Determination of Indigenous Trees and Shrubs with potential for Agroforestry in Lango Farming System

Report for Lira District



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1.0 Introduction

Traditional agroforestry practices have existed for a long time in Uganda although these practices have been rarely documented. In Northern Uganda it is common practice to intercrop *Cajanus cajan* with millet and simsim, while in Soroti and Kumi districts, *Tamarindus indica, Mangifera indica* and *Vitellaria paradoxa* are commonly retained or planted on farmlands (Djimbe and Hoekstra (eds), 1988).

Apart from the systematic placement of trees relative to crops and pastures on farms, rural people are often concerned about the fit of the whole agroforestry practice and trees in general into the larger landscape (Rochelleau, 1988). In many instances farmers have long experience and knowledge of local agroforestry practices and systems. For thousands of years, they have consciously maintained diversity, planted mixed fields systematically to achieve natural crosses, practiced selection and set up their own personal gene banks and far flung exchange systems for acquiring new genetic materials (Chambers, 1989).

1.1 Justification

Farmers' indigenous knowledge of tree shrubs and their management has evolved over time, based on local experience, using local resources and is adapted to local conditions. It presents detailed information of all aspects of land-use management. This knowledge is dynamic, undergoing change and development in response to changes in internal and external environment. Most of this knowledge, however, is not documented and gets lost over generations. At present many of the successful traditional systems are literally losing ground in the face of disruptive changes and increasing pressures on the people and their natural resources (Rocheleau, 1988).

The study of traditional methods by local communities is very important especially for the benefit of agricultural improvement and transfer of new technologies to farmers. Emphasis of farmer priorities, knowledge and innovative capacities plays a central role in the adoption of new systems. Besides, farmers are often conscious about throwing away older varieties and production strategies simply because they are presented with new packages. Understanding indigenous agroforestry practices will therefore benefit the identification of suitable and sustainable agroforestry systems in Lango. Documentation of this indigenous knowledge offers great opportunity not only for agroforestry development, but also modernization of agriculture in the region.

1.2 Objectives

The overall objective of the study was to identify the current and indigenous agroforestry systems that farmers are practicing with the aim of establishing important trees / shrubs for agroforestry development in the farming systems. The specific objectives of the study were:

1. To identify trees / shrubs commonly growing on key niches on farms, their propagation, management, uses and the factors determining their arrangement.
2. To study the role of trees in the farming system, identifying trees / shrubs used for major functions, their sources and availability.
3. To identify actors in agroforestry and assess the role of gender in decision making, division of labour and distribution of benefits from tree growing.
4. Determine indigenous tree / shrub species with potential for agroforestry and establish farmers' most preferred species for future planting.

2.0 Methodology

The study was done in three (3) phases. It started with a rapid rural appraisal (RRA) intended to narrow down the scope, to allow for more rigorous inquiry in a subsequent household survey. The preliminary findings of these two phases were then scrutinized at a stakeholders' feedback workshop. The information presented and discussed in this report is the outcome of this funnel-shaped process (see figure 1).

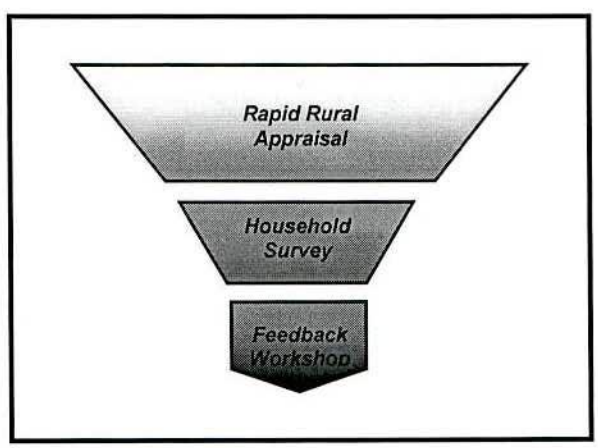


Figure 1. Illustration of the study design

2.1 The Rapid Rural Appraisals (RRA)

The purpose of the rapid appraisals was to identify candidate species that have potential for agroforestry in Lira district in the Lango farming system. In addition, these exercises provided appropriate methodology for: -

- Describing key features of the Lango farming system and establishing the role of trees in this system,
- Understanding traditional and current tree growing practices in the farming system and projecting future agroforestry trends in the system,
- Determining the status of agroforestry awareness, identifying key actors and studying the role of gender in tree growing and use.

2.1.1 Team composition and training

The RRA team comprised a multi disciplinary team of researchers from the Forestry Resources Research Institute (i.e. two foresters, a socio-economist and an agroforestry technician) and Lira District forestry, agriculture and environment departmental staff. The entire team had eight to ten people including two women. Each focus group was facilitated by at least 2 research team members.

The district departmental staff were given one-day training, which equipped them with the background to the exercise and its objectives. They were introduced to RRA methodologies focusing mainly on the tools that were to be used in this particular study. Many field staff, however, had prior experience with these tools.

2.1.2 Site selection

In consultation with the district agriculture, forestry and environment offices, the district was divided into 3 easily discernible agro-ecological zones (Dry, Middle and Lake belts) based on climatic, soils and vegetation characteristics of the areas. One sub-county was randomly selected to represent each agro-ecological zone (see table 1).

In each selected sub-county, one parish was identified considering ease of group mobilization. Considering low variability within sub-counties, the team gauged the subjective selection of units at

this stage to have minimal effect on the findings. Thus, RRA exercises were carried out in 3 parishes. (see table 1). Informants were mobilized from several villages within the parish. One village in the parish hosted the exercise at a convenient venue.

Table 1. Distribution of study sites for the rapid appraisal

Ecological zone	County	Sub-county	Parish
Dry	Otuke	Adwari	Okrokwo
Middle	Dokolo	Dokolo	Igulu
Lake	Kyoga	Awelo	Anamwany

2.1.3 Focus group composition

Four focus groups, of 10 people each, were organised prior to the exercise. These were youths (12- 18 years), women (19 – 49 years), men (19 – 49 years), elders (50 years and above). The arrangement of informants into these particular groups was intended to provide gender responsive information across generations. Group members were drawn from different households.

2.1.4 Tools used

Three tools of rapid rural appraisal were used to achieve the objectives of the exercise, and included focus group discussions, semi structured interviewing and preference ranking. The focus groups enabled gathering of information specific to particular interest groups and to ensure active participation in peer environment. Semi structured interviews facilitated rapid but flexible data capture during the interviews, while preference ranking was instrumental in prioritization of responses.

