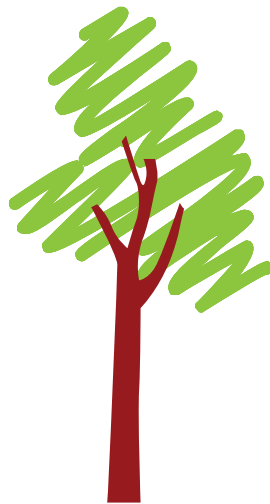


# Kilombero Valley Teak Company



**Forest Management Plan  
2021-2055**

**Updated: July 2021**

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## 1 EXECUTIVE SUMMARY

The Forest Management Plan is updated at least every two years in order to be an accurate reflection of the company's forest operations.

The Chief Executive Officer in cooperation with the Chief Forest Manager is responsible to ensure that the Forest Management Plan is up to date all the time.

### 1.1. Introduction

In 1992 the Commonwealth Development Corporation (CDC) established the Kilombero Valley Teak Company (KVTC), Based on a 99-year lease with the Government of Tanzania. The mandate of the company is to use the development of plantation forestry and timber processing as a means by which to promote sustainable economic, social and environmental development in the Kilombero Valley.

KVTC obtained leasehold rights (1992) to practice forestry on 28,132 ha of land in the Ulanga and Kilombero Districts of Tanzania.. A site for a processing plant was allocated to KVTC in 2008 and construction completed in 2009.

In 2001 the Finnish Fund for Industrial Cooperation Ltd. (Finnfund) purchased a 23% shareholding in KVTC. In 2011 the Global Environment Fund acquired the 77% shareholding from CDC. Finnfund maintained its 23% shareholding.

KVTC's prime objective is to produce high quality teak timber products from plantations which the Company has established, maintained and harvested on a commercial sustainable basis by the application of best international forestry, environmental, health & safety as well as social standards of practice.

KVTC has committed to comply with the Principles and Criteria of the Forest Stewardship Council (FSC) as well as the International Finance Corporation's performance standards. KVTC has been certified according to ISO14001, ISO 45001 standards. Policies and procedures have been implemented by the company to assist management in the implementation and maintenance of the various management systems and principles.

### 1.2. Growth Stock and Plantation Establishment

KVTC is mostly involved in the planting of *Tectona Grandis*. All seed used by KVTC is either purchased from the Tanzania Tree Seed Agency (TTSA) or collected from selected KVTC compartments. Stumps are grown for 7 – 9 months in the KVTC nursery before establishment.

Stumps or seedlings are manually planted once pitting has been completed. Typically, a spacing of 3m x 3m is applied. Planting starts shortly after the first rains in December and continues, depending on the rainy season, until April.

KVTC has implemented a long term tree improvement strategy that combines selection of best performing local material and the importation of clones from a range of native teak growing areas.

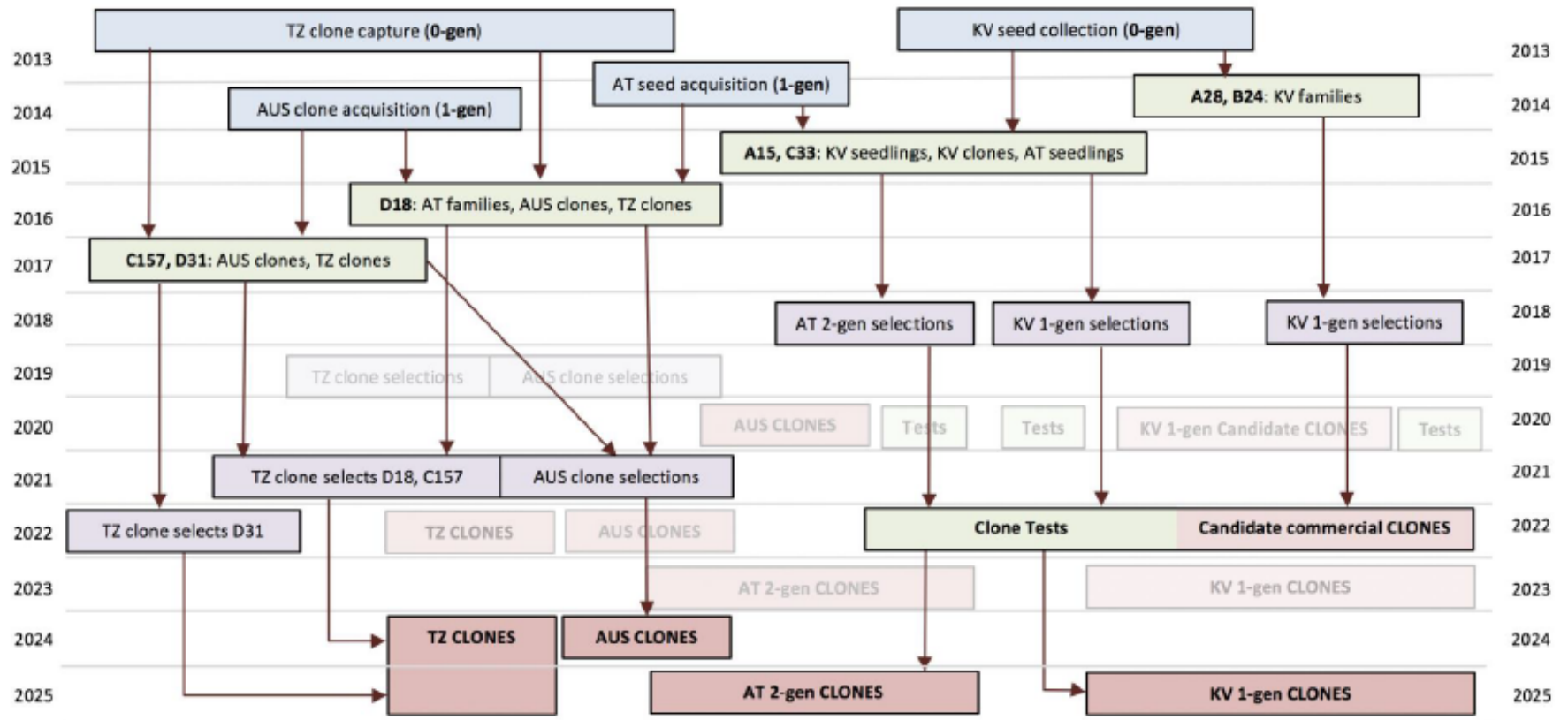
In 2013 KVTC launched a 3 legged research program with assistance from Dr Andrew Callister, an Australian research consultant. It consists of:

- Genetic Program
- Nutrition trials
- Beast management practices

The genetic program coined PROJECT PLUS 20 (P+20) had the objective to develop genetic material that would increase the financial return from KVTC's forestry operations by 20% compared to Tanzanian seed within 10 years. Figure 1 taken from Andrew Callister's report shows the latest schedule of activities for P+20. Seed and clonal material were collected from 80 trees and propagated in the nursery. There were then 7 progeny trials between 2014 and 2017. The best 80 performers were collected in 2019 for clonal reproduction.

Figure 1. Project Plus 20 activities schedule.





*Figure 1. Diagram of key acquisition (blue boxes), testing (green boxes), selection (purple boxes), and deployment (red boxes) activities scheduled under PROJECT PLUS 20. Activities that have been rescheduled since February 2018 are shown as pale boxes. The changes relate to allowing an additional two years for propagating selections made in 2018 and an additional two years for clone trial growth before selection. A minimum three years trial evaluation is maintained for clone trials, pushing the final selection of KV 1-gen clones and AT 2-gen clones back by to 2025.*

In the Nutritional Trials Program, different fertilizers were applied at different ages to different site classes from 2013 to 2015. The main findings from these trials have since been deployed commercially. Nitrogen fertilizer is applied at first thinning in poor sites at the rate of 200kg (or 750kg for 27% CAN) per hectare.

Under the Best Management Practices program, different spacing and thinning plots were established. The results show that the best regime is planting 800 spha, thinning down to 500 spha, then 250 spha. A few high site index classes can be thinned again to 150 spha before age 15 years.

In 2013 KVTC switched from a pre-dominantly seedbed based approach to a vegetative propagation of planting material. The company's nursery has been upgraded to be able to produce around 500,000 plants per annum which would be the equivalent of around 400ha of plantation per annum.

### **1.3. Silviculture Management**

Branches are removed to prevent the formation of knots. The pruning regime is based on height growth, where, depending on the stability of the tree, all branches up to the big branches that formed in the previous dry season are removed. Pruning is repeated annually until a height of 7.5 meters.

Teak is a long living pioneer species sensitive and susceptible to weed suppression. As part of the KVTC weed control strategy, a combination of three activities are performed to control weeds: slashing, circle and chemical weeding.

Thinning is performed to aid in the achievement of desired tree growth and size requirements. The actual felling operation is preceded by mark for thinning, which is the selection and marking of poorer trees, i.e. deformed, diseased and suppressed. The distribution of trees in the compartment is also taken into consideration to allow for an even espacement, based on the regime, after thinning.

### **1.4. Forest Management and Inventory**

The production forest consists of the established teak compartments and the natural woodland where several species could be selectively harvested. The areas are broken up into plantations, each of which is regarded as a management unit. KVTC has four such management units, Nakafulu, Mafinji, Narabungo and Ichima. Each management unit is divided into compartments of various sizes according to age and geographical position for teak and species composition and topography for natural woodland.

