don't know [ Je Kijiji chako kina Kamati ya uendelezaji Misitu? Ndiyo [ ] Hapana [ ] Sijui [ ]

(vi) What is the role of villagers in the management of woodlands in this village? [Nini jukumu la wananakijiji kwenye uendelezaji wa misitu hii?] .....

(vii) Are there any rules set for the management of the woodlands in this area?

[ ] Yes [ ] No [ ] I don't know. If yes, how are they applied? [Je; zipo sheria ndogo ndogo za kulinda Misitu?] [ ] Ndiyo [ ] Hapana [ ] Sijui. Kama ndiyo zinatumikaje? .....

(viii) Which tree species are sacred trees in these miombo woodlands? [Miti gani ya matambiko inapatikana hapa?] .....

(ix) Do you plant any trees for your own use? [ ] Yes [ ] No [Je; huwa unapanda miti aina yoyote kwa matumizi yako? Ndiyo [ ] Hapana [ ] If yes, which tree species do you plant and why? [Kama Ndiyo Miti gani una panda na kwa matumizi gani?].....

(x) Do you have any problems with tree planting? [ ] Yes [ ] No [Je una matatizo yoyote kuhusu upandaji miti [ ] Ndiyo [ ] Hapana

If yes, what kind of problems (Kama ndiyo matatizo gani?)

2. The extent of miombo woodland resources utilisation in the area

[Kiwango cha matumizi ya misitu ya Miombo]

(i) Do you depend entirely on miombo woodlands for your wood requirements?

[Je; unategemea misitu ya Miombo kwa matumizi yako ya kila siku?

1 Yes (Ndiyo) [ ]

2 No (Hapana) [ ]

3 Don't know (Sijui) [ ]

If no, what alternative sources do you have? [Kama sio unapata toka wapi?].....

(ii) Do you use miombo woodlands for income generation? [Unatumia mazao ya miombo kwa kupata fedha?]

1 Yes (Ndiyo) [ ]

2 No (Hapana) [ ]

3 Don't know (Sijui) [ ]

If yes, what is your income generation activity? [Kama ndiyo kazi gani ya kiuchumi unafanya?] .....

(iii) Do other people from outside your village come and harvest wood from your area? [Watu wa nje wanavuna mazao msituni mwenu?]

Yes  No  I don't know

[Ndiyo  Hapana  Sijui

(iv) Do you think people commercialising miombo woodland products deprive others from getting enough resources? [Unafikiri kuyafanyia biashara mazao ya Miombo kunakosesha wengine kupata mazao ya kutosha ya msitu?]  Yes  No  I don't know

Ndiyo  Hapana  Sijui

(v) Should people commercialising pay to compensate those who don't?

Yes  No  I don't know

[Unafikiri wafanya biashara wa mazao ya miombo wangelipishwa kuwafidia wasiofanya biashara?] Ndiyo  Hapana  Sijui

(vi) Do you still get the tree species you prefer most for your various uses? [Bado unapata miti unayopendelea sana kwa matumizi mbali mbali?]

1 Yes (Ndiyo)

2 No (Hapana)

3 Don't know (Sijui)

If no, which species with their respective uses previously preferred but not available now?

[Kama hapana miti gani haipatikani?]

Species [ Jamii]	Uses [ Matumizi]

Which tree species have replaced them? [Miti gani inatumika badala ya hiyo hapo juu?]

Previous species[ya zamani]	Current species used [ya sasa]	Uses [matumizi]

(vii) Do you think there has been changes in the availability of the resources from the miombo woodlands near your village? [Unafikiri kumekuwa na mabadiliko ya upatikanaji wa mazao ya miombo katika kijiji chako?]

1 Yes (Ndiyo)  No (Hapana)  Don't know (Sijui)

If yes, what changes  increased  decreased. state how

[Kama ndiyo, mabadiliko gani  Kuongezeka  Kupungua  Eleza jinsi gani. ....

(viii) Do you know the causes for these changes? Unajua sababu za upungufu?

Yes (Ndiyo)  No (Hapana)  Don't know (Sijui)

If yes, what are they  population growth  Illegal harvesting  fires  agricultural expansion  overgrazing. Other (specify). [Kama Ndiyo sababu gani  Ongezeko la watu

Wizi  Moto  Kilimo kupanuka  Ufugaji nyuki  Nyingine, (Eleza) .....

(ix) Where do you get your woodland resources? [Unapata wapi mazao yako ya misitu?

village woodland  individual woodland  government woodland

Shamba la kijiji  Shamba binafsi  Msitu wa serikali

(x) How far is it from your village to where you obtain your wood resources? [Ni umbali gani toka hapa hadi unapopatia mazao ya msitu? Km.

3. Which woodland resources are preferably used by whom and for which purposes? [Mazao gani ya msitu yanapendelewa na watu gani na matumizi gani?]

(i) Which miombo species do you use for your various needs? [Miti gani ya msitu unatumia kwa matumizi mbali mbali]

Species / uses	Timber	poles	f/wood	charcoal	food	medicine	fodder	others

other = thatches, fibres, home utensils (Mengineyo = Nyasi, Kamba, Vifaa vya nyumbani)

(ii) What other products do you get from the miombo woodland? (Mazao gani mengine unapata kutoka misitu ya miombo?)