2.1.5 The field exercises

One day was assigned for the rapid appraisal in each parish. Prior arrangements were made by the local extension staff to organize the groups and identify venues. On arrival, the research team introduced themselves to the gathering and explained the purpose for the RRA. After the groups were assigned facilitators, separated and got down to discussions, mostly in the local language. Information was outlined on flip charts and details taken down in field notebooks. Information was checked before the groups dispersed. The exercise lasted about three hours.

2.1.6 Summarizing the data

The information collected from the field was summarized and entered in computer. Rankings were converted to ranking points to determine important species and priorities. Responses with highest rank (1) were awarded maximum (5) points; while those with lowest rank (5) were awarded lowest (1) points on a scale of 1 to 5. A response not mentioned among the first 5 priorities by a focus group, was awarded zero (0) points for that particular group. As a primary criterion, priority responses were determined from total ranking points accumulated from all focus group discussions. The number of quotations (times a response is mentioned on a particular item) was considered as the secondary criterion.

2.2 The household survey

The rapid appraisal provided useful insights and sharpened the focus of the study to critical issues and short-listed species. The information from the RRA, however, was short of providing sufficient basis for determining species for agroforestry promotion. Thus, a follow up household survey was designed to:-

- Verify hypotheses drawn from the information collected in the RRA and find out the degree to which these findings can be generalized on the entire district.
- Refine upon and fill gaps in the information gained from the RRA.
- Address areas that require quantitative information, which could not be gathered comprehensively through the rapid appraisal.

2.2.1 Coverage

The survey covered the two of the three agro-ecological zones of Lira district. Due to the prevailing insecurity at the time of data collection, the dry belt was not covered. In the wet and middle belts, 6 sub-counties were selected to from Kyoga and Dokolo counties. In each selected sub-county, two (2) parishes were selected and a village in each visited. Within villages, ten (10) randomly selected households were targeted. Overall, the survey team visited 107 farming households in twelve (12) parishes and six (6) sub-counties of Lira district. (see figure 2 and table 2).

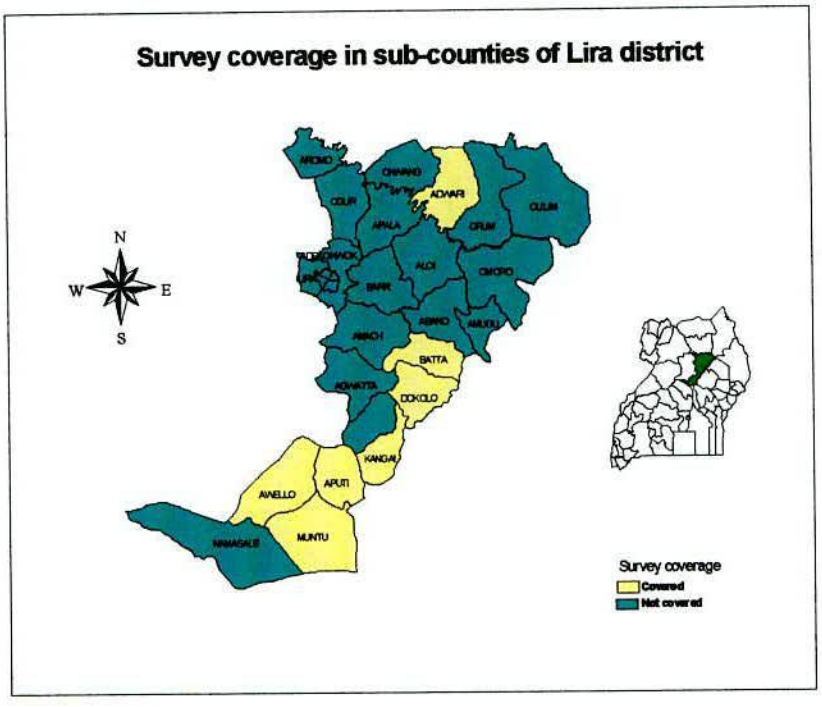


Figure 2. ***Map showing sub-counties covered by the survey***

Table 2.1 *Distribution of study sites for the household survey.*

Agro-ecological zones	Counties	Sub-counties	Parishes
Middle belt	Kyoga	Aputi	Otira, Anywali
		Muntu	Alemere, Amolatar
		Awelo	Akongomit, Anamwany
Lake belt	Dokolo	Bata	Abyenek, Aderolongo
		Dokolo	Angwecibange, Atur
		Kangai	Angwenya, Adwilla

Within households, the head or deputy responded to the interview on behalf of the household. It was common, however, for male household heads to consult their spouses and / or children e.g. on aspects of fruit and firewood utilization and preferences.

2.2.2 Household data analysis

The data was coded and entered in MS-Excel worksheets on computer. Careful cleaning was possible using the auto filter function. The data was exported to SPSS for analysis, which involved descriptive statistics and cross tabulation. The results are mostly tabulated, but on some items presented in graphs.

2.3 Stakeholders' feedback workshop

The stakeholders' feedback workshop the last stage in the survey process. This workshop held on 29th May 2003, at Garden Inn in Lira town targeted departmental heads directly involved in the natural resource management (Agriculture, Forestry, Environment) and the secretariat for production. Participants also included field extension staff, farmer representatives, NGO collaborators.

The workshop presented an overview of preliminary survey results to stakeholders in agroforestry in the district and generated discussion on the extent to which the results were in harmony with the local situation. The workshop evaluated the potential of candidate indigenous species for agroforestry and zeroed in on those with highest potential in the Lango farming system.

3.0 Results

The results of the study are presented in five sections. The first and second sections describe key features of the Lango farming system and tree growing practices in this system respectively. The third explains the role of trees in this system, while the fourth presents priority indigenous species for each role and the criteria for selection. The last section of the results addresses future prospects for agroforestry in the Lango farming system.

3.1 Key features of the Lango farming system

For the scope of this study, description of the farming system considered major land types and land use activities, farming systems (crop and livestock) and aspects of fruit growing.

3.1.1 Land types and land use activities

Agroforestry involves integration of trees with other land use activities. Thus, a clear understanding of these activities is a pre-requisite for identifying appropriate agroforestry options for any location. The land types in Lira were described according to vegetation, soils, wildlife and land use. Most common are croplands, swamps, rangelands, woodlands, rocky and lakeshore areas (see Table 3).

Table 3. Main land types in the 3 agro-ecological zones.