The non production areas are divided into various sections for management purposes and are defined by parameters such as geographical position, conservation value and species composition.

A systematic sampling method is used for assessing the standing timber resource at a sample rate of 10% of the total compartment area. The inventory is carried out at age 5 and thereafter at least once every four years.

The plantation inventory data is captured to and analysed within the Microforest management system based on pre-programmed models and parameters. An inventory report is produced for each compartment following automated analysis. The data is then used in harvesting scheduling to estimate the growth and yield which guides the normalisation of age class process.

A program has been developed to undertake a complete survey of all forestry areas within KVTC landholding. A grid of 250 meters by 250 meters (6.25 hectare) is used to produce sample units. Each unit is numbered and trees are identified. On the basis of this identification a further detailed classification of KVTC's forest land will be applied.

The field data from the natural woodland surveys are captured electronically at the office and yield and location maps produced. The resultant information is used together with growth models to predict the sustainable harvest for each species per natural woodland unit.

#### **1.5. Annual Harvest and Rotation Age**

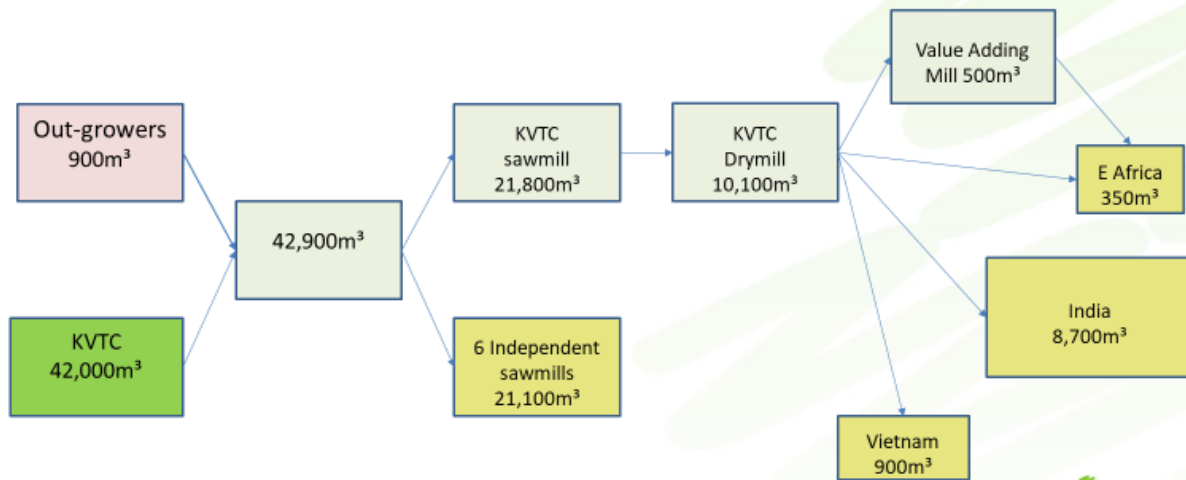
The annual allowable cut is determined through the Microforest system by the harvest scheduler. The annual allowable cut is the utilisable volume that can be harvested each year without compromising the long term sustainable timber supply. This is expressed as cubic metre (m<sup>3</sup>) per year and takes into consideration the current stands with their unique parameters and management regimes as well as potential future stands. The optimum sustained volume is an indication of business sustainability and maximum volume production.

#### **1.6. Markets and Utilization**

In 2007 the process towards developing a wood processing Industry based on thinning and early volumes from KVTC plantation was started. This process resulted in the decision to construct a fully integrated timber processing plant that could produce a variety of products ranging from rough squares, sawn timber, kiln dried timber as well as value added products such as finger jointed and edge glued products as well as solid products such as flooring and decking. The factory was constructed during 2008 and 2009 and was commissioned in August/September 2009

Half the volume harvested is sold as round logs to sawmills that are less than 1km from KVTC's sawmill at Mavimba. The remainder is processed in KVTC's own sawmill. Figure2 shows current wood flow.

**Figure 2 KVTC Wood flow & Markets**



**1.7. Forest Protection and Environmental Management**

KVTC is committed to protect the environment it operates in and will comply with the various standards and management systems it subscribes to. In order to achieve this objective a number of procedures and management practices have been developed

Buffer zones are created for the movement of animals, birds and amphibians to allow movement between larger, protected habitat refuge areas. Any areas that have been converted from natural woodland to teak have undergone a comprehensive pre-felling assessment taking into account biodiversity, wildlife movement, water courses and soil suitability. Local and international specialist have been consulted prior to any conversion took place.

Wildlife is an integral part of the overall biodiversity of the Kilombero Valley. The company maintains a no hunting policy. Anti-poaching patrols and game guards are deployed to control poaching. Participating villages assist KVTC in this regard through village patrols which consist of two village members (paid by KVTC) doing daily patrols.

The use of chemicals is controlled and a process of authorisation has to be followed which is contained within the ISO 14001 system. Only chemicals on the company’s chemical approved list may be used. All chemicals have to be legally registered within Tanzania and conform to the chemical policy guidelines of the Forest Stewardship Council (FSC).

Biodiversity issues are described in the ISO 14001 system. All operations are rated (in the aspect register) and procedures developed to quantify, manage and measure the company's effects on biodiversity. Annual Environmental Management Programmes (EMP's) are implemented for aspects with the biggest impacts. KVTC has conducted numerous research studies within all fields related to the management of teak and miombo woodland. Continuous monitoring, following on baseline studies allows the tracking of changes over time. This allows for improved management prescriptions to be implemented and transparent reporting to stakeholders.

#### **1.8. Social Relations and Extension Programs**

Currently, the company has a very efficient way of distributing social fund money to villages. Apart from the annual social fund, villages provide services such as security patrols and boundary clearing, which earns additional revenue to be spent for projects in the villages.

KVTC and each neighbouring village also make an annual village contract. In this contract, a bonus scheme rewards villages that prevent uncontrolled wild fires, poaching and illegal logging of both teak and indigenous species.

KVTC has an HIV/AIDS programme involving company employees, contractor employees and associated villages.

#### **1.9. Survey Programs**

In order to collect sufficient time series data on the growth of teak for use in the development and calibration of growth and yield models, KVTC has established a comprehensive system of PSP's. PSP are established to cover the range of growing sites and ages present at KVTC. An 11.28 metre circle plot (0.04 of a hectare) is established in the selected area in a compartment; the site should be as homogenous as possible.

Monitoring of the effects of logging and other forest activities are described through the ISO 14001 procedures. All aspects and impacts are regularly evaluated by relevant staff members. These are mitigated through a series of procedures and programmes.

#### **1.10. Monitoring and measuring**

KVTC has adopted a comprehensive monitoring program with a well designed framework and protocols that focuses on rainfall patterns, stream flow and quality, fauna and flora as well as socio-economic impact monitoring. The company has identified Areas of Special Interest that have been assigned with individual management and monitoring programs. An ESG Monitoring report is updated every year and made available to the public.

Annual budgets are drafted and performance is being measured against these as well as set standards, work studies, time studies, physical measurements as well as accounting data. The Forest Planning Manager ensures that compartment data are filled and updated to reflect an accurate position versus the company's Annual Plan of Operations

## **2 COMPANY PROFILE**

In 1992 the Commonwealth Development Corporation (CDC) established the Kilombero Valley Teak Company (KVTC), Based on a 99 year lease with the Government of Tanzania. The mandate of the company is to use the development of plantation forestry and timber processing as a means by which to promote sustainable economic, social and environmental development in the Kilombero Valley.

In 2001 the Finnish Fund for Industrial Cooperation Ltd. (Finnfund) purchased a 23% shareholding in KVTC.

In 2011 the Global Environment Fund acquired the 77% shareholding from CDC. Finnfund maintained its 23% shareholding.

The company subscribes to a set of policies as attached in the annexure.

