

# **Wildlife Conservation Society of Tanzania (WCST)**

Uluguru Mountains Biodiversity Conservation Project  
In collaboration with Uluguru Mountains Agriculture Development Project  
(UMBCP), Regional Natural Resources Office, and the Regional Catchment  
Project Office

## **ASSESSMENT OF FOREST USER GROUPS AND THEIR RELATIONSHIP TO THE CONDITION OF THE NATURAL FORESTS IN THE ULUGURU MOUNTAINS**

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## EXECUTIVE SUMMARY

The study was done in three villages - Tandai, Tegetero and Nyandira located in the Uluguru Mountains, with the aim of gathering information on forest ownership, internal differentiation, forest products harvested, uses, and forest condition. Information on Village committees and other local structures which are related to the management of the forest in the area and groups that do not use the forest, but have an influence on its management was also collected. A number of methods were used to collect the data including transect walks, direct observation, interviews and discussions with key informants.

The study revealed that the Uluguru Mountain forest reserve is having a multiple use for various users surrounding it. The catchment forest reserve is the main source of the majority of the species utilised or preferred by the local people. The preference for certain species is based on various characters such as quality of the wood, stem straightness, size, durability and suitability of the species for the desired use. Deforestation and restricted entry into the forest reserves has forced the local people away from being selective about tree species for fuelwood, and climbing stakes for peas, beans and tomatoes. Most of the recorded species are required for many uses and this affects the condition of the forest as a large number of tree are cut to meet local demand. There are some local initiatives on limited scale to domesticate some of the most useful plant species such as *Urera hypselodendron* and *Basella alba* for vegetables, *Maesa lanceolata* and *Bidens holstii* for medicinal use and *Khaya anthotheca* and *Milicia excelsa* for timber. Different user groups are worried with the current trend of environmental degradation which leads to unavailability of resources. Tree planting was pointed as way to alleviate the problem. It was learnt that species selection has to be demand driven. However, insecure ownership of land embedded in the traditional norms of the Lugurus appears to constrain tree planting on farm lands.

Species composition and structure of the forest in terms of diameter class distribution varies in some parts of studied villages due to past timber exploitation and cultivation in the lower part of the catchment forest done in 1950s. However, many people are still depending on natural forests for many products particularly poles, withies medicinal and timber. Some species e.g. *Ocotea usambarensis* which was heavily exploited in the past is threatened with local extinction. Lack of regeneration for some species such *Ocotea usambarensis* in the forests was observed.

There is an apparent lack of formal structure(s) in some villages to deal with environmental issues. The protection of the catchment forest reserve is purely the responsibility of the central government through its regional catchment project

office. With limited manpower and finances the government is unable to ensure proper management of the reserves and to control the noted high intensity of tree harvesting in the catchment forest as well as the mismanagement of the Nyamiduma planted forest in Nyandira.

The impact of UMADEP on the farming systems and hence conservation of the Uluguru Mountains catchment reserve is limited because of failure to adequately integrate agroforestry practices in existing farming systems. Consequently, the needs of a wide diversity of user groups have not been met. This has resulted in their continued dependence on the forest reserve for the products they need and which are not available in the farmlands.

To address the above, among others, there is need to work with forest user groups as an entry point for developing alternative ways to reduce pressure on the natural forest and avoid conflicting interest on the resources. There is also a need to develop appropriate agroforestry technology within existing farming systems that will provide options for farmers in the area to deal with the problem of soil fertility, continued dependence on natural forest and environmental conservation and involve local communities in the management of forest reserves through village environmental sub-committee that need to be established with roles that are well defined and understood by the villagers.

## CHAPTER ONE

### Background to the study

The forests associated with the Uluguru and the other Eastern Arc Mountains of Tanzania, are extremely important both locally and internationally. Locally, they support the livelihood of millions of people by material supplies and service functions accruing from these mountains. The various products and service functions that are provided by the flora and fauna biodiversity of forests in Tanzania, play a major role in agriculture which is the backbone of the country's economy (Kaiza-Boshe *et al*, 1998).

The forest flora of the Eastern Arc Mountains is marked by high species richness, and degree of endemism (Lovett *et al*. 1997, Thomsen *et al*. 1997). They carry a large number of species of flora and fauna that has a restricted range of occurrence (Fjeldså *et al*. 1993, Newmark 1997). Many studies on biodiversity such as those conducted by Monela (1995), Mahunnah and Mshigeni (1996), Lyaruu and Mwasumbi (1997) justify the importance of the Eastern Arc Mountains for biodiversity conservation.

Over 60 percent of all endemic plant species in Tanzania are reported to occur within the Eastern Arc mountains (Monela 1995, Mahunnah and Mshigeni 1996). The Uluguru and East Usambara Mountains contain a larger share of endemic plants. Because of this, these areas are considered as hot spots for biodiversity conservation and have raised concern both at local, national, and international levels to strengthen the protection of natural forests in these Mountains. The Uluguru Mountain Biodiversity Conservation Project (UMBCP) was initiated to promote environmental conservation in the Uluguru mountains. The project is managed by the Wildlife Conservation Society of Tanzania (WCST). It started in 1999, and works in collaboration with the Uluguru Mountain Agriculture Development Project (UMADEP) based at Sokoine University of Agriculture (SUA), the Regional Natural Resource Office (Morogoro), and the Regional Catchment Forestry Project under the Ministry of Natural Resources and Tourism.

The main objective of the UMBCP is to improve conservation of the globally important Uluguru Mountain Forests. A number of activities to achieve this objective are stipulated in the logical framework for the project. Among other things it includes: support forestry activities such as, establishment of village nurseries, and planting of trees on farmlands, assist the formulation of agreements between forest division and local people on sustainable uses of forests, monitor changes in biodiversity and forest conditions in the Uluguru



Forest Reserves, and support sustainable agricultural practices in villages adjacent to the Uluguru Forest Reserve. There is also a possibility for financing studies that can generate information that can be used to improve project activities related to conservation of biodiversity and improvement of the livelihood of the local people living around the Uluguru Mountain forests.

Several studies have been conducted in the Ulugurus to characterize the biodiversity value of these mountains (Pócs 1976, Svendsen *et al.* 1995, Mabula *et al.* 1994). Furthermore, studies by Senkondo and Kihyo (1994), Lyamuya *et al.* (1994), Bhatia and Ringia (1996) were undertaken to identify the constraints leading to unsustainable utilisation of forest resources and suggest possible solutions. In their study Bhatia and Ringia (1996) pointed out the need for a detailed study of changes in forest conditions, and how this relate to the condition of villages adjacent to the forests. It was against this background that the UM BCP commissioned this study to address issues mentioned above. The terms of reference of the study as prepared by the project were as follows:

- To gather information on forest ownership, internal differentiation, forest products harvested, uses of products, and forest condition
- To gather information on all the different forest user groups
- To gather information on village committees and other local structures which relate to the management of the forest in the area.
- To gather information on groups which do not use the forest, but have an influence on its management

## CHAPTER TWO

### METHODOLOGY

#### Description of Study Area

##### Location, population and settlement pattern

The study was conducted in three villages, namely Tandai, Tegetero and Nyandira located in the Uluguru Mountains in Morogoro Rural District. Of the three villages, Nyandira village is much hillier than the other two villages. For detailed description of the Uluguru Mountain forest reserve see e.g. Lyamuya *et al.* (1994), Fjeldså *et al.* (1995), Lovett *et al.* (1995), Bhatia and Ringia (1996).

The Waluguru who traditionally are both matrilineal and matriarchal inhabit the three villages. The maternal uncle wields great authority in the Waluguru society. He uses his authority to mediate various matters in the family including those related to management and distribution of family resources such as land. Members of the family can easily access land grown with annual crops like maize and beans when not in use. However, land planted with permanent crops including tree crops is considered as an individual property and therefore cannot be easily accessed by other members of the family. This is the type of land that is inheritable by the children of the owner and hence the need to regulate establishment of permanent crops to ensure that family members do have access to land for their subsistence.

In terms of population, Nyandira and Tegetero village are the biggest and smallest respectively (Table 1). The settlements are evenly distributed in Nyandira and Tegetero while a bigger chunk of the Tandai village land especially the area close to the catchment forestry is sparsely settled.

Table 1: Population in the study villages

Village	Population			Number of households
	Men	Women	Total	
Tegetero	638	690	1328	212
Tandai	1275	1417	2692	750
Nyandira	N/A	N/A	4827*	N/A

\* Estimated figure  
N/A (not available)

### **Economic activities**

Crop production provides the main source of livelihood in all the studied villages. Fruit crops are the main sources of household cash income in Tandai. These include ripe banana, citrus and pineapple while banana is the most important cash crop in Tegetero. Nyandira, like in many other villages in Mgeta, is famous for vegetable crops. Through a well established irrigation system, farmers in Nyandira can raise various vegetable crops. Traditionally, cabbage has been the dominant crop. However, its importance has declined over the years due to disease attack which appears to be uncontrollable. Consequently, crops like peas and Irish potatoes have become the dominant crops upon which farmers depend for their survival. The village is also known for growing temperate fruit crops such as pears and plums.

### **Socio-economic infrastructure**

The hilly terrain and high rainfall in the study villages makes the roads inaccessible during the rainy season. As a result public transport to these villages is unreliable. Each village has a primary school and except for Nyandira, Tegetero and Tandai have health facilities owned and managed by the Roman Catholic Mission and government respectively.

### **Sources of and data collection methods**

Data for the study were obtained from a wide range of sources which include: literature review, key informant interviews and discussions with WCST and partner institutions, village government leaders/extension workers, different forest user groups and field survey on farmland and in the catchment forest reserve.

Literature review was done at TAFORI and UMBCP libraries to determine the information gaps. Interviews with UMBCP and its partner institutions (UMADEP and Morogoro Regional Catchment Office) was done in order to explore information on their activities and constraints in the study area. Village leaders and specifically members of the executive committee were consulted for information on the functions performed by the various committees constituting the village government and existing social infrastructure. Interviews with field-level extension agents were done to obtain information on both social and technical issues relevant to the study. Key informant interviews with the various forest user groups was done to explore information on most species preferred, availability and alternative sources for specific forest product..

Field surveys were conducted on farmland and in the catchment forest reserve. Study plots were laid along the transect such that the distance between plots was 1 km (1000m) and 100m in farm lands and catchment respectively. The selection of the distance was based on the fact that farmland areas were more variable with some areas cultivated, some left for fallow and others with disturbed forest, therefore to address the variations long distances between plots was inevitable. While in the catchment forest with less disturbance compared to farmland short distance sampling was adopted. Each plot composed three concentric circles of 1, 3 and 10 metre radii centred. The smallest circle was used to record seedlings. Shrubs and tree saplings were recorded in the middle circle while trees in the largest circle. Estimation of the overall condition or the state of the forest was done on each plot based on the tree growth, forest composition, species diversity and vegetative cover. Furthermore, other records taken on each plot and along the transects included signs of human activities, species and frequency of tree cuts. Trees cut were classified according to diameter categories: <5 dbh (withies, climbing stakes), 5-25 dbh (poles and rafters) and >25 dbh (timber). Data were also collected during transect walks with groups of forest users picked to join the team of researchers. Through these walks the team were able to verify some issues raised during the interviews.

## CHAPTER THREE

### FINDINGS AND DISCUSSION

This Chapter presents and discusses the major findings with respect to forest ownership, internal differentiation, forest products harvested, uses of products, and forest condition. It also addresses issues of village committees and other local structures which relate to the management of the forest in the area, and groups which do not use the forest, but have an influence on its management.

#### Forest Types

The new National Forest Policy (MNRT 1998) distinguishes three main categories of forests as follows:

- The central and local government forest reserves
- Unreserved forests on public lands and
- Private and communal forests

The three types of forests were found in all the three villages. Both the North and South Uluguru forest reserves are of national strategic importance as critical watershed areas, and forest areas with high biodiversity. These forests are under the control of the central government. However, the new Forest Policy recommends that, the long-term goal even for such forests is to delegate the management to other agencies, provided that these agencies prove to have sufficient capacity to manage this kind of forest (MNRT, 1998).

Unreserved forests on public lands exist only in Tandai village on Kitundu ridge bordering with Amini village and at Kihirihiri. Although these forests have gradually been cleared for farming, its forest cover, according to elderly people at Tandai village, resembles the village forest cover that existed between 1920 and 1930. These forests were first believed to occur within catchment area but when the government resurveyed the area the catchment boundary was found to be above these forests and hence they fall within the public land. The study revealed that the destruction of natural forests in the area started when the government issued a license to Taj Mohamed Company to harvest part of these forests. The exploitation of forests was further accelerated when local people started clearing it for farming. Local Government forest reserves in the form of small units of planted forest were observed in Nyandira only. They were planted with Maidini, Makulata, Msombolanga and Mkataluba at Nyamiduma, Vikosa or Maserikali (between Nyandira and Tchenzema villages) and at King'ino. A large part of these forests have now been cleared and about 70% of villagers use it for farming.

Private and communal forests in the form of woodlots, small patches of natural forest and individual trees planted on farmlands, were also observed. Planted forests in the form of woodlots were noted in Nyandira village. A more or less similar form but as two lines/rows of trees of *Khaya anthotheca*, *Grevillea robusta* and *Cedrella odorata* were recorded at Tegetero Roman Catholic Mission. It was reported that *Khaya anthotheca* were planted in 1930's. The mission also own a patch of natural forest demarcated in 1930's. The forest is quit intact and well managed as a catchment forest. Villagers are allowed to collect firewood from it. Except for three sacred forests (Kingalu, Chete and Langwa sacred forests) at Tandai, most sacred forests in Tegetero and Nyandira have been converted to agricultural land due to land scarcity.

Individual trees planted on farmlands were noted in all the studied villages. A wide variety of tree species both exotic and indigenous for various purposes are planted (Table 1). They are usually planted near home compounds and not in far away farm lands. Planting of trees on farm lands is done randomly but with increasing tendency to planting along farm boundaries. In Tandai and Tegetero, trees on farmlands around home compounds form part of an integrated land use system, with trees of wide diversity of uses, representing a typical scene of agroforestry farming systems in the humid lowland of West Africa and South east Asia (Nair 1983). In Nyandira village trees around home compounds comprise mainly of temperate fruit species such as *Prunus americana*, *P. salicifolia* and tomato tree like in Lushoto and Makete Districts.