Dry belt	Middle belt	Lake belt
Croplands	Swamps	Croplands
Swamps	Croplands	Swamps
Woodlands	Rangelands	Rangelands
Rangelands	Woodlands	Woodlands
Rocky areas	Rocky areas	Lakeshore areas

Croplands are characterized by many crop gardens on usually on the most fertile soils available. The vegetation comprises scattered trees and different grass types. The main activities carried out on croplands are cultivation and grazing livestock during the post harvest season.

Swampy areas have dark clay and sandy soils that are difficult to plough and are thus unproductive. These areas are water logged and damp even in the dry seasons, with thorny shrubs, spear grass, couch grass and papyrus vegetation. They are habitats for various wildlife species. The major activities in swamps are livestock grazing, fishing (especially mud fish), crop cultivation (e.g. sugarcane, vegetables) and collection of firewood and mushrooms. They are also sites for hunting giant rats, antelopes and wild pigs and sand extraction.

Rangelands have short grasses, "acidic soils", many trees, seasonal ponds, wild life and many anthills. The major activities done here include firewood collection, livestock grazing, collection of poles for building, crop cultivation, collection of stones, hunting, charcoal burning, recreation, collection of white ants "ngwen" and honey

Many trees, wild life and short grass characterize the forests. The main activities taking place in this land type are hunting, firewood collection, charcoal burning, and collection of medicines, poles and honey.

In the Lake belt large areas are covered by lake, landing sites and markets. There is a lot of human settlement in these areas and activities here include fishing, trading and recreation (drinking places).

3.1.2 Farming system types

The study of farming system types addresses three components; cropping systems, livestock management and fruit growing.

3.1.2.1 Cropping systems

The major crops grown in are cassava, millet and beans. Other crops grown include Simsim, Cotton, maize and groundnuts. Cassava is commonly intercropped with beans, maize, groundnuts and soya beans. Sometimes it is grown as a sole crop. Cassava is planted in both seasons of the year. Millet is intercropped with pigeon peas, simsim, maize and soya beans. Planted by broadcast method, millet is sown in both cropping seasons. Beans are widely grown as a sole crop, but are at times intercropped with cotton, cassava and maize. They are grown in both planting seasons. Maize is usually intercropped with beans, cassava, soya beans, millet, groundnuts or simsim and is grown in both seasons. Simsim is grown as a sole crop but can also be intercropped with sorghum, pigeon peas and cassava. Cotton is mainly planted as sole crop but can also be intercropped with beans, cassava, soya beans and groundnut. It is grown in a single season (see table 4b).

Table 4a. Main crops grown (ranked)

Dry	Middle	Lake belt
Pigeon peas	Millet	Cassava
Sorghum	Beans	Millet
Groundnuts	Maize	Beans
Simsim	Cassava	Simsim
Rice	Simsim	Cotton
Cassava	Sorghum	Maize

Table 4b. Common crop combinations

Crop	Companion crops	Main cropping
Cassava	Beans, Maize, G/nuts	Intercrop
Millet	P/peas, Simsim, Maize	Intercrop
Beans	Maize, Cassava, Cotton	Intercrop
Simsim	Sorghum, P/peas	Sole crop
Cotton	Beans, Cassava, G/nuts	Sole crop
Maize	Beans	Intercrop

3.1.2.2 Livestock management systems

The main livestock types are cattle, goats and sheep. Other livestock types are pigs and poultry (chicken, ducks, pigeons and turkeys). Cattle usually depend on communal grazing and watering but are also tethered. They are kept in kraals commonly made out of thorny shrubs. The bulls are usually castrated. Goats and sheep are mainly tethered but also let to graze free-range during the dry season. They are kept in small sheds near the main house. Pigs are tethered or left to feed free range. They are also fed on leftovers. Pigs are housed in simple wooden paddocks near the home. Poultry feed by free range and are kept in a poultry house.

Table 5a. Main livestock types kept (ranked) systems

Dry	Middle	Lake belt
Cattle	Cattle	Cattle
Goats	Goats	Goats
Poultry	Sheep	Sheep
Pigs	Poultry	Poultry
Sheep	Pigs	Pigs

Table 5b. Livestock management

Livestock	Feeding methods	Housing
Cattle	Communal grazing	Kraals
Goats	Tethering, Free range	External shed
Sheep	Tethering, Free range	External shed
Poultry	Free range	Poultry house
Pigs	Thethering, Free range	Paddocking

3.1.2.3 Major fruits in the farming system

Fruit growing is an important part of Lango farming systems. The important fruits (from on-farm and off-farm) in Lira include *Citrus spp., Mangifera indica, Carica papaya, Psidium guajava, Passiflora edulis* and *Artocarpus heterophyllus* (Exotic) and *Tamarindus indica, Vitex doniana, Strychnos spinosa, Ximenia americana, Annona chrysophylla* and *Carissa edulis* (Indigenous). Table 6 lists important fruit types by zones.

Table 6. Main fruits in the agro-ecological zones in order of importance

Dry belt	Middle belt	Lake belt
Exotic		
Citrus spp.	*Citrus spp.*	*Citrus spp.*
Mangifera indica	*Mangifera indica*	*Mangifera indica*
Carica papaya	*Passiflora edulis*	*Carica papaya*
Psidium guajava	*Carica papaya*	*Psidium guajava*
Passiflora edulis	*Artocarpus heterophyllus*	*Passiflora edulis*
Artocarpus heterophyllus	*Psidium guajava*	*Artocarpus heterophyllus*
Indigenous		
Vitellaria paradoxa	*Vitellaria par.*	*Tamarindus indica*
Vitex doniana		*Vitex doniana*
	Vitex doniana	
Tamarindus indica	*Carissa edulis*	*Strychnos spinosa*
Carissa edulis	*Tamarindus indica*	*Ximenia americana*
Annona chrysophylla	*Ximenia americana*	*Carisa edulis*
Ximenia americana	*Borassus aethiopum*	*Annona chrysophyla*

3.2 Tree growing practices

Tree growing practices are dynamic and evolve over years. To understand existing practices in Lango, a historical perspective into past and present practices is necessary. During the rapid appraisal, this study explored the trends that tree growing in the Lango farming system has taken in the last three decades.

3.2.1 Tree growing practices before the 1970s

In the past, leaving parts of farmland under bush for some seasons was very common practice. Trees were left on croplands to provide shade, fruits and manure on the gardens. Land then was abundant and fallow areas were left for several years, which enabled the growth of various trees and shrubs. These areas doubled as hunting grounds.

In many homesteads, trees were left to grow in areas that were used as burial or ancestral grounds. This practice was a way of marking these grounds for identification by future generations. Retention of trees near homes for windbreaks was also common, while at the same time the trees provided fruits and medicines.