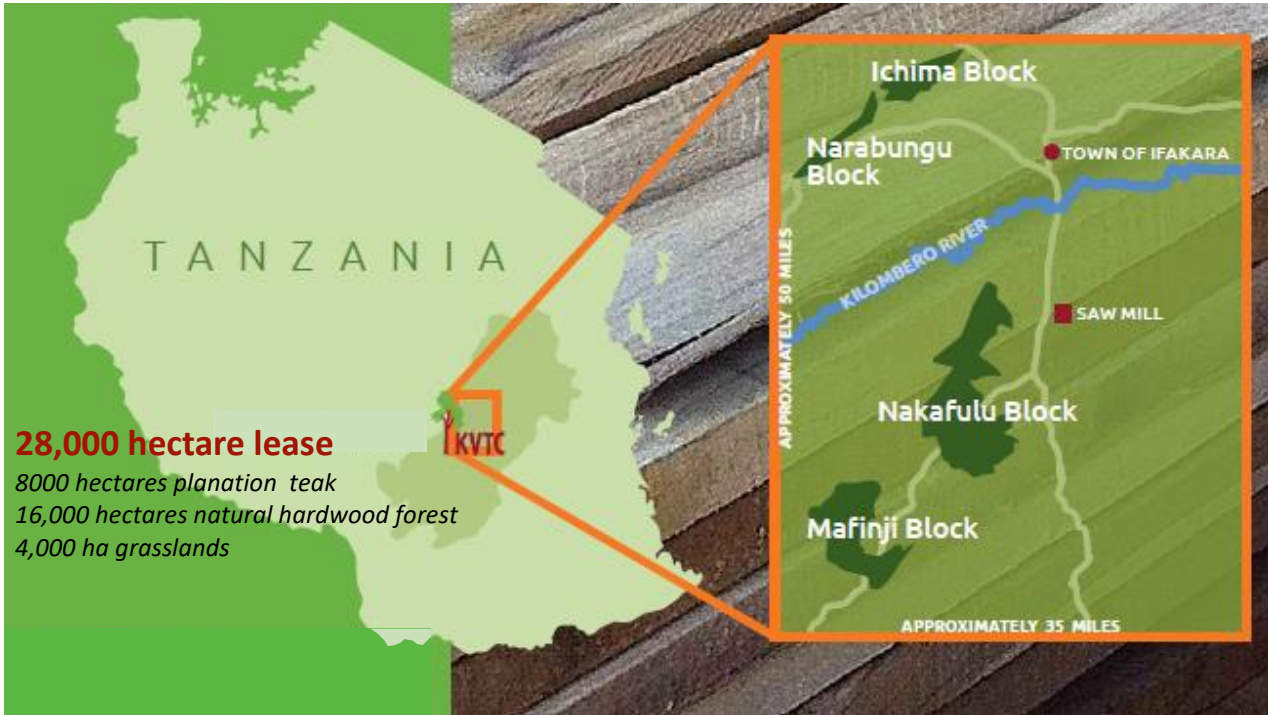
### 3 BASIC RESOURCE DATA

#### 3.1 Legal status of the management area

KVTC obtained leasehold rights (1992) to practice forestry on 28,132 ha of land (*map attachment 1*) in the Ulanga and Kilombero Districts of Tanzania.. A site for a processing plant was allocated to KVTC in 2008 and construction completed in 2009. Both the forest and processing plant land is held under a 99-year lease from the Tanzanian Government. The shareholders of the company are Global Environment Fund and Finnfund.

#### 3.2 Geographic location of the management area

Figure3: KVTC location within Tanzania





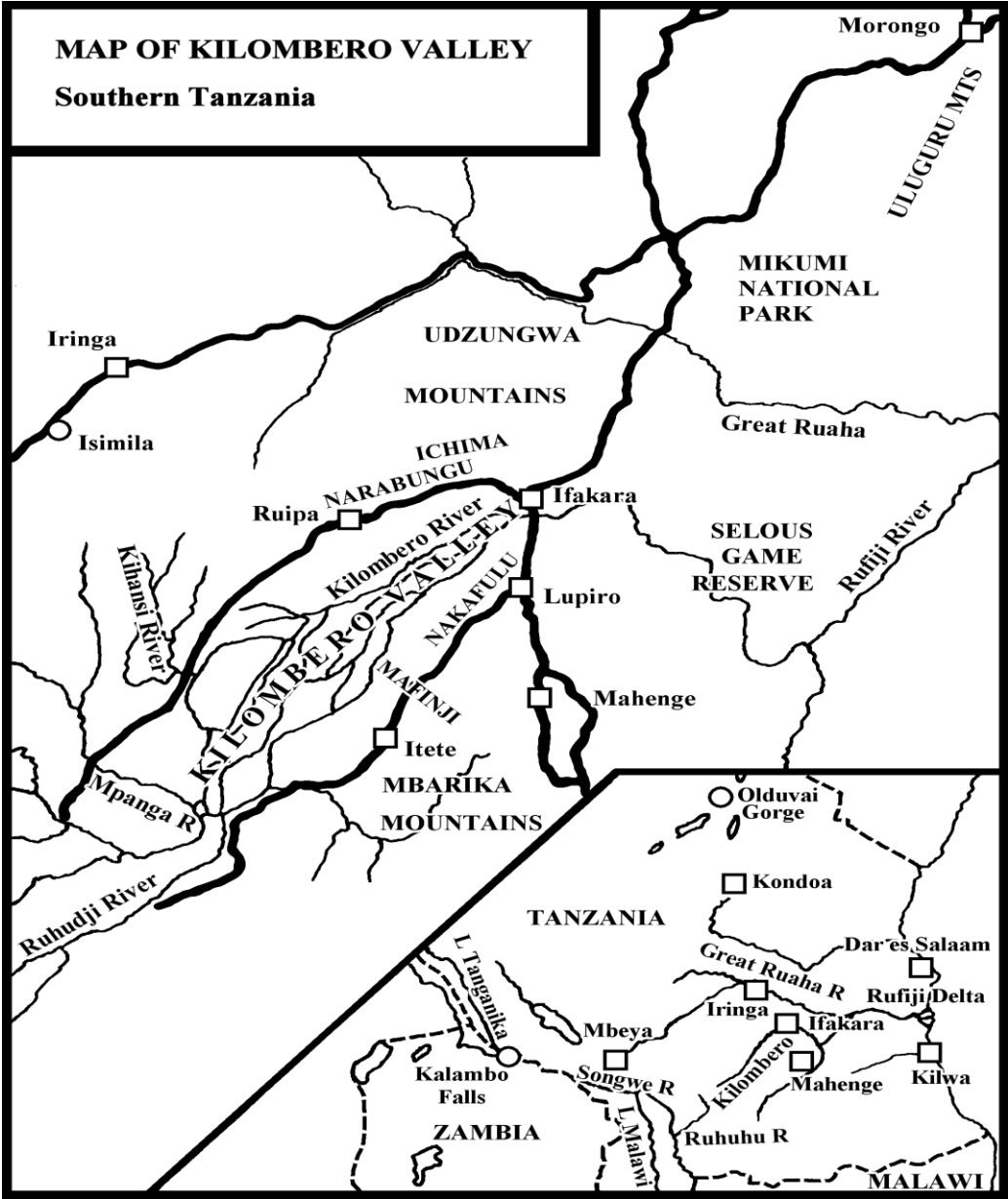


Figure 4: The Kilombero and Ulanga districts

3.2.1 Description of the boundaries of the forest blocks

(i) Block A

Block A or locally known as Ichima  
 Title Number: 47490  
 Land office Number: 157171  
 Land: Farm No 294 at Idete – Mlimba District  
 Term: Ninety Nine Years from 1<sup>st</sup> of January 1994

Size in Hectares: 2636.3 ha

Registered survey plan no: 30103

Description: In the north, block A borders on the Udzungwa National Park with a straight line boundary running east to west down into the Idete River where it follows the river curve linear south to the Idete village land. In the south it borders on the Idete village land and meanders its way to the Doko river and follows the river curve linear north east onto the boundary of the Ihanga forest reserve where it meets up with the Udzungwa boundary in the north.

**(ii) Block B**

Block B or locally known as Narabungu

Title Number: 47489

Land office Number: 157170

Land: Farm No 293 at Namawala – Mlimba District

Term: Ninety Nine Years from 1<sup>st</sup> of January 1994

Size in Hectares: 2111.7 ha

Registered survey plan no: 30103

Description: In the north block B borders on the Namawala village land close to the Matundu forest reserve with a straight line running north east to south west down into the main road that goes to the Ruipa where it follows the road curve linear east to the Namawala village. In the south it follows the Tazara railway line and meanders its way to the Idete prison land where it follows the boundary north and then east onto a tributary of the Idete River and then north again to the main Idete River where it meets up with the boundary in the north.

**(iii) Block C**

Block C or locally known as Nakafulu

Title Number: 47487

Land office Number: 157168

Land: Farm No 283 at Nakafulu – Ulanga District

Term: Ninety Nine Years from 1<sup>st</sup> of January 1994

Size in Hectares: 15171.1 ha

Registered survey plan no: 30015

Description: In the north block C borders on the Ichea river with a straight line boundary running south west down into the Nakafulu river. From here it follows the river curve linear east and then south west meandering its way down south onto the main road to Iragua where it crosses the road at 90 degrees and follows the Namhanga river south and meets up with the Semero river which runs in a north east direction. On the eastern boundaries where it leaves the Semero river it meanders its way around the Ngangu hill to the Nakatete River and follows the river curve linear north crossing the main road once more. It eventually leaves the river at a 90 degree angle and follows around the Namhanga hills where it meets up with the Nakafulu river. The boundary follows the Nakafulu River and at Humburu hill makes a 90 degree turn east where it meanders north east to the Ichea River and follows this where it meets up with the boundary in the north.

**(iv) Block D**

Block D or locally known as Mafinji

Title Number: 47488

Land office Number: 157169

Land: Farm No 282 at Iragua – Malinyi / Ulanga District

Term Ninety Nine Years from 1<sup>st</sup> of January 1994

Size in Hectares: 8212.4 ha

Registered survey plan no: 30014

Description: In the north, the block D boundary runs in a westerly direction from Iragua village. It then turns sharp south west and meanders its way down to the Mafinji River where it follows the river curve linear south east past the game control area . It then leaves the river and meanders first south and then into a south-easterly direction crossing the main road to Itete at a 90 degree angle. When the boundary reaches the upper catchments of the Mafinji River it turns north east and continues as a straight line through the hills up to the Nambiga forest reserve and makes a sharp corner that double backs towards the Nambiga forest reserve boundary. Where it reaches the Nambiga boundary, it follows it around and meanders north where it joins the northern boundary.