## Trees on Farm Lands

### Historical background of tree planting

Tree planting on farm lands started during the coming of the Arabs, and during the German and British colonial periods. This was learnt partly from discussions with old people and from discovering the remains of old mango and jack fruit trees. For example, in Tandai and Tegetero villages there were several very old mango and jack fruit trees with dbh ranging from 130 - 200cm that were possibly planted during the period 1910-1920. According to the elderly people interviewed in Tandai the Arabs brought tree species for fruits mentioned above, including *Syzygium aromaticum* for spice, *Cocos nucifera* for cooking oil and kapok trees whose fiber is used for making mattresses.

Table 2: Exotic and indigenous tree species and shrubs recorded to be planted on farmland at Tandai, Tegetero and Nyandira villages.

Local name	Latin names	Exotic/Indigenous	Tandai	Tegetero	Nyandira
Mdalasini	<i>Cinnamomum verum</i>	Exotic	x	x	
Mkarafuu	<i>Syzygium aromaticum</i>	Exotic	x	x	
Mnazi	<i>Cocos nucifera</i>	Exotic	x	x	
Mshelisheli	<i>Artocarpus altilis</i>	Exotic	x	x	
Parachichi	<i>Persea americana</i>	Exotic	x	x	
Mwembe ng'ongo	<i>Sclerocarya birrea</i>		x	x	
Plamsi	<i>Prunus salicifolia</i>	Exotic			x
Pichesi	<i>P. americana</i>	Exotic			x
Epulus	<i>Molus communis</i>	Exotic			x
Mchungwa	<i>Citrus sinensis</i>	Exotic	x	x	
Mbuni	<i>Coffea arabica</i>	Exotic	X	x	
Mfenesi	<i>Artocarpus heterophyllus</i>	Exotic	x	x	
Mwembe	<i>Mangifera indica</i>	Exotic	x	x	
Mbono	<i>Jatropha urcas</i>		x	x	
Msedelela	<i>Cedrella odorata</i>	Exotic	x	x	
Mgerevelea?Mnya weza	<i>Grevillea robusta</i>	Exotic	x	x	
Maidini	<i>Eucalyptus maidenii</i>	Exotic			x
Makulata	<i>E. maculata</i>	Exotic			x
Msomboulanga	<i>acacia mearnsii</i>	Exotic			x
Mvinje	<i>Casuarina cunninghamiana</i>	Exotic			x
Mzambara	<i>Psychotria megalopus</i>	Exotic	x	x	
Mstafeli	<i>Annona muricata</i>	Exotic	x	x	
Msufi	<i>Ceiba pentandra</i>	Exotic	x	x	
Mitende	<i>Elasis quineensis</i>	Exotic	x	x	
-	<i>Vitex keniensis</i>				x
-	<i>Hagenia abyssinnica</i>				x
-	<i>Sesbania sesban</i>				x
-	<i>Calliandra calothyrsus</i>				x

Local name	Latin names	Exotic/Indigenous	Tandai	Tegetero	Nyandira
Myegea	<i>Kigelia africana</i>			x	
Mkataluba	<i>Cupressus lusitanica</i>	Exotic			x
Mvule	<i>Milicia excelsa</i>	Indigenous	x	x	
Mkangazi	<i>Khaya anthotheca</i>	Indigenous	x	x	
Mtiki	<i>Tectona grandis</i>	Exotic	x		

x indicate village where the species was found

Chief Kingalu, the famous traditional leader of the Waluguru, had keen interest in planting trees for spice and fruit. He requested the Arabs, long time ago, to bring him clove trees. However, they mistakenly brought him *Syzygium cumini* because it is very similar to a clove tree (*Syzygium aromaticum*). As a result of Kingalu's initiatives *Syzygium cumini* and *Syzygium aromaticum* are now among the most popular species on farm lands in Tandai and Tegetero villages.

In 1930 in Tegetero, the Roman Catholic missionaries brought with them many tree species including *Grevillea robusta*, *Persea americana*, *Artocarpus altilis* and *Khaya anthotheca*. The later seeds were brought from Morogoro town. At Nyandira the Germans and British brought a narrow diversity of tree species for planting. They introduced two eucalyptus species, *Eucalyptus maideni* and *E. maculata* for reclaiming the degraded parts of the village and for fuelwood and building poles. They also introduced *Cupressus lusitanica* for timber and *Acacia mearnsii* for fuelwood. Fruit trees, plums, peaches and pears were probably brought after independence.

Appendix 1 gives the list of exotic and indigenous tree/shrub species recorded on farm lands in the three villages studied. Tandai has the highest (49) number of tree species followed by Tegetero (25) and Nyandira has the least diversity (16). Other plants recorded on farm lands and their uses are listed in Appendix 2. The exotic tree species account for 20% of all the trees found on farm lands. Although indigenous tree species account for 80% of the tree species they are rarely planted because of the general belief that they are slow growing. The Tegetero Roman Catholic Mission has helped to demonstrate to farmers that some indigenous trees can be equally fast, or even faster-growing than some of the exotic tree species. For example, the measurements done during this study at Tegetero showed that *Khaya anthotheca* and *Cedrella odorata* both planted in 1930's on the same field, have now reached a dbh of 70 and 54cm respectively. At Tandai *Khaya anthotheca* which was planted in the late 1980's along Mkulumuzi river was recorded to have dbh of 31cm.

Table 3 gives a summary of information about the proportion of farm land that has tree component and pattern of planting based on the tree/shrub records in



the sample plots. The results show that, about 70% of farm lands have a tree and or shrub component and Tandai and Tegetero are leading for this. Between 43% and 60% of the trees are planted and the remaining are naturally growing mostly in fallow fields. Tegetero has the largest area of farm land under fallow probably due to a low human population and hence the inability to cultivate a large area. The low population in the village is partly explained by the fact that many people left the village for other places including Tandai because they did not want to convert to the Roman Catholic religion.

Table 3: Percentage of tree/shrub component in the agricultural landscape according to sample plots.

Characteristic	Tandai	Villages	
		Tegetero	Nyandira
Plots with trees/shrubs	78	100	60
Plots with food crops alone	22	0	40
Plots with tree crops only	44	14	0
Plots under fallow	63	72	22
Mixed species woodlots	11	14	44
Planted trees	50	43	60
Exotic trees/shrubs	82	60	90

In all the villages, trees are rarely planted in close association with food crops as most farmers believe that trees have negative effects on food crops. The most popular tree planting patterns in Tandai and Tegetero are through home gardens; farm boundaries; randomly scattered trees on farm lands; tree orchards in small grooves mainly with tree species for spice. Most farmers also leave and protect the seedlings and young trees of valuable timber trees like *Milicia excelsa* and *Khaya anthotheca* in fallow fields. In Nyandira most of the trees are planted in woodlots; there is none or very little tree component on crop lands despite the effort made by UMADEP to introduce a wide diversity of tree species for planting along contour terraces. This is partly because tree species, which are currently used in the area, are not compatible with their agricultural crops, e.g. *Acacia mearnsii* and *Eucalyptus spp* are believed to compete negatively with agricultural crops.

### Tree density on farm lands

Table 4 gives the mean and range of tree density recorded for seedlings, saplings and mature trees in the sample villages. Density of individual trees recorded in sample plots are given in appendix 1. Nyandira has the highest density of mature trees in the agricultural landscape compared with Tandai and Tegetero. This is because of the high number of old woodlots of fast growing *Eucalyptus maideni*, *E. maculata* and *Acacia mearnsii*. These woodlots were

established in Nyandira for intensive fuelwood production. Highest seedling density was recorded in Nyandira and this is due to the high dispersal and germination rate of *Acacia mearnsii* that is dominant in the whole village catchment area.

In other villages, the large number of seedlings and saplings are of trees and shrubs that are naturally growing in fallow fields. However, a considerable number of these are young trees recently planted in a few farm lands.

Table 4: Density\* of seedlings, saplings and mature trees/shrubs on farmlands

Growth stage		Villages		
		Tandai	Tegetero	Nyandira
Seedlings	Mean	1769	3184	3892
	Range	0-6369	0-9554	0-19108
Saplings	Mean	1651	657	2516
	Range	0-6015	0-2477	0-15923
Mature	Mean	169	59	491
	Range	0-764	0-127	0-2484

\* Density figures are given in plants ha<sup>-1</sup>

### Farmers views and perceptions on farm land trees

The following reflects the views and perceptions of individual farmers and different user groups as well as technical staff with regard to tree planting and management on farm lands:

- There is need to create awareness on the importance of tree planting on farm lands so that majority of the farmers can benefit from the practice.
- Unproductive land has potential for intensive tree planting.
- Farmers prefer mostly multipurpose trees and shrubs with added value for cash income generation and improvement of soil fertility.
- To succeed in tree planting people have to be encouraged to plant in their farmland as village's (communal) woodlots have limited chance of succeeding due to entrenched belief that communal properties benefit the few, especially leaders, and are difficult to sustain.
- Species selection for tree planting on farm land has to be done carefully to ensure that the selected species meet the demand of targeted community. For instance, majority of farmers are reluctant to plant on farm lands some tree species, such as *Eucalyptus maidenii*, *E. maculata*, *Acacia mearnsii* and *Senna*

*siamea* because they are not compatible with agricultural crops and they have low value in some products, for example timber.

- There are few private tree nursery operators because of the high investment required to establish such an undertaking.
- Extension staff and farmers lack knowledge of the most appropriate exotic and indigenous tree species and shrubs for farm land tree planting.
- There is need for villages to prepare land use maps for effective natural resource management.
- There is need for improved information sharing among farmers and extension workers with regard to sources of seed, techniques for seedling production, management and utilisation techniques of different tree species and shrubs that have agroforestry potential in the Ulugurus.
- Improved fallow and rotational woodlots with fast growing multipurpose tree/shrub species such as *Sesbania sesban*, *Tephrosia vogelii* and *Cajanus cajan* for soil fertility improvement have not been exploited in all villages.
- Indigenous tree species such as *Milicia excelsa*, *Khaya anthotheca* and *Antiaris usambarensis* with high canopy that form the lowland rain forest in Tandai and Tegetero are now very rare and majority of farmers are interested in planting them, especially in the first two species.
- *Casuarina cunninghamiana* is a new introduction in the villages of Uluguru Mountains. Species in this genus have high potential for production of best quality firewood and rehabilitation of severely degraded lands. Their potential for timber is low. Farmers need to be informed of this and be supplied with a wide diversity of *Casuarina spp* including *Casuarina oligodon* that has shown to be very fast growing and with good potential for agroforestry in the West and East Usambara mountains (Mwihomeke in prep).
- On-farm trials of raising indigenous tree species practised by a farmer at Nyandira village show impressive growth performance of *Hagenia abyssinica* and *Vitex keniensis*, which are new to the Uluguru Mountains. These tree species could be promoted for agroforestry and for enrichment of the degraded parts of natural forests of the Ulugurus. The same applies to Mseli that is doing well in open fields and plantations in the West Usambara mountains.
- New breeds of coconut and mango trees adapted to villages at higher altitudes such as Tegetero need to be introduced to meet local demand.
- Traditional land tenure is a disincentive to tree planting activities but the traditional system is breaking down in some areas as land becomes a property that can be sold. At Tandai a lot of land is being bought and sold through the influence of the new land laws.

## Natural Forest Condition

### Forest boundary

According to discussions with local communities, the Uluguru Mountain forests were declared as a reserve in 1914. This is supported by the colonial forest administration report (Troup 1940). It shows that many forest reserves in Tanganyika were established during that time. Since then, very little or no changes have been made to adjust the position of the forest reserve boundary. In Nyandira village a small portion of a highly degraded forest was excluded from the catchment forest reserve by moving up the boundary into the more intact forest. In Tegetero, near the Roman Catholic Mission, a forest portion that was earlier given out for crop production was later in early 1950s made part of the forest reserve. Therefore, in general, there are very few areas of secondary forest near the forest boundary.

### Plant species composition

The vegetation of the catchment forest is typical of montane forest, but there is variation in plant species composition due to local climatic variations and altitude. The general rule is that species richness declines with an increase in altitude. In Tandai and Tegetero villages, the forest resembles the montane rain forests of the East Usambaras by having dominant tree species such as *Allanblackia ulugurensis*, *Parinari excelsa*, *Ocotea usambarensis* and remnants of *Antiaris usambarensis* on the lower parts of the catchment forest. In Nyandira, where conditions are less humid and colder, species composition in the forest is low and quite different with *Dodonea viscosa*, *Xymalos monospora* and *Scolopia zeyheri* being the dominant species.

Table 5 shows that the catchment forest adjacent to Tegetero is richer in species, followed by Tandai and Nyandira was the least rich of them all. Tegetero still leads even if we exclude the two exotic species (*Grevillea robusta* and *Cedrella odorata*) which have been used for enrichment of the secondary forest. Based on the common trend that mature and less disturbed ecosystem tends to have high species diversity (von Humboldt, 1994), it seems, therefore, that the catchment forest at Tegetero is more mature and less disturbed than in other villages. This is partly explained by low population pressure and hence low demand for forest products. Poor accessibility to the village also makes it difficult for illegal loggers to exploit the forest profitably.

In the case of Nyandira, the low species diversity could, in addition to high population, probably be explained by the influence of climatic factors. Being on

the leeward side to the west of Tandai and Tegetero, the climate in Nyandira is less humid and according to Janzen (1973), such areas in the tropics tend to have lower species diversity.