It has been an old practice in Lango to grow trees along roadsides. The trees were mainly to provide shade for travelers to rest. The owners of land that bordered the roads also planted trees on roadsides to demarcate the boundaries. This was aimed at preventing encroaching on private lands.

During pre-colonial time, there were many trees growing in rangelands and swamps as part of the natural vegetation. These trees existed because human population was low and tree products were abundant. Also, swamps were sites for traditional prayers e.g. "rain dancing" and trees were left there for cultural reasons. The fear of provoking the wrath of evil spirits prevented cutting of some big trees that often grew there.

Colonial and post independence governments shouldered most of the tree planting responsibility in the 1960s. Tree planting was mainly done in Government forest reserves, rangelands, swamps and in emerging urban areas. Government took deliberate efforts to plant and conserve trees in selected areas for purposes of protecting the environmental. As towns developed, some trees were left to serve as windbreaks and ornamentals.

Trees in public places were most often planted deliberately to serve as memoirs of important occasions. These trees grew to provide shade and windbreaks around public places like churches, schools and administrative buildings. On conversion to timber, these trees generated revenue for the institutions.

3.2.2 Changes in tree growing practices and utilization

Lango has experiences dramatic changes in tree growing in the last three decades. In the past, tree conservation for cultural purposes was central to Lango tradition. Tree preservation used to be common in sacred places. This is not the case today due to increasing levels of poverty amongst an ever-increasing population. Traditional use of practices has been eroded as modern culture set in.

Trees that used to grow in rangelands have given way to human settlements due to increasing population. This has triggered off shortages of tree products resulting in restrictions to their access by individuals. Firewood and poles have subsequently taken on commercial value.

Charcoal burning has become common in the last decade as it is seen as a convenient source of energy for cooking in upcoming urban areas. Brick burning is also picking pace due to increasing tendency for people to construct permanent houses.

In the Lake belt, the use of trees for boat making has increased in both the size and number of boats. As such, big trees that used to exist in the swamps have been cut for timber and boat making. In some areas of the Lake belt, flooding has also destroyed some of the trees that used to grow in the swamps.

In the 1990s, after farmers realizing that trees had disappeared from the landscape, the practice of growing trees in on farm woodlots became common. This was in attempt to keep pace with increasing need for timber for construction. Tree growing was eventually seen as a viable economic undertaking.

3.2.3 Changes in tree coverage and species diversity

Tree coverage has decreased due to increasing human population creating demand for more firewood and farmland. The need for income to sustain large populations has caused increased

boat making and fishing activity. Tree cover has also reduced due to increased charcoal burning and flooding in swamps.

Tree species diversity has generally reduced as high value species are particularly targeted. *Vitellaria paradoxa*, *Ximenia americana*, *Terminalia macroptera*, *Senna siamea*, *Combretum collinum*, loro, *Albizia coriaria* and *Milicia excelsa* used to be common prior to the 1970s, but have become scarce. Charcoal burning, road construction, and felling for timber, firewood and poles have been the main causes. Other factors are bush fires and poor management and clearing for human settlement.

Table 7. Factors contributing to loss of tree cover in the district.

Dry belt	Middle belt	Lake belt
Agriculture	Firewood cutting	Firewood cutting
Charcoal burning	Agriculture	Boat making
Brick burning	Charcoal burning	Charcoal burning
Bush fires	Brick burning	Timber cutting
	Timber cutting	Human settlement
		Flooding

3.2.4 Current tree growing practices in the farming system

Though tree-growing practices are seen in context of the wider landscape, this study had particular interest in the on-farm situation. It is evident that deliberate planting of trees on-farm is not common as retaining trees already growing on-farm. The lack of planting materials is cited as a key hindrance to tree planting on-farm. However, the attitude that trees are "God given" and grow naturally also persists.

For various reasons though, there are marked patterns in the types of trees retained in various locations on the farm. This section explores locations on-farm where trees are commonly found and reasons for this distribution.

Table 8. Locations where trees are commonly grown.

Dry belt	Middle belt	Lake belt
Homesteads	Homesteads	Homesteads
Swamp	Boundaries	Boundaries
Croplands	Croplands	Croplands
Boundaries	Swamps	Woodlots
Arid lands	Forests	Public places
Rangelands	Degraded areas	Swamps
Public places	Woodlots	Around kraals

3.2.4.1 Tree growing around homesteads

Trees are commonly planted or retained around homes to act as windbreaks that protect grass-thatched houses from strong wind. These trees also provide shade and medicines to humans and livestock, building poles and fruits. In many areas, the common species growing around

homesteads are *Markhamia lutea, Mangifera indica, Melia azedarach, Eucalyptus spp, Senna siamea* and *Citrus spp*. Areas near the home are regarded preferred to other farm locations due to ease of tree supervision and management.

3.2.4.2 Tree growing along farm boundaries

Trees are commonly retained along external farm boundaries as boundary markers to prevent land disputes. Boundary plantings are also useful for soil erosion control and provision of shade and windbreaks to adjacent gardens. In addition, they provide a source of building poles and firewood near / within the homestead. Many farm boundaries have *Borassus aethiopum*, "Omara-omara", *Ficus natalensis* and *Markhamia lutea* growing on them.

3.2.4.3 Tree growing in croplands

It is common for farmers when clearing land to retain some trees and shrubs on their gardens for various reasons. These trees provide shade for crops and improve on soil fertility while providing useful products like fruits, firewood and poles to households. *Albizia coriaria, Markhamia lutea, Mangifera indica* and *Citrus spp.* are some common species found on croplands.

3.2.4.4 Tree growing in woodlots

In some households, a portion of the land is set aside for tree growing. Trees in woodlots are mainly intended for providing building poles. The poles can also be sold to generate income. *Eucalyptus spp., Markhamia lutea, Senna seamea* and *Melia azedarach* are some of the common tree species grown in woodlots.

3.2.4.5 Tree growing in other parts of the landscape

Other locations in the landscape important for tree growing were identified as swamps grasslands and public places.

Trees are planted in swampy areas mainly because of the presence of abundant water that can ensure tree survival despite the long dry season. In places where there is land shortage like the Lake zone, tree growing is done in swamps to release other locations for crop cultivation. *Eucalyptus spp.* and *Senna siamea* are the common tree species in swamps providing shade (for livestock and herdsmen), firewood and a habitat for wildlife. In some swamps different types of fruit and medicinal species commonly exist.