### **3.3 Physical characteristics of the area**

#### **3.3.1 Topography and hydrology**

The Kilombero Valley is bounded by the steep Udzungwa block faulted mountains to the north and the Mahenge range in the south. A steep escarpment rising to 1000m forms a natural northern boundary to the KVTC land area. To the south of the escarpment, the topography is generally of low undulating hills and

ridges formed from schist and gneiss. Between the hills and ridges are low lying flat depressions which follow the drainage lines. Some of the low hills are steep-sided with exposures of bare rock. The undulating hills in the north give way abruptly to the flat Kilombero floodplain which is 10-20km wide. The lower river terraces are covered by a complex of swamps, seasonal waterways and oxbow lakes. South of the floodplains, there are a series of low ridges of wide flat depressions which grade into hills and ridges of the Mahenge Range.

Ifakara is bound to the west by the Ruipa River, a large fast flowing river which drains part of the southern side of the Udzungwa Mountains. The Ruipa River flows into the main channel of the Kilombero River near Mofu. It is flanked by back swamps and old ox bow lakes. Within the southern sections of the Matundu and Iyondo Forest Reserves, there are a series of mbugas (grassy valleys or drainage lines, known more widely as dambos) and narrow swamps in closed or partially blocked valleys. The area north of the railway line is drained by the Idete, Doko and Narubungo rivers. These are all small slow moving rivers which discharge into the swamps / wetlands of the Kilombero floodplains. At the base of the escarpment are seasonal swampy depressions.

### **3.3.2 Geology and soils**

#### **3.3.2.1 North of the Kilombero River**

Four major soil types were identified in the northern side of the Kilombero River within the area indicated in subsection 3.2.

The soils of the low hills and ridges, covered by miombo, have all developed from gneiss or schist parent material. Rocky outcrops are common on the steeper hills. The soils are deep and well drained with a thin (generally 5 – 10cm), dark reddish brown sandy loam surface horizon overlying reddish brown sandy clay loam and sandy clay which often contains quartz lines derived from the weathered parent material.

Deep, very dark brown to black clay loams overlying clays, with poor to imperfect drainage; occur along the drainage lines and in the flat depressions between low ridges at the base of the escarpment. The hill soils in specific areas have a thicker (up to 15 – 20cm), dark brown, humus sandy loam surface horizon overlying reddish sandy clay loam becoming sandy clay, and are deep and well drained.

#### **3.3.2.2 South of the Kilombero River**

The southern hills and ridges have a similar geology to those in the North. The soils are generally deep, well drained, dark brown sandy loams to clay loams, overlying reddish brown to dark red sandy clays to clays. In areas around Mafinji a well drained, deep soil with a thin, dark reddish grey clay loam to silt clay loam topsoil overlying a reddish brown to red clay loam to clay can be widely observed.

The second soil type developed on low ridges of different parent material (sandstone). It comprises a deep, well drained, dark grey sandy loam to loamy sand overlying brown to yellowish brown sandy loam to sandy clay loam.

Deep, imperfect to poorly drained, dark grey to black loams to clay loams, overlying mottled brown clay loams to clay, occupy the drainage lines and flat low-lying depressions between the ridges. These soils would be subject to inundation during the wet season. Apparently well drained, grey to dark grey loamy sands, overlying compacted light grey loamy sand to fine sand, are found in the area east towards Nakafulu village. They are associated with wide flat depressions between ridges and with open miombo woodland characterised by stunted trees.

### **3.3.3 Climate**

The Kilombero Valley falls within the southern sub-humid tropical zone of Africa and is therefore characterised by a warm climate and a dry winter. The annual rainfall in Kilombero Valley is unimodal with a mean precipitation of between 1,200 mm and 1,400 mm increasing towards the mountains. The rainy seasons extend from end November to early January and from March to May. In the dry season, the precipitation is less than 20 mm per month, and often no rain falls from July to October. The mean monthly temperature varies between 22°C minimum and 28°C maximum with a peak between October and December.

### **3.3.4 Special features**

#### **3.3.4.1 Archaeological Assessment at KVTC**

It is well recognised that the archaeological sites of Tanzania range from the famous 'early human' fossil hominid sites of Olduvai and Laetoli to Kilwa and other historical ports on the coast. Unfortunately, archaeological work in the Ifakara region of the Kilombero Valley is limited; however a lot of work has been carried out in nearby regions which have provided a general understanding of the history of this area. Archaeological research has been undertaken in the Ruhuhu and Songwe River Valleys to the west and south; in the valleys of the Kihansi, Mapanga and Ruhidji rivers that flow into the Kilombero to the west and south of the KVTC holdings and in the Rufiji Delta to the east of the Kilombero valley.

KVTC has policies and procedures in place for the identification, recording and mapping of sites of archaeological, religious, historical or other cultural sensitivity. A scoping assessment was carried out and a number of Stone Age 'localities' were recorded in the KVTC Plantations (See Annexure 1). Many of those recorded were older than 10 000 years. Heritage sites of high significance are currently monitored by KVTC staff through the Area of Special Interest database to ensure their ongoing protection.

#### **3.3.4.2 Puku**

According to reports, the Kilombero Valley contains a sizeable proportion of the world's population of the wetland dependent Puku antelope *Kobus vardonii*. This antelope is now only found in 18 locations in Africa.

KVTC has tracts of grassland that are utilised by the Puku which, as all animals, enjoy protection from hunting within company boundaries.

### 3.4 Description of the vegetation types

The landforms described in 3.3.2 above have given rise to a distinct set of vegetation types, each with their own characteristic fauna. A clear division between areas where the tree and shrub components dominate (A), and those areas dominated by grasslands (B). The mega community dominated by tree and shrub species (A) can be further subdivided into four communities:

- A.1. *Raphia farinifera* swamp community
- A.2. *Micrococca scariosa* evergreen and riverine forest community
- A.3. *Mariscus – Hyparrhenia rufa* open miombo community
- A.4. *Diospyros usambarensis* dense miombo community

The mega community dominated by grasslands was not divided any further and is shown as:

- B. *Setaria pumilia* grasslands with scattered trees

The following vegetation types are found in and around the KVTC land holdings:

The **Udzungwa Mountains**: Covered by closed evergreen forest occurring in large blocks which are separated by either woodlands (miombo at lower levels, Protea species at altitude) or by a variety of herb-rich grasslands. Only the miombo woodland (defined below) are found within the Project leased area.

The **foothills**: These are dominated by miombo woodland (characterised by species of *Brachystegia* and *Julbernardia*), but including patches of closed forest. The broad valleys with impeded drainage will have wet “swamp” grassland. The steeper valleys may have a riverine forest.

The **floodplain**: There is a slow gradient of vegetation change from the hill miombo to the swamps, oxbow lagoons and meanders flanking the main channels of the Kilombero River. The woodland miombo loses elements associated with free draining red soils and gains elements such as palm. At lower levels, woody vegetation is associated with termite mounds with a “sea” of tall coarse grasses. Occasional shorter grass areas offer grazing to puku.

These three main habitat types are discussed in more detail below:

#### Evergreen Forests

The evergreen forests of The Udzungwa Mountains, and to a lesser extent those of the Mahenge hills, form a major component in the Eastern Arc chain of mountain forest areas of exceptional biodiversity and endemism.

A striking feature of these forests is that, whilst they may have great ecological and structural similarity, they are usually distinctive in terms of species composition. Many species are extremely localised endemics. In close proximity to KVTC for example, there are considerable differences between the lowland evergreen forests of the Matundu Forest Reserve and the more groundwater-dependent forests in Nambiga Forest Reserve.

The evergreen forests and their constituent species are not robust and cannot easily withstand perturbation such as heavy felling and fire. Once disturbed the vegetation succession is likely to move to a more tolerant, fire-resistant community similar to the miombo. Conversely, given adequate and long term protection, the partially disturbed evergreen forests will return to a closed forest community. After logging, evergreen forest will appear to have the physiognomic characteristics of a thicket, but this is a transient phase. The soils and climate of the Kilombero Valley will not support a true thicket (defined as a closed woody formation of height up to 8m, with or without emergent). The logged forests of the Kilombero Valley have an under storey of up to 20m – they are not a degraded thicket. It is increasingly noted that the lowland forests ( $\pm < 400$  masl) of Eastern Africa often have a characteristic appearance, with an emergent storey to 40m above a closed under storey to 20m.

### **Miombo Woodlands**

The Miombo range stretches from Zimbabwe through to southern Tanzania and central Democratic Republic of the Congo. In Tanzania, they occupy about half the land area, occurring in two large blocks in the west and southeast of the country. Much of the Mahenge district is in this south eastern block, as are the woodland areas of Kilombero district (i.e. not the swamps or mountain forests).