Table 5: Number of species counted in the catchment forest sample plots at Tandai, Tegetero and Nyandira villages

Category	Tandai	Tegetero	Nyandira
Upper storey trees	16	25	15
Middle canopy	20	26	10
Shrubs	6	7	4
Other plants (herbs + climbers)	17	10	23
<b>Total</b>	<b>59</b>	<b>68</b>	<b>52</b>

### Vegetation density and natural regeneration

The results in Table 6 show that the Uluguru Mountains catchment forest differs greatly in the different villages in terms of the overall plant vegetation density, density of the most common upper storey tree species, and the structure of the forest with respect to diameter distribution. At Tandai, the most abundant tree species include: *Allanblackia ulugurensis*, *Parinari excelsa*, *Macaranga kilimandscharica*, *Albizia glaberrima*, *Syzygium cumini*, *Newtonia buchananii* and *Synsepalum cerasiferum*. These species are also the most common species in the lowland rain forest of the East Usambara Mountains (Hamilton, 1989). The catchment forest at Tegetero is dominated by *Myrianthus arboreus*, *Sapium ellipticum*, *Vitex amaniensis*, *Erythroxylum emarginatum*, *Cylicomorpha pariviflora*, and a low density of *Newtonia buchananii*, *Allanblackia ulugurensis*, and *Macaranga kilimandscharica* that as noted above have high abundance in Tandai. The catchment forest at Nyandira village is similar to other villages in having *Macaranga kilimandscharica* as one of the most abundant species and *Ocotea usambarensis* as the rarest species. It differs from other villages by having *Dodonea viscosa*, *Maesa lanceolata*, *Myrica salicifolia*, *Cussonia spicata* and *Myrsina melanophloeos* as the most abundant species.

The diameter class distribution results of this study (Table 6), show that more than 90% of the vegetation of the Uluguru mountains forests neighbouring Tandai, Tegetero and Nyandira villages is occupied by small trees, shrubs and wood and woody climbers that are in the diameter class of 25cm or less. Trees with dbh 26cm to 45cm, that normally form the upper storey cover of the forest, constitute less than 10%, and trees larger than 45cm account for 1-3% only. *Ocotea*

*usambarensis* was among the species with the lowest density. The diameter distribution pattern over different villages, especially between development stages, provide better understanding of the status of the species in forest succession.

The catchment forest at Tandai village has a more continuous diameter distribution covering all stages of forest growth than at Tegetero. The largest recorded diameter (255cm) was observed for *Ocotea usambarensis* at Tandai. It is possible that the absence of *Albizia glaberrima* and *Syzygium guineense*, which grow to massive trunk like *Ocotea usambarensis* at Tegetero, contributed to such low diameter distribution. Diameter distribution at Nyandira is limited to a diameter class of 46-55cm that is similar to the secondary forest at Tegetero that has been modified and degraded by cultivation. This supports the observation that forest disturbance is also one of the major causes for poor diameter distribution (Geldenhuys and Murray, 1993).

Table 6: Diameter distribution of trees, shrubs and woody climbers in the Uluguru Catchment forests in sample villages

Diameter class cm	Density ( stems ha-1)			
	Tandai	Tegetero		Nyandira
	Primary forest	Primary forest	Secondary forest	Primary forest
<15	1,600	1300	2,000	2,000
15-25	210	120	80	240
26-35	80	70	20	110
36-45	80	30	10	50
46-55	40	20	20	25
56-65	5	10	–	–
66-75	–	10	–	–
76-85	5	–	–	–
86-95	5	–	10	–
96-105	–	–	–	–
>105	5	10	–	–
Total density	2,030	1,570	2,140	2,425
	Percentage of stems			
<25	90	90	96	93
26-45	8	7	2	6
>46	2	3	2	1

Natural regeneration is more diverse by villages, species and growth stage. In Tandai, *Synsepalum cerasiferum*, *Newtonia buchananii*, *Allanblackia ulugurensis* and *Erythroxylum emarginatum* regenerated profusely in terms of seedlings, saplings and young trees (Table 7). In Tegetero, *Erythroxylum emarginatum* and *Tabernaemontana pachysiphon* were abundant. In Tandai and Tegetero, on average

75% of the canopy species has regeneration, but only 28% in Nyandira have natural regeneration mainly by young trees, there are no seedlings and saplings. It was noted in this study that *Ocotea usambarensis* has no regeneration at all as has been observed in Kenya (Noad and Birnie, 1989), and in the East Usambara mountains (Hamilton and Bensted-Smith, 1989). In South Africa within the Northern Transvaal Forest region, *Ocotea kenyensis* a close relative to *Ocotea usambarensis* has also been noted to have no regeneration (Geldenhuis and Murray, 1993). Density and regeneration of trees species and shrubs recorded in sample plots are shown in appendix 3.

In this study, there seems to be no clear relationship between presence of regeneration and density of mature trees of the species selected. At the Lushoto arboretum a woodlot of *Ocotea usambarensis* established in 1979 maintains considerable amount of natural regeneration through seedlings in the plot. Also in Pare Mountains the species has no regeneration problem (Kalaghe pers. com.). Kimariyo (1972) reported that seeds of *Ocotea usambarensis* in the Usambaras are eaten by squirrels. Also local people in the Usambaras have observed that the squirrels are most likely the most important agents for the regeneration of *Ocotea usambarensis* and *Podocarpus usambarensis*. Other people in West Usambara Mountains report that seeds of *Ocotea usambarensis* are eaten and dispersed also by hornbills, the common bulbul and larger wild animals like the blue monkey and bush baby.

According to some local communities in the Ulugurus, the lack of seedlings of *Ocotea usambarensis* is associated with the fact that birds like the wood doves (Mahuwa) which feed on the seed of this tree and other tree species are now rare in the catchment forest. Msanga (1998) noted that *Ocotea usambarensis* seed has a seed coat that must be peeled off to enhance germination. It could also be that some ecological changes might have occurred that have affected the population and or the behaviour of the agencies that provide this pre-treatment. However, it is difficult through this study alone to explain the regeneration status of *Ocotea usambarensis* and other selected species. More detailed studies on natural regeneration of *Ocotea usambarensis* and other associated species need to be done to shed more light on the subject.

Table 7: Density of regeneration for selected upper storey trees in sample villages in the Uluguru Catchment forests.

Villages	Tree species		Density (plants ha <sup>-1</sup> )				
	Local names	Latin names	Seedlings	Saplings	Young trees*	Mean	Mature upper storey trees
Tandai and Tegetero	Mkumburu	<i>Synsepalum cirasiferum</i>	4,800	0	50	1,617	5
	Mkuvi	<i>Newtonia buchananii</i>	5,300	350	16	1,889	11
	Mkanyi	<i>Allanblackia ulugurrensis</i>	1330	380	58	589	32
	Mfoza	<i>Ficus stuhlmanii</i>	0	0	3	1	5
	Mseli	<i>Ocotea usambarensis</i>	0	0	0	0	14
	Mgama	<i>Parinari excelsa</i>	3,400	180	40	1,207	27
	Lutambala	<i>Erythroxylum emarginatum</i>	8,230	1000	130	3,120	–
	Mlengolengo	<i>Tabernaemontana pachysiphon</i>	1200	270	5	492	–
Nyandira	Mhange	<i>Dodonea viscosa</i>	0	300	170	157	37
	Mnguti	<i>Maesa lanceolata</i>	0	0	50	17	21
	Mkongolo	<i>Macaranga kilimandschrica</i>	0	0	5	2	21
	Mmungu	<i>Myrica salicifolia</i>	0	0	10	3	21
	Mseli	<i>Ocotea usambarensis</i>	0	0	0	0	11

Young trees\* = all trees with 5-15dbh

### Special features in the forest

This study has noted the existence of foreign species that may be invasive and therefore may disturb the condition of the forest. Examples of species that were recorded in the catchment forest which are documented elsewhere as invasive include *Maesopsis eminii*, *Lantana camara* and *Cedrella odorata*. *Maesopsis eminii* is known to be an invasive species in the East Usambara and is able to invade even apparently undisturbed forest with serious threat to the survival of many endemic species (Cronk and Fuller, 1995). Similarly the use of *Cedrella odorata* for enrichment of the catchment forest and for planting on farm lands should be done with great care because it is also among the invasive species. The use of indigenous species is often recommended for enrichment of the catchment forest instead of exotic species. This is because the use of exotic species could result in the modification of the habitat and therefore jeopardise the existence of many species. There also exist trees with special features such as being extraordinarily large. The largest tree in the plot was *Ocotea usambarensis* that had dbh of 255cm.



## User Groups and Plant Species Diversity Exploited

### Type and number of user groups

A list of user groups of forests, trees, shrubs and herbs recorded in the three villages is given in Appendix 6. A total of nine main user groups were identified in Tandai and Tegetero and ten groups in Nyandira village. The number of subgroups varied between 26 in Tegetero to 28 in Tandai.

The three villages do not differ much in the composition of user groups. However, Nyandira is the only village where there is traditional irrigation on farm lands, livestock keeping involving goat for dairy and pig for commercial production of pork. Nyandira is also the only village where intensive use of climbing stakes for peas, green beans and tomatoes is done. The village also has groups of farmers who are involved in collecting indigenous tree seeds and raising of seedlings.

The use of living trees as support to black pepper vines was found a common feature at Tandai and Tegetero villages. There are also some other differences between villages whereby, for example, the use of fuelwood for smoking banana and iron smith works was common in Tandai. The village is also noted for having people with experience in extraction of cooking oil from fruit of *Allanblackia ulugurensis* tree.

Two categories of user groups were identified based on the type of utilities they are benefiting from these resources. The first category that consists of the majority of users who benefit from the productive functions of the forests, trees, shrubs, herbs and other types of plants. The second category consists of those who are benefiting from the biological functions of these resources. This consist of water users and the farmers who are cultivating near forests where conditions of moisture and soil fertility are considered to be more favourable than in farm lands far away from the forest. The water user group has members who range from those who use it for domestic and traditional irrigation on farm lands at village level to those in Dar-es-Salaaam who use the water for domestic and industrial/commercial purposes. The latter group of users depend on the River Ruvu whose source is the Uluguru Catchment Forest Reserve to meet their water needs.

Ecotourism was noted as an emerging activity at Tegetero. Plans are underway to make it one of the formal development activities to be managed under the village government. Under the arrangements being worked out by the village authorities, interested parties will be charged an entry fee for a visit into the

forest and other interesting features in the village. Extension projects working in the area should find out how to assist in identifying such parties such as scientists and tourists. Also the legal procedure for charging and use of the revenue generated should be established.

### **Plant species utilised by different user groups**

An analysis of plant species utilisation by different user groups was done in order to identify the most utilised plant species; their sources and how the user groups interact with each on the utilisation of the species. Appendix 7 gives a list of the most used species by different user groups and its source. Different forest user groups identified 128 plant species out of a total of 273 as the most utilised or preferred species. About 71 species (56%) were recorded to have their source in the forest while 57 species (44%) from farmland. This indicates that the forest is the main source of the species most utilised or preferred by different forest users groups hence the pressure towards utilising forest products from the catchment is considerable.

It was observed that the preference for certain species was based on various characters such as quality of the wood, stem straightness, size, durability and suitability of the species for the desired use. Most of the high value species for different user groups such as timber, high quality poles and rafters, ropes, and medicinal plants are obtained from the forest. This includes *Newtonia buchananii*, *Ocotea usambarensis* for timber, Mhanvi, *Dodonea viscosa*, *Xymalos monospora* and *Scolopia zeyheri* for poles and rafters, Mwenyemkulumi, *Erythroxylum emarginatum*, Lufunalundi and *Dioscorea longicuspis* for ropes. For medicinal use see Hamisy *et al.* (2000). Due to the fact that the process is species selective it affects the tree species composition in a long run. Some of the highly preferred species are now not readily available. For instance during our study we didn't find Mhavi which is a highly ranked pole species. Other species which were mentioned during the interview and were rarely recorded during the field survey include; *Landolphia buchananii*, Lufunalundi, Mwenyemkulumi and Lukanga. Local initiatives to domesticate some of the most useful plant species such as *Urera hypselodendron* and *Basella alba* for vegetables, *Maesa lanceolata* and *Bidens holstii* for medicinal use and *Khaya anthotheca* and *Milicia excelsa* for timber were noted. This effort needs to be encouraged and supported.

Further analysis of the use of species shows that, 50% of the plant species were mentioned for one most important use; 46% for 2-3 uses and 4% for more than three uses. However, with the extensive deforestation that has taken place in the area, the restricted entry and use of forest reserves, together with the high and growing demand for many forest products, there is an increasing trend for species to be used for many uses. For instance, several farmers in the study area

reported that they are often not selective about tree species for fuelwood, and climbing stakes for peas, beans and tomatoes.

An analysis of possible interactions that exist among user groups shows that most of the species given in Appendix 7 compete for many uses. The competition is more serious among wood user groups than non-wood users. For example *Ocotea usamabarensis*, *Khaya anthotheca*, *Artocarpus heterophyllus*, *Synsepalum cerasiferum*, *Albizia gummifera*, *Leptonychia usambarensis*, *Allanblackia ulurugurensis*, *Rhus vulgaris*, *Maesa lanceolata* are highly used for fuelwood, poles, timber and hand tools. This competition affects the condition of the forest as a large number of tree are cut to meet local demand.

There is also competition between wood and non-wood users that need to be harmonised to avoid conflicting interest. For instance, the use of *Milicia excelsa*, *Khaya anthotheca* and *Cedrella odorata* as supporters of black pepper have negative influence on the timber user group. Farmers faced difficulties in deciding whether or not to harvest a tree having black pepper which also has high economic value. Harvesting of mango trees for fuelwood and *Artocarpus heterophyllus* for timber affected negatively the fruit user group. It was also noted that excessive wood harvesting in the catchment forest affects the function of the catchment forests with regard to biodiversity conservation and watershed management. Already people in the study area have noted a decrease in rainfall, unpredictable rainfall pattern and drying of streams due to disturbed hydrological cycle.

## Village committees and their relationship to forest management

At village level development activities are spearheaded by the village government through its executive arm - the village executive committee. The executive committee is made up of a number of committees including the Defence and Security; Finance and Planning Committee and Community Development and Social Welfare. These committees are the main link between the community and outsiders. Any village with strong government leadership could be step ahead in planning village development activities.