Trees growing in grasslands are mostly part of natural vegetation. They are left to grow there as the land is not fertile enough to support crop cultivation. Tree planting is also done as an attempt to improve on the soils in these areas. *Ficus ovata*, *Combretum collinum*, *Terminalia macroptera* and "Lovo" are the common species growing in the grasslands.

In many public places like markets, schools and church compounds, trees are planted to create shade for people gathering in these places. Also, the shrubs provide privacy and serve as "urinals" for large gatherings. Trees in public places also provide products e.g. firewood and timber in the long run. The common tree species in public places are *Ficus natalensis*, *Mangifera indica*, *Antiaris toxicaria* and *Ficus sp.*

3.4 The role of trees in the farming system

Understanding the importance attached to various tree products and services is important before prescribing agroforestry trees for a farming system. Due to variations in physical and socio-economic factors, this often varies between locations and social groups. This section analyzes the role of trees in different ecological zones and gender groups, and describes the nature of each role.

3.3.1 Role of trees in different agro-ecological zones

The provision of building poles, firewood, fruits and windbreaks are the most important uses of trees in the district. It is evident that main uses of trees in the three agro-ecological zones do not vary significantly (see table 9a). However, the importance of fruits is not recognized in the Lake areas. Windbreaks are also ranked lower in the middle belt relative to other zones. On the other hand, the importance of soil conservation and boat making are specific to the Dry and Lake zones respectively.

Table 9a. Role of trees by agro-ecological zones (ranked). Table 9b. Role of trees by gender (ranked).

Dry belt	Middle belt	Lake belt
Poles	Poles	Poles
Firewood	Firewood	Firewood
Windbreaks	Timber	Windbreaks
Fruits	Fruits	Timber
Medicinal	Windbreaks	Boat making
Soil conservation		Medicinal

Men	Women	Youths
Poles	Poles	Poles
Firewood	Firewood	Firewood
Timber	Windbreaks	Windbreaks
Fruits	Fruits	Timber
Windbreaks	Medicines	Charcoal
Boat making	Soil management	Soil conservation
Income	Timber	Fruits

3.3.2 Role of trees by gender

It was hypothesized that gender impacts on the importance different categories of people attach to trees. Though there was consensus that poles, firewood, windbreaks and fruits are the main tree uses in the farming system, men ranked windbreaks as a lower priority, relative to other groups. (see table 6b). Women ranked medicines fairly high though other groups did not mention it. All groups recognized the importance of trees for timber, though women ranked it lower compared to other groups. Also, men did not mention the importance of trees in soil management but instead pointed out income and boat making among the major roles of trees.

3.3.3 Trees as a source of firewood

Firewood is the only source of energy in most rural households in the district. It is used mainly for cooking, but also lighting and warming the house at night and for keeping vigil at funerals. Some households light a fire in the kraal at night to generate smoke to keep off mosquitoes. Commercially, firewood is used for charcoal burning and metal fabrication. It is also sold in trading centres and / or used for distilling "waragi", a local potent gin.

The main sources of firewood are forests and rangelands. However, about 20% of households depend mostly on on-farm sources for firewood, i.e. own farm (17%) or other farms (4%). There is more dependence on on-farm sources for firewood in the wet belt, relative to the middle belt.

Table 10. Availability, purchase and planting of trees for firewood.

Agro-ecological zone	Respondents (%)		
	Experiencing shortage	Purchasing Firewood	Planted trees for firewood
Dry belt	-	-	-
Middle belt	76.9	67.9	20.8
Lake belt	67.3	56.9	12.0
District	**72.1**	**62.5**	**16.5**

Up to 72% of households visited experience shortage of firewood for domestic use. This shortage is more pronounced in the middle belt (77% of households). Overall, 62%

households cope with the shortage by purchasing firewood. A larger proportion (68%) of households in the middle belt purchase firewood compared to the Lake belt (57%). Many of these purchase it on a fairly regular basis.

On-farm planting of trees for firewood is not common. Only 17% of households reported having ever planted trees for firewood. Tree planting for firewood was slightly more pronounced in the middle belt (21% of households) relative to the Lake belt (12%).

74% of households purchase firewood at least once in a month. The percentage of households buying firewood on a monthly basis is higher in the wet belt (83%) in comparison to 67% in the middle belt. Overall, households in the wet belt indicated purchasing firewood more frequently compared to those in the middle belt.

The tendency to depend on naturally growing trees for firewood is the main reason why many households do not deliberately plant trees for this purpose. Lack of planting materials and knowledge on propagation of some species also hinder tree planting for firewood production. Land shortage was also mentioned as a hindrance.

3.3.4 Trees as sources of poles

Poles are used in various sizes depending on the purpose. They are mainly used in hut construction as support for mud walls and roofing. Poles are also useful in constructing shade for resting, shelters for bathing, kraals, making local bridges and slabs for latrines. They are also used to make granaries for food security and racks for drying simsim. Other uses of poles include making parts of musical instruments, ox-carts and handles of tools e.g. the Lango hoe, axes, etc.

The main sources of poles are the forests, individual land holding, rangelands and swampy areas. Few (9.3%) households rely on purchase of poles from the market or other sources. The collection of poles from other farms free of charge is minimal especially in the middle belt.

Table 11. Availability, purchase of poles and planting of trees for poles

	Respondents (%)		
Agro-ecological zone	Experiencing	Purchasing	Planted pole

	Shortage	Poles	trees
Dry belt	-	-	-
Middle belt	65.4	71.7	65.4
Lake belt	77.8	75.9	64.8
District	**71.7**	**73.8**	**65.1**

Generally, supply of poles is below household requirements. In the entire sample, up to 72% of the households faced pole shortage. This was more pronounced in the wet belt. Overall, purchase of poles occurs in about 74% of households, the percentage slightly higher in the middle belt (71.7%). About 65% of households reported having planted trees for pole production.

The frequency of purchasing poles depends largely on a households need for poles e.g. for house construction. About 44% of households purchase poles annually. The majority (75%) of households interviewed purchase poles at least once in 2 years.

The main constraints in planting trees for poles are the lack of planting material, land shortage and a general reluctance to plant trees due to dependency on existing ones. There is also lack of knowledge on tree planting.

3.3.5 Trees acting as windbreaks

Trees play a major role as windbreaks protecting grass-thatched roofs from strong winds. These trees in turn provide shade and support for climbers like passion fruits.