The miombo woodlands as a whole are relatively homogenous in structure, ecology and species composition, although there are differences between the lower altitude miombo and that occurring above 1500m which contains more *Protea* (this type does not occur within KVTC land). Whilst there are great similarities from area to area, there is a consistent pattern of variation within any one site, which reflects catenary's patterns in soil-topographic features. This pattern of change results in slightly different communities on ridge tops slopes and valleys. The lower slopes and flat bottomed valleys of impeded drainage will carry more open woodland of smaller trees. These typically contain species of *Terminalia* and *Combretum*, not the usual miombo dominants of *Brachystegia* spp. At first sight, these lower valley woodlands may appear to have lost the larger elements and so could be believed to be degraded. A further source of variation in the miombo is related to the local history of fire and burning which directly affects woodland density, canopy cover and species composition. The present condition of the miombo can be the result of changes that occurred up to 100 years ago. Some of the more open areas could again be thought of as "degraded".

In general, there is a low species diversity and negligible endemism component at any one locality in the miombo. In terms of species, the Kilombero miombo woodlands are not a high priority for conservation. They occur on old, acid, leached soils and do not carry a high density of wildlife unless they are adjacent to other habitat features such as short grass plains.

## Grassland

This plant community, represented by *Setaria pumilia* and *Oryza sp.*, can both be regarded as indicator species for this plant community as they occur nowhere else in the area. Tree and shrub species are of less importance in this community and trees higher than 5 meters cover only about 5 – 20% of the area whereas smaller trees and shrubs of less than 5 meters only 5 – 10%. The important tree and shrub species encountered in this community are: *Brachystegia boehmii*, *Combretum adenogonium*, *Syzygium cordatum*, *Pseudolachnostylis maprouneifolia* and *Diplorynchus condylocarpum*. It is generally found on the floodplains of the Kilombero River on the north eastern boundary of Nakafulu at elevations of 260 – 310 meters above sea level. The area which supports this community is flat, waterlogged and generally has mid grey to dark grey clayey sand to sandy clay soils.

### 3.5 Description of principal fauna

The Kilombero Valley, adjacent hills and mountains are rich in wildlife resources and large mammals are abundant. These resources contribute to the national economy through the two game controlled areas demarcated on either side of the Kilombero River and have local importance to the village economies. This land use classification was a mechanism to regulate hunting, but as it does not limit settlement, cultivation or access, it has only marginal conservation value. The floodplain is the most important entity in terms of conservation interest and potential for sustainable utilisation. The woodland fauna has been reduced by growing cultivation pressures, and the mountain fauna is now more restricted in movement due to the railway and cultivation.

The Kilombero Valley's remoteness and proximity to the Selous ecosystem allowed it to maintain high populations of lion *Panthera leo*, zebra *Equus quagga*, hippopotamus *Hippopotamus amphibius* and Nile crocodile *Crocodilus niloticus* (UDDNR, 1997). The area also maintained a diverse antelope community, including sable antelope *Hippotragus niger*, waterbuck *Kobus ellipsiprymnus*, buffalo *Syncerus caffer*, bushbuck *Tragelaphus scriptus*, eland *Taurotragus oryx*, Lichtenstein's hartebeest *Alcephalus buselaphus lichensteinii*, southern reedbuck *Redunca arundinium*, bush duiker *Sylvicapra grimmia* and Harvey's red duiker *Cephalophus harveyii* (East 1998). Furthermore, the valley was estimated to hold over 50,000 puku antelope *Kobus vardonii*, which was a large portion of the remaining world population (East 1998). The future survival of puku in Tanzania and the rest of Africa is therefore closely linked to the status of the Kilombero Valley population. As of 2020, most of the fauna listed above has however been pushed out or poached as people flock into the valley from over-populated parts of Tanzania. From time to time buffalo, lions and antelopes are spotted by employees inside KVTC property.

### 3.6 History of management



In 1990 a joint ODA and CDC reconnaissance mission generated the initiative for a plantation development in Tanzania. CDC and the forestry division of the Tanzania Government discussed the possibility of CDC taking over the management of the existing teak plantations in Tanzania. During these discussions it was decided that it would be preferable for CDC to develop its own plantations in accordance with the Tanzania Forest Action Plan, which identifies the need for private sector investment in commercial hardwood plantations.

Kilombero Valley Teak Co. (KVTC) was incorporated in Tanzania in 1992 and secured the occupancy rights to 28,132ha in the Ulunga, Malinyi and Malinyi districts of Southern Tanzania for the development of the planned 15 000 ha teak plantation. First planting commenced in 1993 with the planting of 29ha of *Tectona grandis*. To date KVTC has established 7,963 ha. This is the maximum area plantable.

The main management objective of the CDC investment was to stimulate economic activity in the region in a socially and environmentally responsible manner.

The landholding consists of 4 separate forest units in the three districts with a total of 10 villages bordering these areas and a timber processing plant at Mavimba village.

In 2001, the Finnish Fund for Industrial Cooperation (Finnfund) obtained a 23% shareholding in KVTC.

In 2011 the Global Environment Fund (GEF) of the United States of America acquired the 77% share of CDC. KVTC is now part of GEF's Africa Sustainable Forestry Fund that manages Forestry Assets in South Africa, Swaziland and Mozambique.

### **3.7 Economic environment**

#### **3.7.1 Existing physical infrastructure**

##### **3.7.1.1 Roads**

KVTC roads were initially designed to allow access for the establishment and maintenance of teak plantations. With the start of commercial operations in 2009 a program of continuous improvements and upgrading of the roads and in particular bridges started and is ongoing. Due to the geographic setting and relative size of the plantations it is expected that approximately 65-70% of the raw materials are sourced from the Ulunga & Malinyi Districts and the balance 30-35% from the Mlimba District. In order to minimize lead distances as well as impact on roads and reduce ferry traffic the mill has been strategically positioned in the Ulunga District.

Within the plantation blocks the company operates from Dry weather and Wet weather compartments to minimize the impact on its plantation roads during the rainy season.

### 3.7.1.2 **Headquarters and timber processing plant site**

The processing plant and its associated support functions started operations in Mavimba in August of 2009 after completion of construction and commissioning of the processing plants and equipment.

KVTC Headquarters moved from Ifakara to Mavimba in June of 2010 approximately a year after start-up of the processing activities. Currently all administrative functions as well as managers are working from Mavimba. Shipping and Purchasing departments are based in Dar es Salaam.

## 3.7.2 **Social infrastructure**

### 3.7.2.1 **Population structure and distribution**

Since Tanzania gained independence, the Kilombero Valley has seen three major development projects - all in the Mlimba and Kilosa Districts:

- the establishment and expansion of the Kilombero Sugar Estate currently managed as Kilombero Sugar by Illovo,
- the construction of the TAZARA railway line from Tanzania to Zambia (inaugurated in 1974);
- the development of the Kidatu hydro-electricity scheme.

The age distribution in the three districts in which KVTC operates is typical of rural areas in Tanzania. The population age distribution deviates from a normal distribution with age groups from 0 to 44 years comprising more than 85%. Over 68% of the population is in the 15 – 44 years age bracket, with slightly more females than males.

### 3.7.2.2 **Human settlements**

The settlements located within the Kilombero floodplain are of a temporary nature. Huts are built for use during the cultivation of paddy fields, weeding and harvesting, and are abandoned as floodwaters rise. Similar huts are built by the fishermen, especially during the fishing season (dry season). This pattern is however changing as settlements are becoming more and more permanent.

Permanent settlements are confined to higher ground where floods are not expected. In Ulanga District, the settlements are confined mainly along the Ifakara – Mahenge road and along the Lupiro – Itete road. Some villages in remote areas that were abandoned in the early 1990's have seen re-population since early 2000 e.g. Madabadaba in Malinyi district.

### 3.7.2.3 Infrastructure

In general, most villagers have access to social services such as schools, clinics and water. The 11 KVTC associated villages enjoy funding for the above mentioned issues through their Village contracts and Social funds.

Mlimba District, and to some degree Ulanga District, utilise the services of the TAZARA railway with a station at Ifakara. There are roads from Mikumi via Ifakara to Mahenge with selected upgrading in the mountain pass with asphalt and from Ifakara to Chita (can be closed during the rainy season) and from Lupiro to Mtimbira.

In 2012 the Government of Tanzania signed a contract with a Chinese construction firm to establish a bridge across the Kilombero River. The bridge is now fully operational and replaced a ferry that was operating until the end of 2017.

There is an airstrip at Ifakara that is predominantly used during the hunting season. Telephone services are linked by radio signal and are fairly reliable.

Ifakara is connected by a 33 KVA national grid line from Kidatu to Mahenge and expansions are planned from Mahenge to Mwaya and from Lupiro to Malinyi. The processing site has a dedicated 33KVA grid connection that branches off the main Kidatu-Mahenge line in Mavimba. Power interruptions are frequent and although the line has been less affected by the recent rationing than the urban areas of Tanzania availability throughout the year averages around 85% with periods as low as 65% in particular in the rainy season due to frequent line failures.