During the study it was noted that none of the three villages has established a committee to handle environmental issues. However, of the three, Tandai seems to be doing a little better in managing the resources for the good of the community. Village authorities deploy members of the Defence and Security committee to oversee the protection of forests on public lands. Also the Economic Planning and Finance committee collects a levy from forest and agricultural products harvested in and or passing through the village. Of the revenue collected from the forest products 30% is used by village government to fund various development projects such as education and health while the rest goes to the Town Council in Morogoro.

The following comments made by the village authorities and community members with respect to the management of the catchment/reserve forests reflect their alienation in the management of the same:

- Outsiders benefit more from the catchment forest reserve than communities living near them, e.g. water users.
- There is no transparency in issuing permits to pitsawyers on public land, and there is poor follow-up regarding the conduct of the licensee in the forest.
- Forest extension staff rarely attend village meetings hence villagers' views are not taken into consideration in the management of the reserve.
- Villagers are not updated with current information e.g. changes in the new forest policy.
- Village government lack confidence and funds to follow-up many issues related to forest management.
- Foresters exploit the forests for their own good although they pretend to protect them.
- There are some conflicts between neighbouring villages on the protection of both catchment and public forest e.g. people from neighbouring villages do illegal harvesting in other villages.
- There is poor response or lack of action to improve natural regeneration of some threatened tree species such as *Ocotea usambarensis*.
- Villagers need to be allowed to harvest dead/fallen valuable timber species in the catchment forest under agreed conditions.

Given the absence of formal structures, which specifically deal with matters related to environment/natural resources management the village authorities, have limited or no influence on the management of the forest reserves. This has also partly contributed to the limited involvement of local communities in the management of forest reserves. However, the Act establishing the village government provides for establishment of sub-committees as the need may arise to handle issues of importance to the development of the village. At this juncture establishing of an environmental sub-committee in study villages is inevitable. Establishing of this sub-committee will stimulate forest management in respective villages. This sub-committee could have the following roles:

- supervise and control utilisation of forest resources
- ensure regulation concerning the natural resource utilisation are adhered
- plan and supervise environmental related activities
- prepare and implement environmental by-laws for natural resources management
- promote sustainable use of natural resources etc.

To promote sustainable forest management under village government the Uluguru Mountain Biodiversity Conservation Project and its partners could assist preparation of Village Resource Management Plan. Forest user groups could be taken as an entry point during the preparation of Village Resource Management plan. Responsibility of implementation of the management plan in the village could be with the environmental committee. Financial support from the UMBCP can be granted to village projects that aim at promoting sustainable use of forest products and management. However, village by-laws need to be enacted to empower the environmental committee for effective implementation of the management plan and Village Resource management Plan. Furthermore the strategy for inter-school competition on environmental matters which has been initiated by the UMBCP at Tandai and Nyandira has to be strengthened and if possible not only schools but also villagers.

### **UMADEP activities and its influence on forest management**

The Uluguru Mountains Agriculture Development Project (UMADEP) aims to improve agricultural production in the Ulugurus. It started in 1990 focusing on improved vegetable and fruit production. Currently in addition to the improvement of crop and livestock production, it addresses issues that impacts on agricultural development such as credit and transport. Promotion of intensive agricultural production through better land husbandry practices is given high priority by the project in order to increase productivity per unit area. In the long run such an approach will contribute to sustainable protection of forests in the

Uluguru Mountains, a large part of which has been cleared for farming. To achieve its objectives the UMADEP promotes many activities including:

- Contour terraces for soil and water conservation that are planted mainly with vegetable crops.
- Production of dairy goats for milk and manure. Pig rearing is also quite common at Nyandira village, where the majority of the people are Christians. Manure from the pigs is extensively used for soil fertility improvement in the terraces.
- Establishment of tree nurseries, mainly by primary schools for afforestation.
- Provision of credit facilities for farmers at Nyandira and Tandai and other neighbouring villages.
- Identification/establishment of farmer groups for farmer-to-farmer visits and training.
- Indigenous knowledge systems mainly in traditional use of plants as medicine for human diseases and as pesticides.

It is now almost 10 years since the UMADEP was established in the Ulugurus. Considering that agricultural development is a slow process, this is too short a period for the project to have significant impact on the farming system and hence on the conditions of the natural forest. However, it was interesting to note that the project has succeeded in promoting the use of contour terraces as a larger proportion of farmers in Nyadira have adopted them. Furthermore, many farmers in all three villages interested in growing trees on their farm lands instead of depending on the natural forests for the same.

The major constraint facing the UMADEP, like many other related development projects in Tanzania, and in many parts of Africa (Kerkhof, 1990) is lack of a well-developed and functioning holistic approach to solve the problem of declining land productivity. There are also a number of other issues that the project need to be address including:

- Integration of trees on farm lands to meet the growing local demands for fuelwood, timber, fodder, climbing stakes etc.
- Soil productivity aspects of trees through appropriate agroforestry practices e.g. improved fallow, hedge row intercropping (alley cropping), trees on contour terraces, etc.
- Preparation of village land use plans for effective natural resource management.
- Development of infrastructure for irrigation agriculture in order to serve many more farmers than is currently the case in Nyandira. There is also need to educate the local people of the importance of irrigation agriculture in villages where potential for the same exist, such as Tegetero.
- Improvement of germplasm for many tree and agricultural crops.
- Domestication of high value indigenous plants.

It is expected that these issues will be addressed through collaborative programmes involving the UMADEP and UMBCP.

### **The role of regional catchment forest office**

The Regional Catchment Forest Office in Morogoro is responsible for managing central government forest reserves that are of strategic importance as watershed areas. These include the North and South Uluguru forest reserve. The establishment of the North Uluguru forest reserve is reported to have started in 1914 and completed in the early 1950s. According to the maps of the Uluguru forest reserve prepared in 1964 the location of the boundary by altitude varies in different villages. The forest reserve starts at c.1000-1200 masl in Tandai and Tegetero and c.2000 masl at Nyandira. The forest reserve reaches the highest point of about 2600 masl at Kimhandu and Lukwangule peaks in Uluguru South.

Among the activities undertaken by this office include the following:

- Creation of awareness among people on the importance of the protection of the Uluguru Mountain forests for water catchment.
- Carrying out patrols around and inside the forest to curb illegal harvesting and detect encroachment into the forest.
- Cooperation with other different organisations such as the UMADEP and UMBCP that can influence the protection of these forests.
- Assessment of water yield in rivers originating from these forests. Currently work is established along the Ngerengere and Bigwa rivers.
- Formulation and dissemination of strategies to prevent cultivation along rivers. Farmers are advised to set a buffer zone between the riverine and farm land. The recommended buffer zone for major rivers and streams respectively is 50m and 30m.

The following are some of the constraints that affect the performance of the office in managing the catchment forest reserve:

- Inadequate number of extension staff making it difficult to detect and control illegal harvesting.
- Lack of local communities involvement in the protection of the forests.
- Lack of linkage with local government in Morogoro that supports its activities
- Lack of adequate information on the status of the forests, user groups and the plant species that are harvested and threatened or endangered in the catchment.
- Lack of updated maps of the forest reserve.

- Lack of integration of activities undertaken by the office and various organisations (including UMADEP) involved in the conservation of the Uluguru Mountains at the level of planning and implementation.
- Extension staff are ill-informed of the new National Forest Policy.



## CHAPTER FOUR

### CONCLUSION AND RECOMMENDATIONS

#### Conclusion

The Uluguru Mountain Catchment forest reserve has a multiple use for various users surrounding it. The community surrounding it depends on it as the main source of many products and services. Also the reserve is an asset of national values and International interests where natural resources have to be conserved in order to provide adequate sustained yield of products for the benefit of people with less deterioration of habitat and maintaining the areas unique natural ecosystem, aesthetic and scientific interest.

The catchment forest reserve is the main source for the majority of the species utilised or preferred by the local people. The preference for certain species is based on various characters such as quality of the wood, stem straightness, size, durability and suitability of the species for the desired use. Deforestation and restricted entry into the forest reserves has forced the local people away from being selective about preferred tree species for fuelwood, and climbing stakes for peas, beans and tomatoes. Most of the recorded species are used for many uses and this affects the condition of the forest as a large number of trees are cut to meet local demand. Some species e.g. *Ocotea usambarensis* which was heavily exploited in the past is threatened of extinction due to poor natural regeneration. Lack of regeneration in the forests has no clear relationship to the current harvesting intensity and to the population of mature trees in the studied forests. There are some local initiatives on a limited scale to domesticate some of the most useful plant species such as *Urera hypselodendron* and *Basella alba* for vegetables, *Maesa lanceolata* and *Bidens holstii* for medicinal use and *Khaya anthotheca* and *Milicia excelsa* for timber. Tree planting was pointed out as means towards attaining sustained availability of tree products. However, insecure ownership of land embedded in the traditional norms of the Lugurus appears to constrain tree planting on farm lands.

The impact of the UMADEP on the farming systems and hence conservation of the Uluguru Mountains catchment reserve is limited because of failure to adequately integrate agroforestry practices in existing farming systems. Consequently, the needs of a wide diversity of user groups have not been met hence their continued dependence on the forest reserve for many products.

There is an apparent lack of formal structure(s) in some villages to deal with environmental issues. The protection of the catchment forest reserve is purely the responsibility of the central government through its regional catchment office.

With limited manpower and finances the government is unable to ensure proper management of the reserves and hence the noted high intensity of tree harvesting in the catchment forest as well as the mismanagement of the Nyamiduma planted forest in Nyandira.

It is obvious that conservation of Uluguru Mountains forest reserve will not be achieved without the support of local communities. Therefore, involvement of local communities in decision-making and management is essential. Benefit sharing mechanisms which will contribute to the local communities' economic development and provision of alternative sources of forest products are required to attain ecologically sustainable production and utilisation of natural resources.

### **Recommendations**

Based on the above conclusion the study makes the following recommendations:

- Forest user groups should be used as an entry point for developing alternative ways that reduce pressure on the natural forest and avoid conflicting interest on the resources.
- Village environmental sub-committee need to be established with roles that are well defined and understood by the villagers.
- To ensure sustainable utilisation of resources Village Resource Management Plan need to be prepared.
- The selection of tree species for planting on the farm lands should be demand-driven, compatible with other land use, adapted to site condition, free of legal restriction, fast growing with high yields and good quality products.
- Farmers should be encouraged to plant a wide diversity of indigenous tree species on farmland that can withstand diseases and pests.
- Derelict sites on farmland should be earmarked for intensive tree planting.
- Appropriate agroforestry technology need to be developed within existing farming systems that will provide options for farmers in the area to deal with the problem of soil fertility, continued dependence on natural forest and environmental conservation.
- In addition to *Khaya anthotheca* and *Milicia excelsa* a number of indigenous plant species both for wood and food that are on the verge of extinction. These have to be identified for domestication.
- Strategies for improving natural regeneration of the rare species such as *Ocotea usambarensis* have to be developed.
- There is need to integrate appropriate agroforestry practices in existing farming systems.

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## APPENDECES

Appendix 1: Tree density (tree/ha) on farmlands at Tandai, Tegetero and Nyandira villages

Local name	Scientific names	Tandai	Tegetero	Nyandira	Exotic/Indigenous
Kitugutu		3	64		Indigenous
Mtunu	<i>Harungana madagascariensis</i>	64			Indigenous
Mkundekunde	<i>Senna persiana</i>	6			Indigenous
Mdarasini	<i>Cinnamomum zeylanicum</i>	64	159		Exotic
Mchungwa	<i>Citrus sinensis</i>	32			Exotic
Mparachichi	<i>Persea americana</i>	3	14		Exotic
Mng'ongo	<i>Sclerocarya birrea</i>	3			Indigenous
Mshelisheli	<i>Artocarpus altilis</i>	3			Exotic
Mfenesi	<i>Artocarpus heterophyllus</i>	3	5		Exotic
Mwiza	<i>Bridelia micrantha</i>	64	32		Indigenous
Mzambarau	<i>Syzygium cuminii</i>	6			Exotic
Mwembe	<i>Mangifera indica</i>	10			
Msada	<i>Vangueria infausta</i>	6			Indigenous
Mkuyu	<i>Ficus lutea</i>	10			Indigenous
Mtomokwe	<i>Annona senegalensis</i>	32			Indigenous
Mtunukiwala	-	3			Indigenous
Mwambalasimba	<i>Senna hirsuta</i>	3			Indigenous
Mhokahoka	-	6			Indigenous
Msedereya	<i>Cederela odorata</i>	3			Exotic
Mzenkonzeko	<i>Hoslundia opposita</i>	3			Indigenous
Mtamba/Kivambo/Mfoza	<i>Ficus stuhlmanii</i>	13			Indigenous
Mkarafuu	<i>Syzygium aromaticum</i>	10	9		Exotic
Mbono	<i>Jatropha curcus</i>	32	9		Indigenous
Mkulagembe/Msulu/Kitunune	<i>Rhus vulgalensis</i>	6		32	Indigenous
Mvule	<i>Milicia excelsa</i>	6			Indigenous
Msugusugu	<i>Erlangea cordifolia</i>		9		Indigenous
Kisukuma	-	10			Indigenous
Mhelehele	--	32			Indigenous
Mtelewanda	<i>Markhamia obtusifolia</i>	64			Indigenous
Mkumburu	<i>Afrosersalisia cerasifera</i>	3	14		Indigenous
Kilulunzi	<i>Byrsocarpus orientalis</i>	3			Indigenous
Mbwendere/Nyarungubi	<i>Cyphostemma adenocaulle</i>	6			Indigenous
Mbaazi	<i>Cajanus cajan</i>	3			Exotic
Msasa	<i>Ficus exersperata</i>	3			Indigenous
Luhalamila/Luhambamti	<i>Culcasia scandens</i>	64			Indigenous
Mkanyi	<i>Allanblackia uluguruensis</i>	32			Indigenous
Mkuvi	<i>Newtonoa buchananii</i>	32			Indigenous
Mdosa	<i>Greenwayodendron suaveolens</i>	32			Indigenous
Lubambalamaziwa	<i>Rytigynia lichenoxenos</i>	10			Indigenous
Kitunuse	<i>Tarenna pavettoides</i>	32			Indigenous
Mdulu	--	13			Indigenous