Table 12. Availability and planting of trees for windbreaks

Agro-ecological zone	Respondents (%)	
	Need for Windbreaks	Planted Windbreaks
Dry belt	-	-
Middle belt	100.0	83.0
Lake belt	96.2	72.5
District	**98.1**	**77.9**

Nearly all (98%) households sampled expressed need for windbreaks on-farm. This was mostly felt in the Middle belt. Up to 78% of the households had planted trees on-farm purposely to serve as windbreaks. This practice is also more pronounced in the middle belt.

3.3.6 Trees as sources of fruits and food

One of the main roles of trees and shrubs is their contribution to the local diet and household food security. A variety of fruits are consumed in households, either eaten fresh or used to spice up millet meal. The sale of fruits provides an opportunity for generating cash income to some households. Some fruits (e.g. Shea nut) are used for extraction of oil used for cosmetic purposes and also sold for income. The leaves of some trees are eaten as vegetables.

Most households get much of the fruits they consume from their own farms and from forests. The collection of fruits from other farms free of charge is minimal (6.7% of households). On the other hand, 18% and 15% of households rely mostly on rangelands and the markets for their fruit supply, respectively.

Table 13. Availability, purchase of fruits and planting of fruit trees

Agro-ecological zone	Respondents (%)		
	Experiencing shortage	Purchasing fruit	Planted fruit Trees
Dry belt	-	-	-
Middle belt	49.0	68.6	75.5
Lake belt	67.9	69.2	82.7
District	**58.7**	**68.9**	**79.2**

Up to 59% of households indicated facing shortage of fruits. A significantly larger percentage of households in the Lake belt (68%) face a shortage of fruits, relative to the middle belt (49%). On the other hand, a large percentage of households (69%) in the both belts purchase fruits.

About 80% of households reported having planted fruit trees on-farm. This was more common in the Lake belt. Farmers that had not planted indicated lack of planting material

and knowledge on tree planting as the hindrances to planting fruit trees. Others factors are low interest in tree growing and the tendency to regard natural stands as sufficient.

3.4 Important indigenous trees in the farming system

The determination of important trees and shrubs began by identifying priority species for each of the major roles during the rapid appraisals. During the household survey, these species were subjected to rating across key selection criteria for each use. This section presents priority indigenous trees and shrubs according to major roles.

3.4.1 Priority indigenous poles species

During the RRA, the study dug into the specific qualities of a "good pole". Apparently, there is no perfect pole, as quality of a pole depends on the purpose for which it is sought. Generally, however, poles are gauged basing on their strength (i.e. not breaking easily), straightness, flexibility against strong wind and resistance to termites and borers. They should also be fast growing, attaining good size and coppicing well, in addition to serving multiple functions.

Table 15. High priority indigenous pole species

Species	Ranking points		Percentage
	Total	Mean	Preference*
Markhamia lutea	226	4.19	66.4
Senna siamea	174	3.22	9.3
Terminalia macroptera	159	2.94	12.1
Bridelia scleroneuroidii	107	1.98	7.5
Combretum collinum	83	1.54	2.8
Piliostigma thonningii	72	1.33	1.9

* **Respondents mentioning species as the best for poles.**

The priority indigenous pole species as determined from the total ranking points accumulated are *Markhamia lutea*, *Senna siamea* and *Terminalia macroptera*. The majority (66%) of respondents concurred on *Markhamia lutea* as best indigenous pole species. Though *Senna siamea* was ranked higher than *Terminalia macroptera*, the latter was more frequently mentioned as first priority.

- *Markhamia lutea* is rated highly for pole production mainly due to its high coppicng ability, fast growth and straight poles ideal for roofing. These poles are strong and fairly withstand borers. However, *Markhamia lutea* poles are considered inappropriate for wall construction.

- *Senna siamea* is a fast growing species that coppices well and produces straight poles, ideal for roofing. On the other hand, however, the species is susceptible to borers and termites. It is not recommended for wall construction.

- *Terminalia macroptera* is rated highly as a pole species because it produces strong poles are that are resistant to termites and borers. *Terminalia macroptera* poles are highly recommended for wall construction. These poles though are not straight which makes them inconvenient for roofing. The species' also grows slowly and coppices quite poorly.

3.4.3 Important indigenous trees for firewood

Good firewood is determined from its ability to light easily and sustain a steady flame without producing lots of smoke. Producing embers that are used for ironing and preserving fire overnight is another attribute of good firewood. It should also be easy to split and not thorny.

Table 17. High priority indigenous firewood species

Species	Ranking points		Percentage
	Total	Mean	Preference*
Combretum collinum	509	4.76	86.0
Albizia malacophylla	235	2.20	3.7
Combretum fragrans	225	2.10	1.9
Terminalia macroptera	199	1.86	4.7
Bridelia scleroneuroidii	199	1.86	1.9
Vitellaria paradoxa	145	1.36	5.6
Combretum molle	109	1.02	0.0

* **Respondents mentioning as best indigenous species for firewood**

Combretum collinum ranked highest among indigenous species for firewood. This is determined from total ranking points acumulated and high level of respondent consensus. The other priority species are *Albizia malacophylla* and *Combretum fragrans*. Other candidate species include *Terminalia macroptera* and *Bridelia scleroneuroidii*.

- *Combretum collinum* is rated highly for firewood because it is not thorny, dries quickly and is relatively easy to break or cut. Its firewood burns for long, producing little smoke and many embers. However, it produces lots of ash in the process.

- *Albizia malacophylla* is a non-thorny species that is easy to break or cut. It also dries and lights easily. However, firewood from this species emits lots of smoke, burns out quickly and does not produce embers.

- *Combretum fragrans* is also a non-thorny species and its firewood lights easily. It is, however, slow drying and hard to split. Its firewood produces a lot of smoke and ash but few embers.

3.4.4 Important indigenous trees for windbreaks

The service of trees as windbreaks protects grass-thatched houses from strong wind. The trees that serve as windbreaks are ideally tall with a large, dense canopy. They also need to have strong root system and flexible trunk that does not break against force of the wind. Table 18 presents the priority indigenous species for windbreaks in Lango.

Table 18. High priority indigenous windbreak species

Species	Ranking points		Percentage
	Total	Mean	Preference*
Markhamia lutea	314	2.94	33.6
Ficus natalensis	278	2.60	26.2
Melicia excelsa	267	2.50	17.8
Albizia coriaria	265	2.50	12.1
Melia azedrach	179	1.67	0.9
Combretum molle	171	1.60	4.7
Vitellaria paradoxa	126	1.18	3.7

* **Respondents mentioning as the best indigenous windbreak species**

Markhamia lutea is evidently the best indigenous species for windbreaks as determined from the total ranking points accumulated. *Ficus natalensis*, *Melicia excelsa* and *Albizia coriaria* are the other important priority species for this purpose.