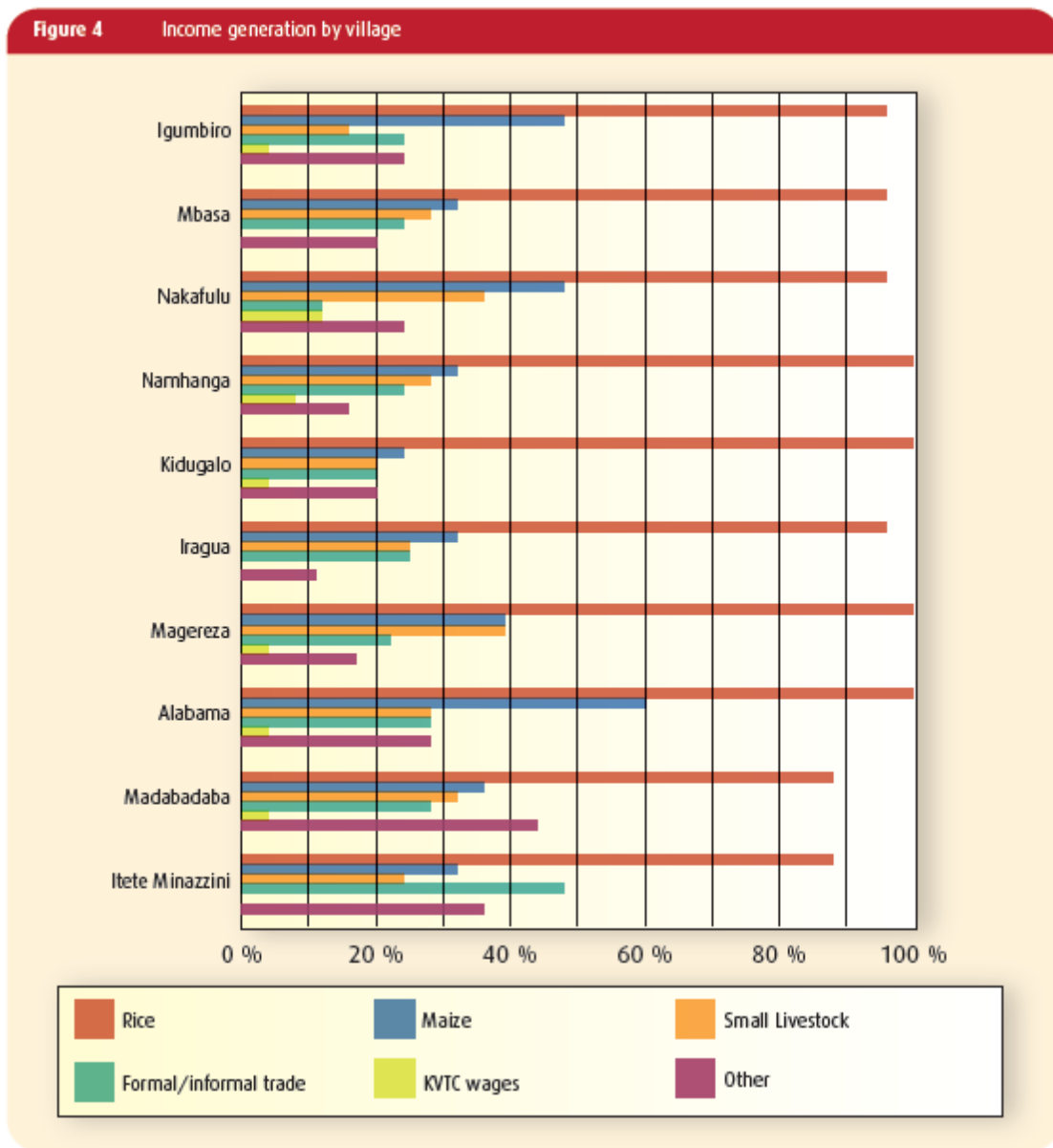
### 3.7.3 Other resource activities within the management area

The income of people residing in the Kilombero valley is low. Their livelihood is dependent on subsistence agriculture and fishing. The main trade crop is rice, which is also the main food crop. Other food crops include maize, bananas, cassava, coconuts, vegetables and fruits; some of which are sold locally for cash.

Information on household income and expenditure suggests that people cannot meet their daily expenditure from agriculture alone. There is hence a great need to supplement these incomes. A socio-economic study was conducted in the KVTC participating villages to understand the resources used by KVTC participating villages.

The outcome of the study showed that local brewing was the most important in the category of Other Source of Income (See Table 1). Brewing was a value adding process to low market price products. Women were brewing alcohol based on maize and finger millet.

Coconuts are tapped to produce popular alcohol known as “Tembo”. In Iragua wild palm trees are tapped to produce alcohol known as “Mkoche”.



**Figure 5: Income Generation by Village**

### 3.7.3.1 Charcoal Production

Participating villagers were given an opportunity to produce charcoal from KVTC clear felled stands prior to establishment. This project assisted in reducing impacts in neighbouring miombo where harvesting takes place on a large scale. The timber species predominantly consist of *Brachystegia bussei* and *Brachystegia bohemii*.

However since KVTC is fully established legal charcoal production on KVTC land has seized as KVTC no longer converts areas for plantation establishment.

### 3.7.3.2 Non timber forest utilisation

The importance of these natural resources is accentuated by the strong subsistence economy. In times of drought and flood, yields of food crops are reduced and the forest resources provide famine support.

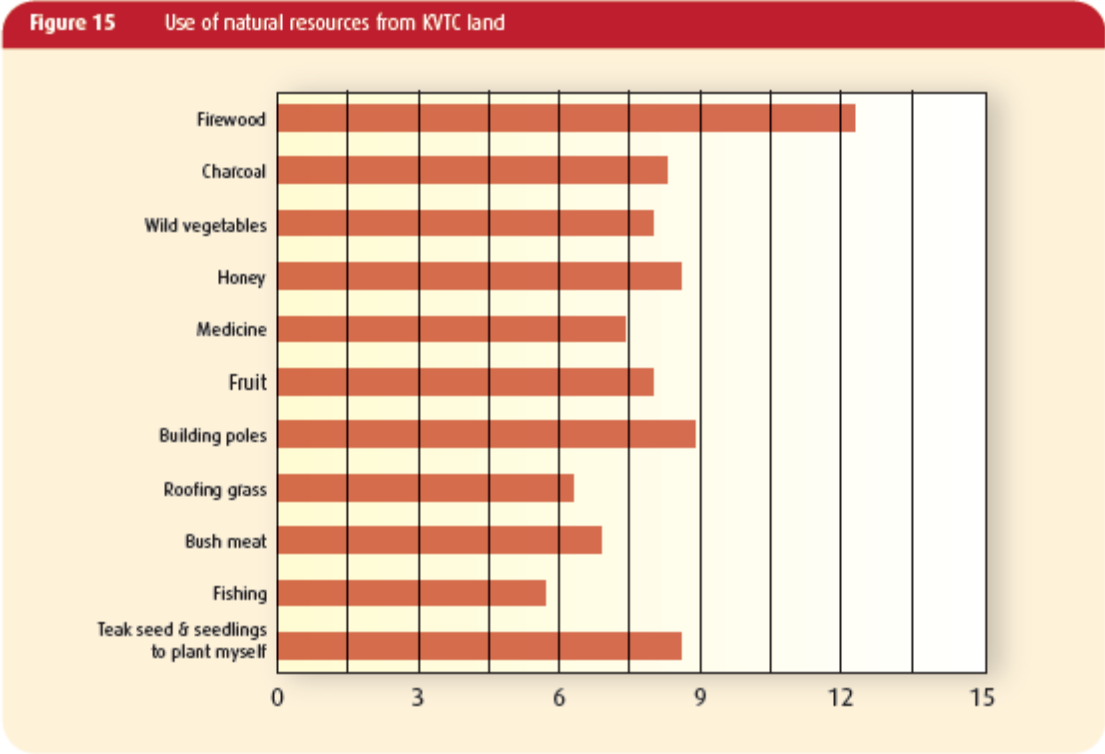
As villages grow, pressure on the remaining natural areas will increase. A study on the utilisation of Non Timber Forest products (NTFP's) completed in 2005 for KVTC indicated the following:

A large proportion of the people interviewed (92%) said that they collect NTFP's and that they also bought NTFP's on occasion. More than half the interviewers said that they regularly visit a herbalist for cultural reasons or for minor illnesses. Female members of the household are sent to collect common items such as fruits, vegetables or firewood but men are used to collect charcoal or honey.

**Table 1: NTFP preferences by communities (N=100)**

NTFP type	Rating
Vegetables	1 <sup>st</sup>
Grass	2 <sup>nd</sup>
Tree bark	3 <sup>rd</sup>
Firewood	4 <sup>th</sup>
Fruit	5 <sup>th</sup>
Mushrooms	6 <sup>th</sup>
Poles	7 <sup>th</sup>

A further study in 2011 showed following use of NTFP from forests on KVTC land



**Figure 6: Use of Natural Forest from KVTC Land (Keystone, 2011)**

Based on the outcome of the 2011 study and the fact that many people were not familiar with the “do’s and don’t’s” on KVTC land KVTC developed the conservation land policy (see Annexure) which clarifies to all stakeholders what is and what isn’t allowed on KVTC land.

## 4 OBJECTIVES OF MANAGEMENT

KVTC's prime objective is to produce high quality teak timber products from plantations which the Company has established, maintained and harvested on a commercial sustainable basis by the application of current international forestry, environmental, health & safety as well as social standards of practice.