Local name	Scientific names	Tandai	Tegetero	Nyandira	Exotic/Indigenous
Mfuruti	<i>Vitex amaniensis</i>	3			Indigenous
Mhilihili pori	<i>Sorindeia madagascariensis</i>	3			Indigenous
Kifonali	<i>Mesogyne insignis</i>	10			Indigenous
Mtomondo	-	3			Indigenous
Msenze	<i>Celtis gomphophylla</i>	32			Indigenous
Mfuru	<i>Vitex doviana</i>		5		Indigenous
Msenene	<i>Clausena anisata</i>		32		Indigenous
Mlilati	<i>Zenkerella schliebenii</i>		5		Indigenous
Kizabi	<i>Agelaea heterophylla</i>		32		Indigenous
Mpera	<i>Psidium guajava</i>		9		Indigenous
Luhungavisozi	-		64		Indigenous
Mbetambeta	<i>Alsodeiopsis schumanii</i>		32		Indigenous
Kisembeta	<i>Centella asiatica</i>		64		Indigenous
Ludendego	<i>Dioscorea lonicuspis</i>		5		Indigenous
Mvumvu	<i>Triumfetta cordifolia</i>			11	Indigenous
Msholebambwa	<i>Tarenna nigrescens</i>		5		Indigenous
Mdugutu	<i>Clerodendrum cephalanthum</i>		14		Indigenous
Lusoto	<i>Bothriocline tomentosa</i>		32		Indigenous
Mhange pori	-		9		Indigenous
Luhalamila	<i>Culcasia scandens</i>		64		Indigenous
Lukokwa/Lutambala	<i>Erythroxylum emarginatum</i>	32	64		Indigenous
Kaskazi	-		32		Indigenous
Mtugutu	--		32		Indigenous
Mkengepori	<i>Albizia gummifera</i>		32	4	Indigenous
Gerevelia/Mnyaweza	<i>Grevillea robusta</i>		32	64	Exotic
Mubuni	<i>Coffea arabica</i>		32	32	Exotic
Mngutinguti	<i>Maesa lanceolata</i>		64		Indigenous
Makulata	<i>Eucalyptus maculata</i>			95	Exotic
Mkataluba/Msepulasi	<i>Cupressus lusitanica</i>			32	Exotic
Luchelechele	<i>Phyllanthus anarus</i>			7	Indigenous
Vigenge	-			11	Indigenous
Mwalimudumu	<i>Hypericum revolutum</i>			32	Indigenous
Msombolanga	<i>Acacia mearnsii</i>			414	Exotic
Maidini	<i>Eucalyptus maidenii</i>			350	Exotic
Mfifi	<i>Rubus scheffleri</i>			11	Indigenous
Mkilingala	<i>Pavonia urens</i>			32	Indigenous
Lutizo	<i>Veronica abyssinica</i>			32	Indigenous
Nomomomo	<i>Leonotis mollissima</i>			7	Indigenous

Appendix 2: List of farmland plant species recorded at Tandai, Tegetero and Nyandira villages.

Local name	Scientific name	Habit	Tandai	Tegetero	Nyandira	Uses
Mdalasini	<i>Cinnamomum zeylanicum</i>	tree	x	x		Spice, fuelwood
Mkarafuu	<i>Syzygium aromaticum</i>	tree	x	x		spice
Mnazi	<i>Cocos nucifera</i>	tree	x	x		cooking oil
Ndizi	<i>Musa sp</i>	herb	x	x		commercial fruits
Magimbi	<i>Calocasia esculenta</i>	herb	x	x	x	
Pilipilimanga	<i>Piper nigrum</i>	climber	x	x		commercial spice
Mshelisheli	<i>Artocarpus altilis</i>	tree	x	x		fruits
Parachichi	<i>Persea americana</i>	tree	x	x		fruits
Mwembe ng'ongo	<i>Sclerocarya birrea</i>	tree	x	x		fruits
Plamsi	<i>Prunus salicifolia</i>	tree			x	fruits
Pichesi	<i>Prunus americana</i>	tree			x	fruits
Epulusi	<i>Molus communis</i>	tree			x	
Mchungwa	<i>Cirtus sinensis</i>	tree	x	x		fruit
Mkahawa	<i>Coffea arabica</i>	tree	X	x		cash crop, fuelwood, poles
Mfenesi	<i>Artocarpus heterophyllus</i>	tree	x	x		fruit
Mwembe	<i>Mangifera indica</i>	tree	x	x		fruits
Mbaazi	<i>Cajanus cajan</i>	shrub	x	x		medicinal, oil seeds
Mbono	<i>Jatropha curcus</i>	shrub	x	x		medicinal
Msedelela	<i>Cedrela ordotata</i>	tree	x	x		timber, poles
Mgerevelea/ Mnyaweza	<i>Grevillea robusta</i>	tree	x	x		timbers, poles, fuelwood
Maidini	<i>Eucalyptus maidenii</i>	tree			x	timber, fuelwood ,poles, climbing stakes
Makulata	<i>E. maculata</i>	tree			x	timber fuelwood, poles, climbing stakes
Msimboulanga	<i>Acacia mearnsii</i>	tree			x	fuelwood, poles, climbing stakes, ropes, fuelwood
Mnyanyamti	<i>Lycopersican esculentum</i>	herb	x	x	x	fruit
Mvinje	<i>Casuarina cunninghamiana</i>	tree			x	Fuelwood, timber
Mzambarau	<i>Syzygium cuminii</i>	tree	x	x		fruit, fuelwood
Mstafeli	<i>Annona muricata</i>	tree	x	x		fruit
Mfifi	<i>Morus alba</i>	tree			x	fodder, fruit
Msufi	<i>Ceiba pentandra</i>	tree	x	x		fibre for mattress
Kaeba/Kisamvu	<i>Manihot sp.</i>	tree	x	x		vegetable
Mitende	<i>Elacis quineensis</i>	tree	x	x		oil
Mihogo	<i>Manihot exculents</i>	shrub	x	x		food
Mpapai	<i>Carica papaya</i>	tree		x		fruit
Mpunga		Grass	x	x		
Mahindi	<i>Zee mays</i>	Grass			x	food
Viazi vitamu	<i>Ipomoea batatas</i>	climber	x	x		food

Local name	Scientific name	Habit	Tandai	Tegetero	Nyandira	Uses
Maboga	<i>Cucurbita sp.</i>	climber	x	x	x	fruits, vegetable
-	<i>Vitex keniensis</i>	tree			x	potential for agroforestry and gap enrichment
-	<i>Hagenia abyssinnica</i>	tree			x	potential for agroforestry and gap enrichment
Utupa	<i>Tephrosia vogelii</i>	shrub			x	<b>Demonstration plots</b>
-	<i>Sesbania sesban</i>	shrub			x	"
-	<i>Calliandra calothyrsus</i>	tree			x	"
Myegea	<i>Kigelia africana</i>	tree		x		Medicinal
Mkataluba/Msepulasi	<i>Cupressus lucitanica</i>	tree			x	Timber, poles, fuelwood
Viazi mviringo	<i>Solanum tuberosum</i>	herb			x	food
Mnanasi	<i>Ananas comosus</i>	herb	x	x		fruit, Cash crop
Kaskasi	-		x	x		Thatch grass, erosion control
Miwa	<i>Sacherrum officinalum</i>	grass	X	x		food chewed
Mvule	<i>Millicia excelsa</i>	tree	x	x		timber, medicinal
Mkangazi	<i>Khaya anthotheca</i>	tree	x	x		timber, poles, hand tool, fuelwood, medicinal
Mtama	<i>Sorghum vulgare</i>	grass	x	x		food
Mahimbi	<i>Colocacia sp.</i>	herb			x	food
Mtomokwe	<i>Annona senegalensis</i>	tree	x	x		fruits, fuelwood, hand tool
Mguhu	<i>Syzygium cordatum</i>	tree	x	x		Firewood
Mkuyu	<i>Ficus lutea</i>	tree	x	x		medicinal, pepper support
Msasa	<i>Ficus exersperata</i>	tree	x	x		medicinal, pepper support
Msada	<i>Vangueria infausta</i>	tree	x	x		medicinal, fruit, firewood,
Mwiza	<i>Bridelia micrantha</i>	tree	x	x		firewood, poles, handtools
Msambwa	<i>Afrosersalisia sp.</i>	tree	x	x		fuelwood, poles
Mfuru	<i>Vitex doviaana</i>	tree	x	x	x	fruit, firewood
Mkundekunde	<i>Senna petersiana</i>	tree	x	x		Medicinal, firewood
Mkong'onolo	<i>Cussonia arborea</i>	tree	x			Traditional beds
Msada pori/Msadamuhulo/Msadamwitu	<i>Canthium oligocarpum</i>	tree	x	x		firewood, Medicinal, withies
Mbefu	<i>Trema oreintalis</i>	tree	x	x		shade, Medicinal
Mwale	<i>Bombax rhodognophalon</i>	tree	x	x		sacred sites
Mvulavula	<i>Albizia harveyii</i>	tree	x			firewood
Mfoza/kivambo/Mtamba	<i>Ficus stuhlmanii</i>	tree	x	x		pepper support, medicinal, firewood



Mtunukiwala	-		x	x		firewood, Medicinal
Mnzekonzeko	<i>Hoslundia opposita</i>	tree	x			firewood, medicinal, poles
Local name	Scientific name	Habit	Tandai	Tegetero	Nyandira	Uses
Msenze	<i>Celtis zenkeri</i>	tree	x	x		firewood
Mpera	<i>Psidium guajava</i>	tree	x	x	x	fruit, firewood, medicinal
Tugutu kubwa	<i>Vernonia myriantha</i>	herb	x	x	x	Medicinal
Mgude	<i>Sterculia appendiculata</i>	tree	x	x		Sacred sites
Mbila	<i>Antiaris usambarensis</i>	tree	x	x		Sacred sites
Mwanakadahwa	<i>Cineraria grandiflora</i>	shrub	x			Withies, poles, & firewood
Mgida/Mkongolo	<i>Macaranga kilimandscharica</i>	tree	x	x	x	Firewood, poles, climbing stakes
Mdugutu	<i>Clerodendrum cephalanthum</i>	shrub	x	x		
Luhangehange	<i>Crotalaria sp Aphloia theiformis</i>	shrub	x	x		
Kitunuse/mbunipori	<i>Tarena pavattoides</i>	shrub			x	fuelwood, poles
Mwalimudung'u	<i>Hypericum revolutum</i>	shrub			x	Climbing stakes, fuelwood
Mkarati	<i>Erythrophleum suaveolens</i>	tree	x	x		Black smith charcoal
Mkenge	<i>Albizia gummifera</i>	tree	x	x		Firewood, handtools
Mlongelongo	<i>Chrysophyllum sp.</i>	tree	x			Poles, Medicinal
Msenene	<i>Dracaena sp.</i>	shrub	x	x	x	Ornamental, medicinal,
Mkumbulu	<i>Synsepalum cirasiferum</i>	tree	x	x		Poles, firewood, fruits
Mtunu	<i>Harungana madagascariensis</i>	tree	x	x		Firewood, poles, medicinal, hand tool
Mkulugembe/msulu /kitunune	<i>Rhus vulgalensis</i>	shrub	x	x	x	Firewood, climbing stakes, fruit
Mtelewanda	<i>Markhamia obtusifolia</i>	tree	x			firewood, handtools, poles
Mngutinguti	<i>Maesa lanceolata</i>	tree	X	x	x	firewood, poles, medicinal, climbing stakes
Mkengekapala	<i>Albizia sp.</i>	tree	x	x		firewood, support pepper, handtools
Mkanyi	<i>Allanblackia uluguruensis</i>	tree	x	x		poles, cooking oil, sacred site
Mkole	<i>Isolana heinsenii</i>	tree	x	x		poles, firewood, medicinal, fodder
Mhangahange	<i>Dodonea viscosa</i>	tree	x			firewood
Mbaazipori	<i>Cajanus sp.</i>	shrub	x			medicinal
Mkuvi	<i>Newtonia buchananii</i>	tree	x	x		poles, timber
Mdigisi	<i>Dracaena usambarensis</i>	tree			x	sacred site
Kitomvutomvu	<i>Caloncoba welwitschii</i>	tree	x	x		handtools,