- *Markhamia lutea* is a fast growing, multi-purpose species that attains great height and root depth. The species has a long life span and is resistant to destruction by termites or strong winds. Its relatively small / narrow canopy is its only undoing as a windbreak species.

- *Ficus natalensis* has almost all attributes required of windbreak species; a wide canopy, long life span, resistance to strong winds, fast growth and good height. On the other hand, however, this species does not have many other uses.

- *Albizia coriaria* and *Melicia excelsa* are the other priority species for windbreaks. Their height, large canopies, long life spans and resistance to termites and strong winds render these species ideal for windbreaks. Both species, however, are quite slow growing.

3.4.5 Important indigenous fruit species

The criteria for determining the quality of a fruit varies from one fruit type to another. Thus, a wide range of criteria pointed e.g. taste (sweetness or sourness), attractive colour, fleshiness and marketability are considered. The ideal fruit tree should also be resistant to pests (especially termites) and diseases, have a short gestation period and bear many fruits

regularly. It should also be able to serve other functions in the seasons when it is not fruiting.

Table 19. High priority indigenous fruit species

Species	Ranking points		Percentage Preference*
	Total	Mean	
Vitex doniana	338	3.16	10.3
Butyrospemum paradoxum	304	2.84	46.7
Tamarindus indica	279	2.61	23.4
Carissa edulis	239	2.23	7.5
Strychnos spinosa	205	1.92	2.8
Annona chrysophyla	105	0.98	3.7
Ximenia americana	102	0.95	3.7

* **Respondents mentioning as best indigenous fruit species.**

Priority indigenous fruit species as determined from total ranking points accumulated in the survey are *Vitex doniana*, *Vitellaria paradoxa*, *Tamarindus indica* and *Carissa edulis*. Note though that much as *Vitex doniana* was ranked highest (on points), only 10% of respondents placed it as best species. A larger section of respondents ranked *Vitellaria paradoxa* and *Tamarindus indica* as first priorities.

- *Vitex doniana* is rated highly among fruit species as it bears many fruits after a few years. Its fruits have good taste, flavour and attractive color. However, their small size and inadequate flesh and juice content are the negative attributes of this species.

- *Vitellaria paradoxa* bears many fruits of good taste and flavour. On the other hand, however, this species takes long to fruit and its fruits also rarely grow to big size. Their juice content is insufficient.

- *Tamarindus indica* puts on attractive fruits with many positive attributes; good flavour, juicy, fleshy and growing to satisfactory size. This species also fruits after a few years of growth although it bears only a few fruits at a time.

- *Carissa edulis* bears many fruits quite early, though they do not grow to big size. However, the species is rated high on other attributes especially taste, attractive colour and juice content of its fruits.

3.5 Opportunities for tree growing in the farming system.

As a way forward for on-farm tree growing in the farming system, the study considered the suitability of various locations or niches and other opportunities for promoting agroforestry.

3.5.1 Locations for future tree planting

The following section presents on-farm and off-farm locations identified as having potential for tree growing in future. These include areas around homesteads, farm boundaries, croplands, swamps and degraded areas.

Table 20. Locations for future tree planting

Dry belt	Middle belt	Lake belt
Homesteads	Homestead	Homestead
Croplands	Boundary	Boundary
Swamps	Croplands	Croplands
Boundaries	Swamps	Degraded areas
Degraded areas	Roadsides	Swamps
Public places	Woodlots	Woodlots

The homestead is considered an ideal location for tree planting in future because trees planted there provide fruits, building poles, shade and later on timber. These trees will also act as windbreaks and serve as ornamentals. The tree species suggested for planting in homesteads are mainly fruit species like *Mangifera indica, Citrus spp. Psidium guajava, Carica papaya* and *Artocarpus heterophyllus*. Also *Vitellaria paradoxa, Anacardium spp., Milicia excelsa, Senna siamea, Markhamia lutea*, Elgon teak and Mahogany were mentioned.

Degraded areas are also a probable niche for tree growing in future. The areas are largely unutilised and planting trees there would be good strategy for maximising land use. The trees planted in arid areas can provide firewood, medicines and poles as well as acting as windbreaks. This will in the end, help to rehabilitate the land. Trees suggested for planting in degraded areas are *Vitellaria paradoxa, Mangifera indica, Milicia excelsa, Markhamia lutea* and *Senna siamea*.

Boundary plantings also have potential in this area, as the location is associated with fast growth of trees. They will also serve as windbreaks and boundary markers. Suggested tree species for boundaries include *Borassus aethiopum, Markhamia lutea* and *Ficus natalensis*.

Crop gardens are recommended for tree planting in future in this area as a way of conserving the soil. Trees planted on the gardens will also provide shade to crops. Suggested species suitable for planting on croplands are *Markhamia lutea, Melia azedrach, Vitellaria paradoxa, Gmelina arborea, Ficus natalensis, Combretum collinum* and *Albizia coriaria*.

Tree planting in future is also advocated for in swamps since this will make maximum use of available land Trees in swamps are expected to increase their water retention capacity. These trees are also to provide shade and firewood while at the same time acting as windbreaks. Swamps also have sufficient water even in dry season to enable good tree survival and growth. Thus, they are regarded a suitable site for future tree planting. Trees preferred for planting in swamps are *Vitex doniana, Markhamia lutea*, "Opok" and *Melia azedrach*.

Woodlots are considered suitable niche for tree planting in future as they limit on the competition between trees and crops. Trees are also easier to manage when planted in woodlot, than when they are scattered in various locations on the farm. Suggested tree species for woodlots are *Markhamia lutea, Senna siamea* and *Milicia excelsa*.

3.5.2 Factors favouring tree growing

The impetus to plant and manage trees lies in various factors that manifest a need to do so. This section presents factors pointed out as likely to compel farmers to plant trees on-farm in the near future. Though these factors varies between zones, there are some cross-cutting issues (see table 23).

Table 23. Factors encouraging planting of trees and shrubs on-farm

Dry belt	Middle belt	Lake belt
Land availability	Income generation strategy	NGO / CBO collaboration
Technical support	Increasing demand for tree products	Technical support
Awareness on tree planting	Soil fertility problems	Investment strategy
Presence of fast growing species	Need for windbreaks on farm	Increasing demand for tree products
NGO / CBO collaboration	Awareness on tree planting	Income generation strategy

The presence of technical support from NGOs, CBOs and Church based organisations offers an opportunity for collaboration in promoting tree growing. These can be strengthened through work of research and district departmental staff.