### 4.1 Plantation Management

In order to manage the plantations the 4 main plantation areas have been subdivided into 5 blocks of equal sizes:

- |  |                              |
|--|------------------------------|
| 1) Ichima and Narabungo (in Kilombero District)      | +/-1,500ha of planted areas  |
| 2) Nanji, Humburo and Nak 1 & 2 (all in Nakafulu)    | +/-1,800ha of planted areas  |
| 3) Nak proper, Nak South and Nak 3 (all in Nakafulu) | +/-1,800ha of planted areas  |
| 4) Mgombalenga and Majengo (all in Mafinji)          | +/- 1,800ha of planted areas |
| 5) Mafinji Proper (all in Mafinji)                   | +/-1,200ha of planted areas  |

Each block is managed by a Plantation Manager who reports to the Chief Forest Manager. The Chief Forest Manager reports to the CEO. Plantation Managers are rotated across the blocks on a regular basis to provide them with exposure to the different areas within KVTC land holding.

A Plantation manager will be responsible for following aspects of his/her plantation block:

- Day to day running of the plantation block
- All silvicultural activities in the plantation blocks including contractor operations
- Issuing of Job Instructions and inspection of compartments before signing off on jobs carried out
- Fire Protection, Fire Lookouts and Fire Fighting Crews
- Plantation Roads
- Pre- and post-harvesting handover of compartments
- Natural Woodland management
- Security of the Plantation block
- Health and Safety of workers and contractors within the plantation block
- Environmental Management of the plantation blocks

All Plantation managers are issued with motor cycles and radios; the Chief Forest Manager has a vehicle at his disposal for the execution of his work.

## 5 FOREST ORGANISATION

Summary of areas at KVTC:

- The present land holding is 28,132 ha in the Kilombero and Ulanga Districts.
- Due to teak being site specific and the company's biodiversity considerations, KVTC has only established 7,963 ha on the existing landholding.
- Since March 2009 no further conversion of miombo woodland to teak has taken place.
- The areas not converted to teak are currently managed under a conservation regime and are protected from any impacts. Generally these areas consist of buffer zones, riparian zones and areas of high biodiversity. It is possible that in the future the company will undertake some sustainable utilization of its miombo forest resources, this will be done in accordance with international best practices and through reduced impact logging techniques
- Those area classified as grasslands (Table 3) container relatively low conservation value and the company is currently reviewing the potential of agricultural development on these areas.

**Table 2: KVTC classification of areas of occupancy (as at December 2020)**

Land use category	Total
Established Teak Plantation	7,360
Other species research plots	33
Temporarily unplanted (TUP)	570
<b>Total</b>	<b>7,963</b>
Potential evergreen and riparian forests	1,800
Dense Miombo	3,780
Open Miombo	6,448
Grassland	7,880
Roads, other infrastructure & quarries	212
Power Lines (TANESCO)	49
<b>Total</b>	<b>20,169</b>
Plantation and TUP area	7,963
Indigenous woodland and infrastructure area	20,169
Certificate of occupancy	28,132

### 5.1 Classification of forested areas

#### 5.1.1 Production forest

The production forest consists of the established teak compartments and the natural woodland where several species could be selectively harvested. The areas are broken up into plantations, each of which is regarded



as a management unit. KVTC has four such management units (see Table 3). Each management unit is divided into compartments of various sizes according to age and geographical position for teak and species composition and topography for natural woodland.

#### 5.1.1.1 Division of production forest

All information about the compartments and sub compartments are contained within the Microforest Management system in the compartment register. Compartments are allocated a letter A, B, C, D according to the location per plantation. Each compartment is assigned a sequential number and each sub compartment of a compartment a sequential letter of the alphabet starting with “a”.

### 5.1.2 Non-production forest

The non-production areas are divided into various sections for management purposes and are defined by parameters such as geographical position, conservation value and species composition.

#### 5.1.2.1 Division of Natural woodland - forest type stratification

The *object based mapping method* was used by KVTC to perform a remote sensing based land cover classification for all natural areas. In this method, the feature recognition is based on image objects extracted in a previous image segmentation step, not on single pixels. This segmentation permits the formation of homogeneous objects which correspond to human perception, taking into account contextual information. This improves the value of the final classification and cannot be fulfilled by common pixel-based approaches. The satellite images were derived from SPOT 4 with two CCD sensors, a multi spectral sensor and a mono spectral (or panchromatic) sensor. SPOT Panchromatic (sensitive to all visible colours) has 10 x 10 m spatial resolution and contains 1 band. It is similar to a black and white photograph. It has a radiometric resolution of 8 bits. SPOT XS, or multi spectral, has 20 x 20 m spatial resolution, 8-bit radiometric resolution, and contains 4 bands. The width of the swath is 60 x 60 km for nadir viewing and 80x80 km for off-nadir viewing at a height of 832 km. In Table 4 the most important SPOT 4 features are given.

**Table 3:SPOT 4 Satellite Spectral Bands and Resolutions (source: SPOT IMAGE, supplemented)**

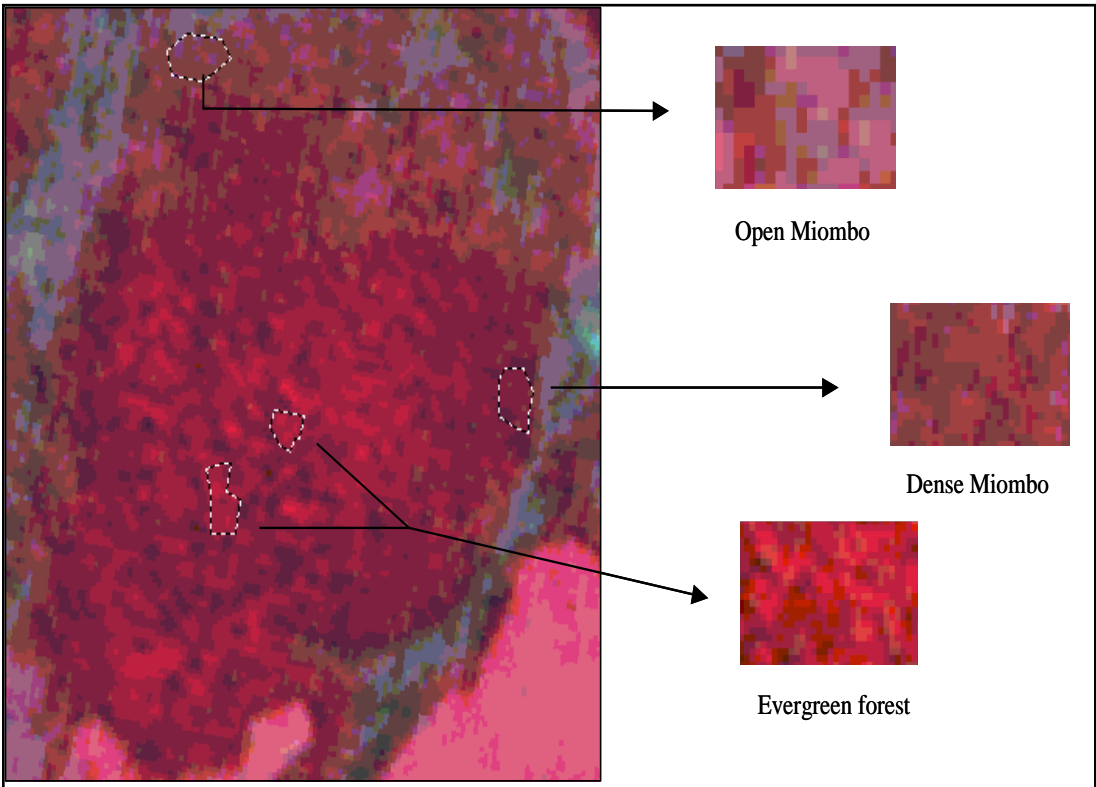
Electromagnetic spectrum	Pixel size	Spectral bands
Mono spectral (red)	10m	0.61 - 0.68 µm
B1:green	20m	0.50 - 0.59 µm
B2:red	20m	0.61 - 0.68 µm
B3:near infrared	20m	0.78 - 0.89 µm
B4:mid infrared (MIR)	20m	1.58 –1.75 µm
B1= This band corresponds to the green reflectance of healthy vegetation. B2= This band is used for discriminating between plant species. It is also useful for soil boundary and geological boundary delineation. B3= This band is especially responsive to the amount of vegetation biomass		

B4= This band is particular sensitive to soil moisture content, leaf moisture content and vegetation cover.

**Results of the stratification**

KVTC forest classification has a clear definition for each distinguished forest type found, considering that there are not one but various Miombo forest classifications for the company.






The signature analysis of a given area determines the classification of the forest types.



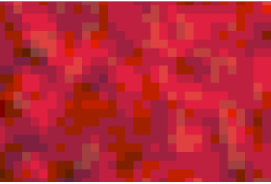

**Figure 7: An example of the "common pixel based clusters"**

The following definition was applied under Class description with an adjoining photograph (see images below). The SPOT 4 training sample is derived from the common pixel based cluster.