Mamboleo	<i>Galinsoga parviflora</i>	herb			x	firewood vegetable
Kifutafuta	<i>Ageratum comyzoides</i>	herb			x	medicinal
Kigondichangodo	<i>Spilanthes mauritiana</i>	herb			x	fodder for pigs
Mnyangevuvu	<i>Conyza sumatrensis</i>	herb			x	
Nyaweza	<i>Bidens pilosa</i>	herb			x	vegetable
Local name	Scientific name	Habit	Tandai	Tegetero	Nyandira	Uses
Mlamagego	<i>Melanlthera scandens</i>	herb			x	medicinal
Hombonele	<i>Triumfetta annua</i>	herb			x	vegetable
Mwinika	<i>Crassocephalum crepidioides</i>	herb			x	medicinal
Lunengenenge	<i>Oxalis corniculata</i>	herb			x	medicinal
Mkilingala	<i>Pavonia urens</i>	shrub			x	medicinal
Kitindi	<i>Cerastium indicum</i>	herb			x	vegetable
Buni	<i>Coffea arabica</i>	tree			x	fodder
Silu	<i>Pteridium equilinum</i>	fern			x	medicinal
Lweza	<i>Helichrysum schimperii</i>	shrub			x	medicinal
Ndagokubwa	<i>Cyperus ajax</i>				x	fodder
Kidaka	<i>Cyphostemma braunii</i>	climber			x	medicinal
Mmungi	<i>Myrica salicifolia</i>	tree			x	firewood, climbing stakes, poles, medicinal
Mnomonomo	<i>Leonotis mollissima</i>	herb			x	nector, medicinal
Kologa	<i>Commelina benghalensis</i>	herb			x	fodder for pigs
Nyaluganza	<i>Crassocephalum montuosum</i>	herb			x	medicinal
Kunzegele	<i>Indigofera atriceps</i>	shrub			x	
Luchelechele	<i>Phyllanthus amarus</i>	herb			x	
Mnamvu	<i>Triumfetta rhomboidea</i>	shrub			x	vegetable
Lutizo	<i>Veronica abyssinica</i>	herb			x	medicinal
Mkaroti	<i>Agrocharis incognita</i>	herb			x	vegetable
Mwambalasinba	<i>Senna hirsuta</i>	shrub			x	medicinal
Mgwani	<i>Bambusa vulgaris</i>	grass	x			poles, handtools
Mpilipililukwala	<i>Capsium frutescens</i>	shrub	x			Medicinal
Mwepula	-		x			Medicinal
Unumvu	<i>Triumfetta cordifolia</i>	shrub	x			vegetable
Bunyufu	<i>Isoglossa lactea</i>	shrub	x			
Kinzasu	<i>Dissotis rotundifolia</i>	shrub	x	x		medicinal
Kibumu/Bumu	<i>Mucna pruniens</i>	herbcli mber	x			medicinal
Hungahunga	<i>siphonochilus kirkii</i>	herb	x			medicinal
Mwidi	<i>Justicia heterocarpa</i>	herb	x	x		vegetable
Derega	<i>Basella alba</i>	climber	x	x		vegetable
Chunga	<i>Sonchus luxurians</i>	herb	x	x		vegetable
-	<i>Lantana camara</i>	shrub	x	x		
Lugwekulu	<i>Polygonum sp.</i>	Herb	x			
Kimbwigambwiga	<i>Spermacose princeae</i>	herb	x			medicinal
Nyangenamlamu	<i>Desmodium adscendens</i>	climber	x			
Kigutwi	<i>Centella asiatica</i>	herb	x			
Mhokahoka	-		x			
Gole	<i>Adenia cissampeloides</i>	climber	x			medicinal
Kilulunzi	<i>Byrsocarpus orientalis</i>	shrub	x			

Lufeyafeya	<i>Ipomea obscura</i>	climber	x			medicinal
Mhuluhundu	<i>Momodica foetida</i>	climber	x			medicinal
Kuduvu	<i>Justicia striata</i>	herb	x			
Mbwembwe/Nyawewa	<i>Bidens pilosa</i>	herb		x		vegetable
Lusoto	<i>Bothriocline tomentosa</i>	shrub		x		medicinal
Local name	Scientific name	Habit	Tandai	Tegetero	Nyandira	Uses
Kidere	<i>Rhoicissus tridentata</i>	climber		x		medicinal
Purure	<i>Achyranthes aspera</i>	herb		x		
Lukokwa	<i>Erythroxylum emarginatum</i>	climber		x		ropes, medicinal
Luhalamila/Lubambanti	<i>Culcasia scandens</i>	climber		x		medicinal, ropes
Ludendego	<i>Dioscorea lonicuspis</i>	climber		x		
Kisembeta	<i>Centella asiatica</i>			x		
Segambwa				x		medicinal
Msholebambwa	<i>Tarenna nigrescens</i>	shrub		x		
Kizabi	<i>Agelaea heterophylla</i>	shrub		x		medicinal
Msugusugu	<i>Erlangea cordifolia</i>	shrub		x		medicinal
Kindukule				x		medicinal
Lumotomoto	<i>Hibiscus surattensis</i>	shrub		x		medicinal

**Appendix 3: Density of tree and shrub species (plants/ha) in Catchment forest adjacent to Tandai, Tegetero and Nyandira villages**

Name	Latin names	Tandai				Tegetero				Nyandira			
		Seedlings	<5 DBH	5-25 DBH	>25 DBH	Seedlings	<5 DBH	5-25 DBH	>25 DBH	Seedlings	<5 DBH	5-25 DBH	>25 DBH
Mdosa	<i>Pauridiantha paucinervis</i> spp holstii	9554	4600	477									
Lubambalamaziwa	<i>Rytigynia lichenoxenos</i>	6369	8138										
Mnyagengo/Kifonali	<i>Mesogyne insignis</i>	54140	5661	605		6369	3534	382	32				
Mkole	<i>Leptonychia usambarensis</i>	38216	8493	605			6016	350					
Mkuvi	<i>Newtonia buchananii</i>	12738	3892	64	127	9554	4600	127	32				
Mgama/Muula	<i>Parinari excelsa</i>	9554	1769	318	159	50955	708	32					
Kisusulamugi	<i>Canthium oligocarpum</i> ssp captum	0	1769	32			2123	32				191	
Kitunuse	<i>Tarenna paveltoides</i>	25477	354					32					
Mzambaramwitu	<i>Syzygium guineense</i>	28662	1415	191	64	12739							
Mkanyi	<i>Allanblackia uluguruensis</i>	0	3184	636	127		1415	64	32				
Mhilihili	<i>Sorridelia madascariensis</i>	0	3184	96				32	32				
Muhumula	<i>Maesopsis eminii</i>	0	708	0									
Mzindanguruwe	<i>Maytenus undata</i>	0	353				708						
Bandebande	<i>Agelaea heterophylla</i>	9554	1769	32									
Mkengeng'alala	<i>Albizia glaberrima</i>				159								
Chundi	<i>Memecylon cogniauxii</i>	3185		64									
Mgida/Mkongolo	<i>Macaranga kilimandscharica</i>		1769	478	127			64				350	159
Mkwizili/Mgonang'hanu	<i>Sapium ellipticum</i>		1062	127	32		1062	64					
Mkumburu	<i>Synsepalum cirasiferum</i>		708	318		57324	2123	32					
Mfoza	<i>Ficus stuhlmanii</i>				32								
Kihagamuhulo	<i>Cola microcarpa</i>	28662											
Msenze	<i>Caloncoba welwitschii</i>		1062					64	32				
Kidimudimu	<i>Rinorea arborea</i>		3184										
Konge	<i>Urera hypselodendron</i>		1062									354	
Kisemelele	<i>Trichilia emetica</i>	31845	1415				2123	191	32			1769	
Luhomamvise	-		354										
Mwenyemadola	-		354										
Msungungale	-			64			708						
Mnembenembe	<i>Mimulopsis kilimandscharica</i>	6369				2547		64					
Kitomvutomvu	<i>Lasianthus glomeruliferus</i>		354	64			5308	32					

Mfuruti	<i>Vitex amaniensis</i>		1062	32				32					
Name	Latin names	Tandai			Tegetero				Nyandira				
		Seedlings	<5 DBH	5-25 DBH	>25 DBH	Seedlings	<5 DBH	5-25 DBH	>25 DBH	Seedlings	<5 DBH	5-25 DBH	>25 DBH
Mlawilila	<i>Xylopia aethiopica</i>		1769	64									
Musu	<i>Syzygium spp</i>		708				354	32			354		
Mseli/Mvumba	<i>Ocotea usambarensis</i>				191				32				32
Mtunu	<i>Harungana madascariensis</i>		354										
Msangana	<i>Strombosia scheffleri</i>	47771	354				2862						
Mgidamuhulo	<i>Sericanthe odoratissima</i>		1415	64			3539						
Mnguwanguwa	<i>Anthocleista grandiflora</i>			32									
Mhembeti	-		354		32		354						
Kidimupori	<i>Memecylon semseii</i>		1062										
Mdulu	-		354	32									
Mdugutusungu	<i>Vernonia hymenolepsis</i>					22293	3185	32		3185	354		
Mwizapori	<i>Brideria micrantha</i>						354						
Mkenge	<i>Albizia gummifera</i>					6369	1062						
Msederela	<i>Cedrella odorata</i>						354	32					
Mgerevelia/Mnyaweza	<i>Grevillea robusta</i>						2123	350					
Mlungulungu	<i>Zanthophyllum deremens</i>						2123	64					
Mngutinguti	<i>Maesa lanceolata</i>						708						
Mbefu	<i>Trema orientalis</i>						354	159					
Msenenemwitu	<i>Clausena anisata</i>						708	32					
Kibugamwiru/Kibwetabweta	<i>Alsodeiopsis schumannii</i>					31847	708	32					
Mkamate	-						708	32					
Msole	<i>Tarenna nigrescens</i>						354						
Msambwamwaka	-						1415						
Msenene	<i>Euphorbia egleri</i>						1062				1415	159	
Mzugu	<i>Trilepsium madagascariensis</i>						1415	32					
Mbira	<i>Antiaris usambarensis</i>						708						
Mibuni	<i>Coffea arabica</i>						1769	32					
Mbalazi	<i>Chrysophyllum perpulchrum</i>					19108	1415						
Mlongelonge	<i>Tabernaemontana pachysiphon</i>					35032	1769	255	64				
Lupwagaya	<i>Myrianthus arboreus</i>							127	127				
Mnyalumbwizi	<i>Betiera pauloi</i>						354	32					
Kigidamuhulo	<i>Caloncoba welwitschii</i>					9554	3539	96					
Msanzavikwa	<i>Tarenna quadrangularis</i>					1239	2123	159					
Mhelele	-						4600	255					
Sembe	<i>Cyathea manniana</i>						4600	637			1769	892	

Mfuru	<i>Vitex doniana</i>					354	32	32					
Name	Latin names	Tandai			Tegetero			Nyandira					
		Seedlings	<5 DBH	5-25 DBH	>25 DBH	Seedlings	<5 DBH	5-25 DBH	>25 DBH	Seedlings	<5 DBH	5-25 DBH	>25 DBH
Mlumangandu	<i>Schefflera lukwangulensis</i>					6369	2477	159				64	64
Lutambalamwege	-						354						
Mwenyenhanu/Lumbugi	<i>Desmodium adscendens</i>						2830	255	32				
Msadamwitu	<i>Canthium oligocarpum ssp captum</i>					6369	708	32	32				
Nyakititu	<i>Agelaea heterophylla</i>					41402	2831						
Msambwamwitu	<i>Deinbolia borbonica</i>						1769						
Lutambala	<i>Erythroxylum emarginatum</i>					9954	2123	318	32				
Mhange	<i>Dodonea viscosa</i>									85987	8846	605	64
Mkwegu	<i>Xymalos monospora</i>										21235	287	
Mzona	<i>Scolopia zeyheri</i>										3537	191	
Mnguti	<i>Maesa lanceolata</i>									3185		478	159
Mbwimbwi	<i>Cussonia spicata</i>										354	318	96
Mbembeni	<i>Nuxia floribunda</i>										2477	318	96
Mtununwe	<i>Rhus vulgaris</i>									6369	1769	287	32
Kiberuberu	<i>Chassalia spp</i>									15924	1415	32	
Mpigito	<i>Rytigynia lichenoxenos</i>									9554	708	159	
-	<i>L.kilimandscharicus</i>										1062	64	
Mgelemang'ondo	<i>Myrsine melanophloeos</i>											159	
Mbenesengo	<i>Ochna holstii</i>									12739	1415	96	
-	<i>Cryptocarya kibertiana</i>											159	32
Mfumbi	<i>Berssama abyssinica</i>											159	
Mfifi	<i>Rubus scheffleri</i>									9554	354		
Mwalimudumu	<i>Hypericum revolutum</i>										1062		
Mungi	<i>Myrica salicifolia</i>											32	32
-	<i>Psychotria goetzei</i>									35032	354	191	

**Appendix 4:** Tree species and number of tree individuals cut per plot for withies or stakes ( 1), poles (2) and timber (3) in catchment forest adjacent to Tandai, Tegetero and Nyandira villages.

Local names	Scientific names	Tandai			Tegetero			Nyandira		
		1	2	3	1	2	3	1	2	3
Kifonali/Mnyagen	<i>Mesogyne insignis</i>		6		3	6				
gu										
Mkuvi	<i>Newtonia buchananii</i>		1	2	1		1			
Msangana	<i>Strombosia scheffleri</i>			2	1					
Mgida/Mkongolo	<i>Macaranga kilimandscharica</i>									
Mkumburu	<i>Synsepalum cirasferum</i>			2	3					
Mkanyi	<i>Allanblackia ulugurensis</i>		3			5				
Musu	<i>Syzygium sp.</i>					1				
Mhilihili	<i>Sorindeia madascariensis</i>				3	1				
Mfuru						1				
Lutambala/Lukok	<i>Erythroxylum emarginatum</i>				6	2	5			
wa										
Msanzavikwa	<i>Tarrena quadrangularis</i>			3						
Kimbweto	<i>Alsodeiopsis schumanii</i>	3		1						
mbweto/Kibugamwiro/										
Mperamwitu										
Mlengolengo	<i>Tarbernaemontana pachysiphon</i>			4	1					
Mlilati	<i>Zenkerella schliebenii</i>				1	1				
Mgama/Muula	<i>Parinari excelsa</i>				1					
Mkenge	<i>Albizia gummifera</i>					1				
Mlumangandu	<i>Bertiera pauloi</i>			3	2			2		
-	<i>Trycalisia</i>		1							
Mbarazi	<i>Chrysocephyllum perpulchrum</i>					1				
Sembe	<i>Cyathea maniana</i>					6			4	
Kiberuberu	<i>Chassalia sp.</i>			1			5			
Mzindanguruwe	<i>Maytenus undata</i>	2		1						
Mkole	<i>Isolana heinsenii</i>		5		2	3				
Kihangehange		2		1	1					
Mvumba/Mseli	<i>Ocotea usambarensis</i>		3			2			4	
Mnguti	<i>Maesa lanceolata</i>								3	2
Mzona	<i>Scolopia zeyheri</i>							6	4	
Mkwego	<i>Xymalos monospora</i>							8	7	
Mhange/Mhange	<i>Dodonea viscosa</i>							3	9	
hange										
Mfumbi/	<i>Bersama abyssinica</i>							2		

Mpapaipori Mbwimbwi	<i>Cussonia spicata</i>						1	2		
		Tandai			Tegetero			Nyandira		
Local names	Scientific names	1	2	3	1	2	3	1	2	3
Mkongolo/ Mgida	<i>Macaranga kilimandscharica</i>	1					2	3		
Mungi/Mumungi	<i>Myrica salicifolia</i>							1		
Mwelemang'ondo	<i>Myrsine melanophloes</i>						1	2		
Msada	<i>Vangueria infausta</i>							1		
Mbenesengo	<i>Ochna holstii</i>						3	2		
Msomolo	<i>Ficalhoa laurifolia</i>							1		
Mtununwe/ Msulu	<i>Rhus vulgaris</i>							1		
Mpigito	<i>Rytigynia lichenoxenos</i>							4		
Msusulamugi	<i>Halleria lucida</i>							1		
No. individuals	<i>No. individuals</i>	20	5	34	37	8	36	45	6	
No. species		9	2	15	17	3	12	15	2	



**Appendix 5:** List of plant species recorded in the catchment forest reserve adjacent to Tandai, Tegetero and Nyandira villages.