In many areas in the dry belt, land is still available for tree planting. Elsewhere however, where population density is high, the resultant scarcity of tree products compels farmers to plant trees on-farm as a strategy for guaranteeing future supply.

In light of increased demand for tree products along with their commercialization, tree growing is seen as an alternative source of income for households. Similarly, tree growing offers an alternative investment option to households for future needs.

4.0 Conclusion

The conclusions of this study draw mainly from the outcome of the stakeholders' feedback workshop. Review of the findings revealed that integration of indigenous trees and shrubs with other land use activities on-farm like crop cultivation (cassava, millet, beans, simsim, cotton and groundnuts) and livestock rearing (cattle, goats, sheep, pigs and poultry) is a quite selective undertaking. In addition consideration is given to other enterprises (trading, brewing, casual labouring) so as to fit agroforestry into the whole production system. Concern is taken to prescribe trees that improve or at least do not curtail upon the returns of other farm enterprises.

Considering that population increase features as a major factor leading to loss of tree cover in the Lango region, determination of indigenous trees and shrubs with potential for agroforestry also considered multiplicity of uses or benefits to the farmer. Multipurpose species are given priority especially those that serve the major roles identified in the study (firewood, poles, fruits, windbreaks and shade). The following species are important to farmers and stand an opportunity of being grown on-farm:-

Fruit species

- *Vitellaria paradoxa*
- *Annona senegalensis*
- *Vitex doniana*

Non-fruit species

- *Markhamia lutea*
- *Terminalia macroptera*
- *Albizia malacophylla*

- *Tamarindus indica*
- *Carissa edulis*
- *Strychnos spinosa*
- *"Amalera"*
- *Ficus natalensis*
- *Combretum collinum*
- *"Kano"*
- *"Olam"*

The importance of these indigenous species and potential for agroforestry are summarized in appendices 1 and 2. This list, however, is not entirely binding as throughout this report, many other indigenous species have been pointed out to serve key roles to farmers in the Lango system. The purpose of this study was to determine and document these species as a foundation for further agroforestry research and development activities in this farming system.

Appendix 1. Priority indigenous fruit species for agroforestry

Species	***Importance***	***Potential for agroforestry***
Vitllaria paradoxa	▪ Poles ▪ Windbreaks ▪ Firewood ▪ Shade ▪ Fruits ▪ Charcoal ▪ Oil from seeds (source of income) ▪ Timber ▪ Seeds used as feed for livestock	▪ Useful for boundary marking ▪ Soil fertility enhancing ▪ Poles for kraal construction
Annona senegalensis	▪ Fruits ▪ Firewood ▪ Fodder	▪ Increases soil fertility
Vitex doniana	▪ Fruits ▪ Firewood ▪ Fodder ▪ Windbreaks ▪ Shade ▪ Timber	▪ Not competitive with crops
"Amalera"	▪ Fodder ▪ Fruits ▪ Firewood	▪ Soil erosion control
Carissa edulis	▪ Fruits ▪ Fodder ▪ Medicines (Roots cure epilepsy)	▪ Multiple uses
Tamarindus indica	▪ Shade ▪ Windbreaks ▪ Firewood ▪ Spicing bread and porridge ▪ Fruits ▪ Poles	▪

Strychnos spinosa	▪ Firewood ▪ Shade	▪

Appendix 2. Priority indigenous non-fruit species for agroforestry

Species	*Importance*	*Potential for agroforestry*
Markhamia lutea	▪ Poles ▪ Windbreaks ▪ Firewood ▪ Boundary marking ▪ Shade ▪ Medicine (for placenta) ▪ Timber	▪ Compatible with crops and livestock ▪ Leaves decompose to enhance soil fertility ▪ Soil erosion control ▪ Soil fertility ▪ Poles for kraal construction
Terminalia macroptera	▪ Poles ▪ Timber ▪ Windbreaks ▪ Firewood ▪ Charcoal ▪ Shade ▪ Fodder	▪ Fodder and shade for livestock
Albizia malacophylla	▪ Timber ▪ Firewood ▪ Windbreaks ▪ Shade	▪ Canopy is not close which allows survival of crops
Ficus natalensis	▪ Fodder for livestock ▪ Shade ▪ Poles ▪ Windbreaks ▪ Firewood	▪ Enhances soil fertility
"Olam"	▪ Firewood ▪ Windbreaks ▪ Shade ▪ Fodder	▪ Leaf litter decomposes to increase soil fertility ▪ No competition with crops
Combretum collinum	▪ Firewood ▪ Charcoal ▪ Poles ▪ Medicines (roots cure dysentery)	▪
"Kano"	▪ Timber ▪ Firewood ▪ Poles	▪

Appendix 1. List of tree and shrub species

	Scientific name	Luo name
1.	*Albizia coriaria*	ITEK
2.	*Albizia malacophylla*	ABATA
3.	*Anacardium ocidentale*	
4.	*Annona chrysophylla*	OBWOLO
5.	*Antiaria toxicaria*	ELWA
6.	*Artocarpus heterophyllus*	
7.	*Borassus aethiopum*	TUGU
8.	*Bridelia scleroneuroidii*	ORWECO
9.	*Cajanas cajan*	
10.	*Carica papaya*	
11.	*Carissa edulis*	ACUGA
12.	*Citrus spp.*	
13.	*Combretum collinum*	ODUGU
14.	*Combretum fragrans*	
15.	*Combretum molle*	IYORO
16.	*Eucalyptus spp.*	KALITUSI
17.	*Ficus natalensis*	ITUBA / ANANGA
18.	*Ficus ovata*	EBULE
19.	*Ficus sur*	EBUU
20.	*Gmelina arborea*	EMALAINA
21.	*Mangifera indica*	
22.	*Markhamia lutea*	SAMBIA
23.	*Melia azedrach*	ALIRA
24.	*Milicia excelsa*	ILWA
25.	*Passiflora edulis*	
26.	*Piliostigma thonningii*	OGALI
27.	*Psidium guajava*	
28.	*Senna siamea*	GASIA
29.	*Strychnos spinosa*	AKWALAKWALA
30.	*Tamarindus indica*	CWAO
31.	*Terminalia macroptera*	OPOK
32.	*Vitellaria paradoxa*	YAO
33.	*Vitex doniana*	OWELO
34.	*Ximenia americana*	OLIMO
35.	_	LOVO
36.	_	OLIGO
37.	_	OMARA-OMARA