Local name	Scientific name	Habit	Tandai	Tegetero	Nyandira	Uses
Mdosa	<i>Greenwayodendron suaveolens</i>	tree	x			withies, fuelwood, poles, rafters
Mdosa	<i>Pauridiantha paucinervis ssp holstii</i>	tree	x			withies, fuelwood, poles, rafters
Kuduvi	<i>Psilotrichum seleranthum thwaites</i>	herb	x			
Lubalamaziwa	<i>Rytigynia lichenoxenos</i>	shrub	x			medicinal, ropes
Mgitamwitu	-		x			
Mnyagengo/Kifonali	<i>Mesogyne insignis</i>	tree	x	x		poles, fuelwood, rafter
Luhambamti/Luhalamila	<i>Culcasia scandens</i>	climber	x	x		medicinal, ropes
Mkole	<i>Leptonychia usambarensis</i>	tree	x	x		Poles, fuelwood, medicinal
Mkole	<i>Isolana heinsenii</i>	tree	x	x		Poles, fuelwood, medicinal
Mkuvi	<i>Newtonia buchananii</i>	tree	x	x		timber, fuelwood
Mlamkadabwa	<i>Cineraria grandiflora</i>	herb	x			medicinal
Mgama/Muula	<i>Parinari excelsa</i>	tree	x	x		poles, medicinal, fruits, rafters
Kisusulamugi	<i>Canthium oligocarpum ssp captum</i>	tree	x	x		fuelwood, withies
Mlilati	<i>Zenkerella schliebenii</i>	tree		x		poles
Kitunuse/Mbunipori	<i>Tarenna pavetoides</i>	tree	x	x		fuelwood, poles
Mlongelonge	<i>Tarbernaemontana pachysiphon</i>	tree	x	x		medicinal
Mzambaramwitu/Mguhu	<i>Syzygium guineense</i>	tree	x	x		fruits, hand tool
Mkanyi	<i>Allanblackia uluguruensis</i>	tree	x			poles, fuelwood, cooking oil extracted from seed, medicinal
Ludaha	<i>piper capense</i>	herb	x	x	x	medicinal
Mhilihili	<i>Sorindeia madagascariensis</i>	tree	x	x		building poles, fruits and fuelwood
Muhumula	<i>Maesopsis eminii</i>	tree	x			

Local name	Scientific name	Habit	Tandai	Tegetero	Nyandira	Uses
Kiberuberu	<i>Chassalia umbraticola</i>	shrub	x	x	x	withies, climbing stakes
Mzindanguruwe	<i>Maytenus undata</i>	shrub	x	x		medicinal, hunting trap
Bandebande	<i>Agelaea heterophylla</i>	shrub	x			medicinal
Mlowelowe	<i>Myrianthus holstii</i>	tree	x			medicinal, fruits and poles
Mhembahemba	-		x			
Chundi	<i>Memecylon cogniauxii</i>	shrub	x			
Mgida/Mkongolo	<i>Macaranga kilimandscharica</i>	tree	x	x		fuelwood, poles, fuelwood,
Mkwizili/Mgona ng'hanu	<i>Sapium ellipticum</i>	tree	x	x		fuelwood,
Mguhu	<i>Psychotria megalopus</i>	tree	x	x		fuelwood
Mkumburu	<i>Synsepalum cirasiferum</i>	tree	x	x		fruits, poles, fuelwood
Mfoza/Kivambo/ mtamba	<i>Ficus stuhlmanii</i>	tree	x			ropes
Bungomuhulo/B ungo	<i>Landolphia kirkii</i>	climber	x			fruits
Mtambala/Kung usigi/Mdagavelo	<i>Dalbergia lactea</i>	climber	x	x	x	
Kihagamuhulo	<i>Cola microcarpa</i>	tree	x	x		fuelwood, building poles
Ngobedi	<i>Costus sarmentosus</i>	herb	x	x		fruits
Msenze	<i>Caloncoba welwitschii</i>	tree	x	x		building poles
Konge	<i>Urera hypselodendron</i>		x		x	vegetable
Kidimudimu	<i>Rinosea arborea</i>	tree	x			fuelwood
Kisemelele	<i>Trichilia emetica</i>	tree	x			fuelwood, handle tool
Hungahunga	<i>Siphonochilus kirkii</i>	herb	x			medicinal
Kidweledwele	--		x			
Luhomamvise	-		x			
Mwenyemadola	--		x	x		
Msungungale						
Kambamoyo	-	climber	x			
Silu ya mlungu	<i>Adiantum poiretii</i>	herb	x	x		
Mnembenembe	<i>Lasianthus glomeruliferus</i>	tree	x	x		fuelwood
Mnembenembe	<i>Mimulopsis kilimandscharica</i>	tree	x	x		fuelwood
Lukalagazigwa	<i>Danais xanthorrhoea</i>		x			
Kitomvutomvu	<i>Caloncoba welwitschii</i>	tree	x	x		hand tool
Mfuruti	<i>Vitex amaniensis</i>	tree	x	x		timber, fuelwood, rafter, timber
Mlawilila	<i>Xylopia aethiopica</i>	tree	x	x		building poles, timber,

Local name	Scientific name	Habit	Tandai	Tegetero	Nyandira	fuelwood Uses
Musu	<i>Syzygium guineense</i>	tree	x	x		fruits, withies, fuelwood
Musu	<i>S. cordatum</i>	tree	x	x		fruit, withies, fuelwood
Kifulwe	<i>Acalypha fruticosa</i>	herb	x			medicinal
Kifulwe	<i>Bochmeria macrophylla</i>	herb	x			medicinal
Lutambala/Luko kwa	<i>Erythroxylum emarginatum</i>	tree	x			fuelwood, hand tool
Mseli/Mvumba	<i>Ocotea usambarensis</i>	tree	x	x	x	timber, medicinal, poles, hand tool, fuelwood
Mdulu	-	tree	x			hand tool
Tumbotumbo	-	climber	x			
Mtunu	<i>Harungana madascariensis</i>	tree	x			fuelwood, poles, medicinal, gums, hand tool
Msangana	<i>Strombosia scheffleri</i>	tree	x	x		fuelwood, poles
Kibendubendu	<i>Chassalia parvifolia</i>	shrub	x			withies, fuelwood, climbing stakes
Mzambara	<i>Psychotria megalopus</i>	tree	x			
Mgidamuhulo	<i>Sericanthi odoratissima</i>	tree	x			poles, fuelwood
Ng'hembeng'hem be	-		x			
Mnguwa	<i>Anthocleista grandiflora</i>	tree	x	x		
Mhembeti	-		x			
Luhangilamundo	<i>Cola microcaspa</i>	tree	x			fuelwood
Mkozongo	-		x			
Mvule	<i>Milicia excelsa</i>	tree	x			timber, medicinal, hand tool
Kidimupori	<i>Pauridiantha paucinervis</i>	tree	x			
Kidimupori	<i>Memecylon semseii</i>	shrub	x			
Nyakititu	<i>Agelaea heterophylla</i>	shrub		x		
Msenze	<i>Celtis gomphophylla</i>	tree		x		fuelwood
Msambwamwitu	<i>Deinbolia borbonica</i>	tree		x		medicinal
Mguhumbwitu	-			x		
Mpapaimwitu/M fumbi	<i>Bersama abyssinica</i>	tree		x	x	fuelwood
Mdugutusungu	<i>Vernonia hymenolepis</i>	shrub		x	x	medicinal
Lupwagaya/Mk wagala	<i>Myrianthus arboreus</i>	tree		x		edible fruits, poles
Mwenyenhanu	-			x		
Kibugamwiru/Ki bwetabweta	<i>Alsodeiopsis schumanii</i>	tree		x		poles, fuelwood

Msangati	<i>Cylicomorpha parviflora</i>	tree		x		
Lutambalamwege	-			x		
Local name	Scientific name	Habit	Tandai	Tegetero	Nyandira	Uses
Mkenge	<i>Albizia gummifera</i>	tree		x		poles, fuelwood, handle tool
Mlumangadu	<i>Bertiera pauloi</i>	tree		x	x	poles, fuelwood
Mlumangadu	<i>Schefflera lukwangulensis</i>	tree			x	fuelwood, poles
Mlumangadu	<i>Oxyanthus speciosus</i>	tree		x	x	fuelwood, poles
Kwezele	<i>Landolphia kirkii</i>	climber		x		
Sembe	<i>Cyathea maniana</i>	tree/fern		x	x	building poles
Luhenga	<b><i>Dracaena usambarensis</i></b>	tree		x		
Mlungulungu	<i>Zanthophyllum deremens</i>	shrub		x		medicinal
Mhelehele	-			x		
Msanzavikwa	<i>Tarenna quadrangularis</i>	tree		x		fuelwood
Lugogandima/Mgegeba	<i>Toddalia asiatica</i>	climber		x	x	medicinal
Lugogandima	<i>Acacia schweinfurthii</i>	climber		x		medicinal
Kitunune	<i>Rhus vulgaris</i>	shrub		x		edible fruits, fuelwood
Mbalazi	<i>Chrysocephalum perpulchrum</i>	tree		x		poles, timber, fuelwood
Msambwamwaka	-			x		
Mzugu	<i>Trilepsium madagascariensis</i>	tree		x		pole, fuelwood
Mbira	<i>Antiaris usambarensis</i>	tree		x		timber, pole
Msole	<i>Tarrena nigrescens</i>	tree		x		fuelwood
Msenene mwitu	<i>Clausena anisata</i>	shrub		x	x	fuelwood
Msenene	<i>Euphorbia egleri</i>	shrub			x	fuelwood
Mkamate	-			x		
Mngutinguti/Mnguti	<i>Maesa lanceolata</i>	tree		x	x	fuelwood, poles, climbing stakes and medicinal
Mbefu	<i>Trema orientalis</i>	tree		x		shade, medicinal
Kisungusungu	<i>Erlangea cordifolia</i>	herb				medicinal
Kinzasu	<i>Dissotis rotundifolia</i>	herb		x		medicinal
Mwiza	<i>Bridelia micrantha</i>	tree		x		poles, fuelwood, hand tool
Lusegwa	<i>Lantana camara</i>	shrub		x		
Lung'angale				x		
Mazelule	<i>Waltheria americana</i>	herb		x		
Lukwa	<i>Dioscorea longicuspis</i>	climber		x		medicinal, ropes
Kihavihavi	<i>Albizia glaberrima</i>	tree		x		fuelwood

Bwendere	<i>Cyphostemma adenocaula</i>	shrub		x			fuelwood
Lukwangasale	<i>Smilax kraussiana</i>	climber		x			
Local name	Scientific name	Habit	Tandai	Tegetero	Nyandira		Uses
Msederela	<i>Cedrella odorata</i>	tree		x			timber, poles
Mgerevelia/Mnya weza	<i>Grevillea robusta</i>	tree		x			fuelwood, timber, poles, climbing stakes
Mdugutu	<i>vernonia myriantha</i>	shrub		x			medicinal
Mdugutu	<i>Clerodendrum cephalolanthum</i>	shrub		x			medicinal
Mvugwa	<i>Justicia glabra</i>	herb			x		vegetable
Pelea	<i>Elatostemma monticolum</i>				x		
Mnamvu	<i>Triumfetta rhomboidea</i>	herb			x		vegetable
Msembelele/Sem belele	<i>Trichilia emetica</i>	tree			x		
Mhange	<b><i>Dodonea viscosa</i></b>	tree			x		fuelwood, poles, medicinal
Mkwego	<i>Xymalos monospora</i>	tree			x		poles, fuelwood, climbing stakes
Mzona	<i>Scolopia zeyheri</i>	tree			x		poles, fuelwood, medicinal, climbing stakes
Nyambande	<i>Cyphostemma hildebrandtii</i>	climber			x		
Mubule	<i>Marsdenia abyssinica</i>	climber			x		
Kibemenzu					x		
Mbwimbwi	<i>Cussonia spicata</i>	tree			x		poles, climbing stakes, fuelwood
Mfumbi	<i>Bersama abyssinica</i>	tree			x		fuelwood
Mkwele	<i>Dombeya cincinnata</i>	tree			x		
-	<i>Psychotria goetzei</i>	shrub			x		
Magobonzwa	<i>Impatiens hamata</i>	herb			x		pig fodder
Mumungi	<i>Myrica salicifolia</i>	tree			x		poles, climbing stakes, fuelwood, medicinal
Mwalimudumu	<i>Hypericum revolutum</i>	shrub			x		fuelwood, climbing stakes
Mjegeto	<i>Bidens holstii</i>	herb			x		medicinal
Mpigito	<i>Rytigynia lichenoxenos</i>	shrub			x		climbing stakes,
Mfifi	<i>Rubus scheffleri</i>	climber			x		fruits
Mbembeni	<i>Nuxia floribunda</i>	tree			x		fuelwood
Duduwa	<i>Lobelia morogoroensis</i>	shrub			x		
Mselele	-				x		
Kiberuberu	<i>Chassalia parvifolia</i>	shrub			x		climbing stakes, fuelwood
Msonzo	<i>Cornus volkensii</i>	shrub			x		

Mkongolo/Mgida	<i>Macaranga kilimandscharica</i>	tree			x	poles, climbing stakes, fuelwood
Local name	Scientific name	Habit	Tandai	Tegetero	Nyandira	Uses
Mwelemang'ondo	<i>Myrsine melanophloes</i>	shrub			x	poles, climbing stakes, fuelwood
Moza	<i>Allophylus abyssinica</i>	tree			x	poles, fuelwood
Tumbung'uku	-				x	
-	<i>Rytigynia uhlingii</i>	shrub			x	
Mbenesengo	<i>Ochna holstii</i>	tree			x	poles, climbing stakes, fuelwood
-	<i>Oxyanthus speciosus</i>	tree			x	
Msadapori	<i>Canthium oligocarpum ssp captum</i>	tree		x	x	fuelwood, withies
-	<i>Cryptocarya libertiana</i>	tree			x	
-	<i>Rhamnus prinoides</i>	shrub			x	
Msada	<i>Vangueria infausta</i>	tree			x	medicinal, fruits, fuelwood
-	<i>Premna hildebrandtii</i>	climber			x	
Kiswasi	<i>Agelaea heterophylla</i>	shrub			x	medicinal
Kiasu	<i>Jaundea pinnata</i>	climber			x	medicinal
Msomolo	<i>Ficalhoa laurifolia</i>	tree			x	fuelwood, poles, rafters
Kiberuberu	<i>Chassalia umbraticola</i>	shrub			x	climbing stakes, fuelwood, withies
Kuduvu	<i>Justicia striata</i>	herb			x	vegetable
Kuduvu	<i>Isoglossa lactea</i>	herb			x	vegetable
-	<i>Mimulopsis solmsii</i>	herb			x	
Msusulamugi	<i>Halleria lucida</i>	shrub			x	climbing stakes, fuelwood, withies
-	<i>Lasianthus ceriflorus</i>	tree			x	
-	<i>L. grandifolius</i>	tree			x	
-	<i>Galiniara saxifraga</i>	tree			x	poles

**Appendix 6 : User groups of Catchment and farmland plants and other resources at Tandai, Tegetero and Nyandira villages.**

User group	Group size	Consumption	Village*		
			Tandai	Tegetero	Nyandira
<b>Fuelwood</b>					
Domestic	all households	10-20kg per day	*	*	*
Hoteliers	2-4 small hotels	3-10 bundles per day	*	*	*
Banana warming	20 banana traders	4 bundles per day	*		
Local brewers	26 local brewers	3 bundles per day	*	*	*
Iron smitherers	1-2 people		*		*
<b>Timber</b>					
Carpenters	2-4 groups		*	*	*
Pitsawyers	Not given	20 sawn timber per day	*	*	*
<b>House building</b>					
Poles	10-30% households	200 poles per household	*	*	*
Ropes	50-80% households		*	*	*
Withies	50-80% households		*	*	*
Rafters	50-80% households		*	*	*
Thatch grass	90% households		*	*	*
<b>Handtools</b>					
Bush knife	all households		*	*	*
Hoe	all households		*	*	*
Mortar (vinu)	all households		*	*	*
kitchen tools	all households		*	*	*
Other tools			*	*	*
<b>Herbalists</b>	5-10 well known		*	*	*
<b>Climbing stakes</b>					
Peas	30-50% households				*
Tomato	30-50% households				
Green beans	30-50% households				
Black pepper	>60% households		*	*	
<b>Indigenous food gatherers</b>					
Vegetables	90% households		*	*	*
Fruits	?		*	*	*
Cooking oil	?		*		
Honey	?		*	*	
Hunters	Very few hunters		*	*	
Crab fishers	Very few hunters		*	*	
Fodder, goats/pigs	>50% households				*
<b>Water users</b>					
Domestic use in villages	All households		*	*	*
Domestic use in towns	Many in Dar es Salaam				
Traditional irrigators	90% vegetable growers				*
Industries	Several in Dar esSalaam				

<b>Farming community</b>					
Cultivators near forest	Several people		*	*	*
<b>Others</b>					
Ecotourism				*	
Indigenous tree seed collectors	Few people				*
Sacred use	1-3 sacred forests		*	*	*
Total main groups			9	9	10
Total subgroups			28	26	27

\*Villages where user group is present



**Appendix 7:** Species highly preferred by different forest user groups at Tandai, Tegetero and Nyandira villages.

Local name	Scientific names	1	2	3	4	5	6	7	8	9	10	11	12	13	No. users	Source
Mwiza	<i>Bridelia micrantha</i>	*		*											2	Farmland
Mkenge	<i>Albizia gummifera</i>	*		*						*					3	Farmland
Mhavi		*		*											2	Forest
Mkumbulu	<i>Synsepalum cerasiferum</i>	*		*				*							3	Forest
Mtunu	<i>Harungana madascariensis</i>			*						*					2	Farmland
Mdulu	-									*					1	Farmland
Mkarati	<i>Erythrophleum suaveolens</i>	*								*					2	Farmland
Msenze/Kitomvutomvu	<i>Caloncoba welwitschii</i>	*								*					1	Farmland
Mgwami	<i>Bambusa vulgaris</i>	*		*											2	Farmland
Mfenesi	<i>Artocarpus heterophyllus</i>	*	*					*		*					4	Farmland
Mfuru	<i>Vitex doniana</i>	*						*							2	Farmland
Mwembe	<i>Mangifera indica</i>	*						*		*					3	Farmland
Mzambara	<i>Psychotria megalopus</i>	*						*		*					3	Farmland
Mkuvi	<i>Newtonia buchananii</i>	*	*												2	Forest
Mgama/Muula	<i>Parinari excelsa</i>	*													1	Forest
Mgombogombo	-	*													1	Forest
Mgida/Mkongolo	<i>Macaranga kilomandscharica</i>	*		*				*							1	Forest
Mkangazi	<i>Khaya anthotheca</i>	*	*							*					3	Farmland
Mvule	<i>Milicia excelsa</i>		*					*							2	Farmland
Mseli	<i>Ocotea usambarensis</i>	*	*	*		*				*					5	Forest
Mbalazi	<i>Chrysophyllum perpulchrum</i>	*	*												2	Forest
Mlawilila	<i>Xylopi aethiopica</i>		*												1	Forest
Mhange	<i>Dodonea viscosa</i>	*		*											2	Forest
Mnyaweza	<i>Grevillea robusta</i>	*	*	*											3	Farmland
Mkataluba	<i>Cupressus lusitanica</i>		*												1	Farmland

Msedelela	<i>Cedrella odorata</i>		*	*			*										3	Farmland
Mkanyi	<i>Allanblackia uluguruensis</i>	*		*			*										3	Forest
Lukwa	<i>Dioscorea longicuspis</i>				*			*									2	Forest
Luziwana	<i>Landolphia buchananii</i>				*												1	Forest
Kibumu	<i>Mucna pruriens</i>				*												1	Forest
Lukanga					*												1	Forest
Mwenyemkulumi					*												1	Forest
Lufunalundi					*												1	Forest
Ludehu					*												1	Forest
Mtomokwe	<i>Annona senegalensis</i>	*			*												2	Farmland
Mkande	<i>Aphloia theiformis</i>	*	*														2	Forest
Mtiki	<i>Tectona grandis</i>	*	*	*													3	Farmland
Mwarobaini	<i>Azadirachta indica</i>						*										1	Farmland
Mkole	<i>Lyptonychia usambarensis</i>	*		*		*											3	Forest
Lubuli					*												1	Forest
Local name	<i>Scientific names</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	No. users			
Msombolanga	<i>Acacia mearnsii</i>	*		*	*		*										4	Farmland
Mwalimdungu	<i>Hypericum revolutum</i>	*					*										2	Forest
Mshelisheli	<i>Artocarpus altilis</i>							*									1	Farmland
Msada	<i>Vangueria infausta</i>					*		*									2	Forest
Bungo	<i>Landolphia kirkii</i>							*									1	Forest
Msambwa	<i>Sysepalum sp.</i>							*		*							2	Forest
Msambia								*									1	Farmland
Mhilihili	<i>Sorrindelia madascariensis</i>							*									1	Forest
Msangati	<i>Cylicomorpha parviflora</i>										*						1	Forest
Mpera	<i>Psidium guajava</i>	*				*		*									3	Farmland
Mpwagaya	<i>Myrianthus arboreus</i>							*									1	Forest
Mkuyu	<i>Ficus lutea</i>					*	*			*							3	Farmland
Chamvi	<i>Tragia brevipes</i>					*											1	Forest
Lumbugi				*													1	Forest

Msangana	<i>Strombosia scheffleri</i>	*																1	Forest
Lutambala/Lukokwa	<i>Erythroxylum emarginatum</i>	*			*													2	Forest
Mibuni	<i>Coffea arabica</i>	*						*	*									3	Farmland
Mparachichi	<i>Persea americana</i>								*									1	Farmland
Mwembeng'ong'o	<i>Sclerocarya birrea</i>								*									1	Farmland
Msasa	<i>Ficus exasperata</i>	*				*	*											3	Farmland
Mbembeni	<i>Nuxia floribunda</i>	*																1	Forest
Mlumangadu	<i>Schefflera lukwangulensis</i>	*																1	Forest
Mfifi	<i>Rubus scheffleri</i>								*									1	Farmland
Lufifi	<i>Rubus pinnatus</i>								*				*					2	Farmland
Mhombo	-									*								1	Forest
Mhangehange	<i>Dodonaea viscosa</i>	*																1	Forest
Mbwendere	<i>Cyphostemma adenocaulis</i>	*																1	Forest
Msembelele	<i>Trichoscypha ulugurensis</i>	*																1	Forest
Konge	<i>Urera hypselodendron</i>									*								1	Forest
Mzona	<i>Scolopia zeyheri</i>			*														1	Forest
Mnguti	<i>Maesa lanceolata</i>	*				*	*											3	Forest
Pulamsi	<i>Prunus salicifolia</i>							*	*									2	Farmland
Epulusi	<i>Molus communis</i>							*	*									2	Farmland
Pichesi	<i>Prunus americana</i>							*	*									2	Farmland
Msulu/mtunune	<i>Rhus vulgaris</i>	*		*				*	*									4	Farmland
Mjegelo	<i>Bidens holstii</i>							*										1	Forest
Mkwego	<i>Xymalos monospora</i>	*		*														2	Forest
Peasi									*									1	Farmland
Kibugamwiru/Kibwetabweta	<i>Mesogyne insignis</i>	*																1	Forest
Maidini	<i>Eucalyptus maidenii</i>	*	*					*										3	Farmland
Makulata	<i>E. maculata</i>	*	*					*										3	Farmland
Mvinje	<i>Casuarina cunninghamiana</i>	*	*															2	Farmland
Mstafeli	<i>Annona muricata</i>							*										1	Farmland

Mnazi	<i>Cocos nucifera</i>							*							1	Farmland
Mkarafuu	<i>Syzygium aromaticum</i>												*		1	Farmland
Mdalasini	<i>Cinnamomum verum</i>												*		1	Farmland
Mfoza/Kivambo/mtambo	<i>Ficus stuhlmanii</i>	*				*	*								3	Farmland
Mwale	<i>Bombax rhodognaphalon</i>												*		1	Farmland
Mdugutu	<i>Clerodendrum cephalanthum</i>					*									1	Farmland
Mkongonolo	<i>Cussonia arborea</i>	*								*					2	Farmland
Mvulavula	<i>Albizia harveyi</i>	*													1	Farmland
Kitunuse	<i>Tarenna paveltooides</i>									*					1	Farmland
Mkundekunde	<i>Senna petersiana</i>					*									2	Farmland
Mkengekalala	<i>Albizia glaberrima</i>	*								*					2	Farmland
Mbono	<i>Jatropha urcas</i>					*	*								2	Farmland
Kaeba/kisamvu	<i>Manihot glaziovii</i>									*					1	Farmland
Mfuruti	<i>Vitex amaniensis</i>	*	*												2	Forest
Myegea	<i>Kigelia africana</i>					*									1	Farmland
Mbilimbi	-									*					1	Farmland
Mtende	<i>Elasis quineensis</i>									*					1	Farmland
Mchungwa	<i>Citrus sinensis</i>									*					1	Farmland
Kifonali/Mnyagengo	<i>Mesogyne insignis</i>	*		*											2	Forest
Musu	<i>yzygium guineense</i>			*											1	Forest
Msanzavikwa	<i>Tarenna quadrangularis</i>			*											1	Forest
Mlengolengo	<i>Tabernaemontana pachysiphon</i>			*											1	Forest
Mlilati	<i>Zenkerella schliebenii</i>			*											1	Forest
Sembe	<i>Cyathea manniana</i>			*											1	Forest
Mberuberu	<i>Chassalia spp</i>			*											1	Forest
Mzindanguruwe	<i>Maytenus undata</i>			*											1	Forest
Mfumbi	<i>Bersama abyssinica</i>			*									*		2	Forest
Mbwimbwi	<i>Cussonia spicata</i>			*		*									2	Forest
Msusulamugi	<i>Halleria lucida</i>					*									2	Forest

Mmungi	<i>Myrica salicifolia</i>			*			*									2	Forest
Mwegelemangondo	<i>Myrsine melanophloeos</i>		*				*									2	Forest
Msomolo	<i>Ficalhoa laurifolia</i>			*			*									2	Forest
Mbenesengo	<i>Ochna holstii</i>			*			*									2	Forest
Mpigito	<i>Rytigynia lichenoxenos</i>			*			*									2	Forest
Derega	<i>Basella alba</i>								*							1	Forest
Mwidu	<i>Justicia heterocarpa</i>								*							1	Farmland
Mnamvu	<i>Solanum nigrum</i>								*							1	Farmland
Total species 128		52	16	36	13	14	28	27	7	16	1	2	2	2			

Note: 1= Fuelwood, 2= Timber, 3= Poles and rafters, 4=Ropes, 5= Herbalists, 6= Climbing stakes, 7= Fruits, 8= Vegetables, 9=Handtool, 10= Beehives, 11=Fodder, 12= Spices, 13= Sacred sites (N.B details for herbalist species see Hamisy *et al.* 2000)