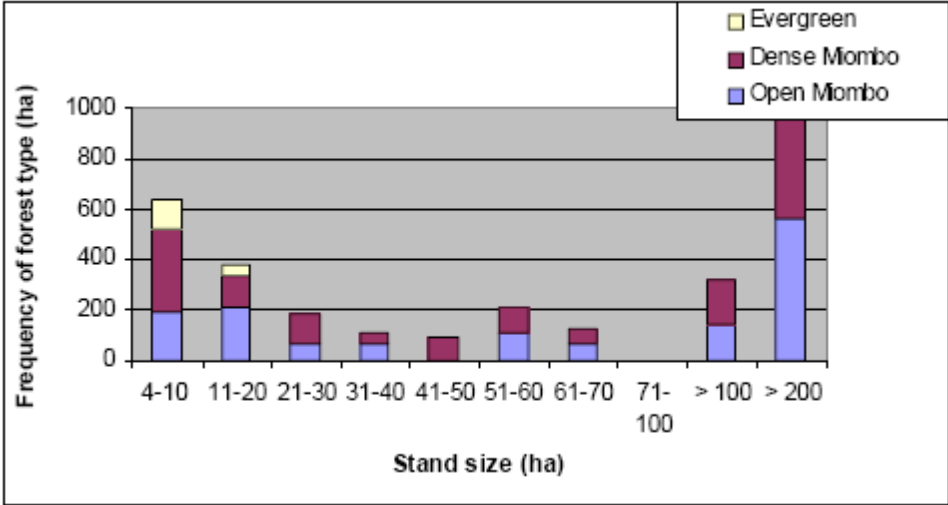
SPOT 4 Training sample	Photograph	Class Description
------------------------	------------	-------------------

	 	<p><b>Dense Miombo</b></p> <p>Tree species:  <i>Brachystegia boehmii</i>, <i>Combretum molle</i> and <i>Dalbergia nitidula</i>.                  Lianas and climbers occasionally</p> <p>Structure:                  Dense Miombo stands comprise an almost 20 m high, dense over storey and shrubs in the under storey. A grass cover varies depending on the degree of light penetration</p>
<p><b>SPOT 4 Training sample</b></p>	<p><b>Photograph</b></p>	<p><b>Class Description</b></p>
		<p><b>Open Miombo</b></p> <p>Tree species:  <i>Brachystegia boehmii</i>,  <i>Brachystegia bussei</i>, <i>Pterocarpus angolensis</i> and <i>Burkia africana</i>.                  Structure:                  Open Miombo stands have an open over storey, with a height in</p>

		<p>excess of 5 m and a characteristic grass layer.</p>
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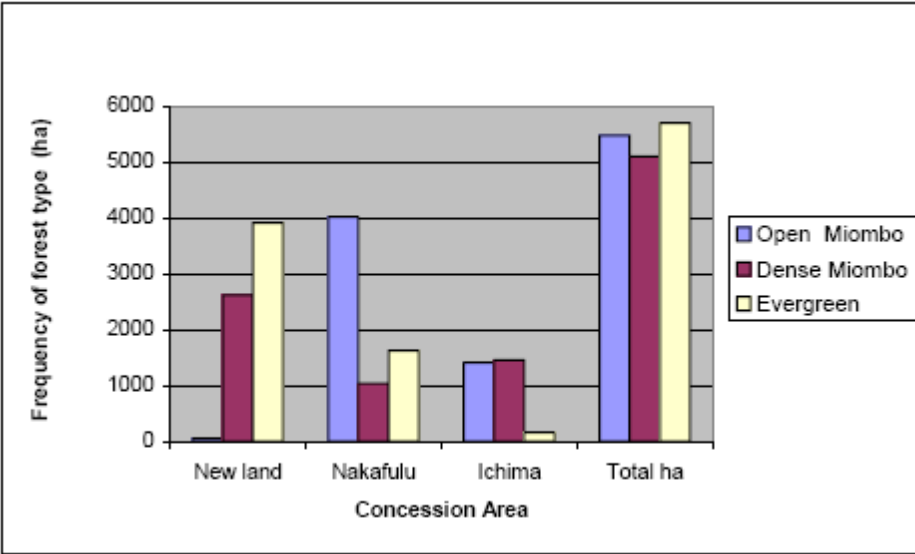
SPOT 4 Training sample	Photograph	Class Description
		<p><b>Evergreen forest</b></p> <p>Tree species: <i>Markhamia zanzibarica</i>, <i>Terminalia sambesiaca</i>, <i>Milettia usamarensis</i>, <i>Lettowianthus stellatus</i>, <i>Zanthoylum holtzianum</i> and <i>Xeroderris stuhlmanii</i></p> <p>Absent tree species: <i>Brachystegia boehmii</i>, <i>Uapaca nitida</i> and <i>Pterocarpus angolensis</i></p> <p>Structure: Tree layer &gt; 5m in height an up to 25% in density. The density of the lower vegetation layers depends to a large extent on the density of the canopy layer.</p>

The classification output contains a mixture of very small sized objects (0.02- 4ha) as well as large objects (> 200 ha). A threshold size must be defined in order to justify the silvicultural management, conservation and harvest potential of the sites. Micro-sites have therefore been excluded.



**Figure 8: Distribution of forest types**

A summary of the distribution of forest types in stands > 4 ha is represented in Fig 9. In each plantation area, the distribution of forest types is different.



**Figure 9: Distribution of forest types (restricted to areas above 4 ha)**

**5.1.3 Other**

Other areas include offices, buildings, roads and quarries. The main office is situated at Mavimba and there are forestry camps in Ulanga ,Malinyi and Mlimba districts situated on and off the property.

## **6 INVENTORY OF FOREST RESOURCES**

### **6.1 Timber Resources – management level inventory**

#### **6.1.1 Type of inventory and sampling design**

##### **6.1.1.1 Plantation forest enumeration**

A systematic sampling method is used for assessing the standing timber resource at a sample rate of 10 % of the total compartment area. The inventory is carried out at age 5 and thereafter it takes place together with every thinning (“thinning control”) or at least once every four years.

A circle plot with a radius of 9 meter is laid out in a grid pattern of 100m x 50m. All the diameters at breast height (dbh) are measured with a digital calliper and the height of two trees in every plot with a minimum of 30 height measurement per compartment are measured with a hypsometer.

##### **6.1.1.2 Natural woodland survey**

A program has been developed to undertake a complete survey of all forestry areas within KVTC landholding. A grid of 250 meters by 250 meters (6.25 hectare) is used to produce sample units. Each unit is numbered and trees are identified. On the basis of this identification a further detailed classification of KVTC's forest land will be applied.

In a later stage a more detailed analysis will be undertaken in areas where sustainable selective harvesting could take place. A grid of 100 meters by 100 meters (one hectare) will be used to produce sample units. Each unit will be numbered and all utilisable trees will be identified. Each identified tree will be numbered, its location measured with GPS, the diameter at breast height measured with a calliper, the total and merchantable height measured with a hypsometer and the species recorded.

##### **6.1.1.3 Analysis and evaluation of inventory results**

The plantation inventory data is captured to and analysed within the Microforest management system based on pre-programmed models and KVTC specific parameters. An inventory report is produced for each compartment following automated analysis. This report provides all the basic compartment data and related statistical parameters from the enumeration. After interpretation by management it is authorised for use and automatically updates the compartment information on the database system. The data is then used in harvesting scheduling to estimate the growth and yield which guides the normalisation of age class process.

It is envisaged that in future field data from the natural woodland surveys are captured electronically at the office and yield and location maps produced. The resultant information would be used together with growth models to predict the sustainable harvest for each species per natural woodland unit.

#### 6.1.1.4 **Pre-harvest inventory**

Pre harvest inventory has been described in inventory 6.1.1.1

#### 6.1.1.5 **Post-harvest inventory**

At time of harvesting or thinning the predicted yield will be compared with the actual yield delivered to the sawmill. Microforest has the functionality to capture actual volumes per compartment, which allows the generation of reports which compare actuals with predicted volume.

## **7 SILVICULTURAL SYSTEM**

### **7.1 Regeneration method - Teak**

#### **7.1.1 Nursery & Genetic Development**

During the period 1992-2012 virtually all planting at KVTC was done with stumps produced in the company's seedbed nursery. All seed used by KVTC was either purchased from the Tanzania Tree Seed Agency (TTSA) or collected from selected KVTC compartments. Stumps are grown for 7 – 9 months in the KVTC nursery before establishment. In preparation for planting, the stumps are removed from the soil and cut above the root collar and approximately 12 centimetres below the root collar to prepare a stump.

KVTC has implemented a long term tree improvement strategy that combines selection of best performing local material and the importation of clones from a range of native teak growing areas.

In 2004 KVTC imported ten clones from a research centre in Malaysia during 2004. These clones were initially planted as trials and the best performing ones are now being produced on production scale.

The results from the Malaysian clonal program further encouraged the company to develop an in-house clonal program. At present KVTC continues the re-production of 8 out of the 10 Malaysian clones and has added 29 Tanzanian/KVTC clones to its clonal program.

In 2013 KVTC has switched from a pre-dominantly seedbed based approach to a vegetative propagation of planting material. The company's nursery has been upgraded to be able to produce around 500,000 plants per annum which would be the equivalent of around 400ha of plantation per annum.

Main components of the new nursery are:

- 1 Clonal Garden Tunnel of 8m x 35m
- 1 Rooting Tunnel of 8m x 35m
- 1 Miniature mother stock tunnel 6m x 9m
- 1 Rooting tunnel 6m x 9m
- 1 Transition tunnel 6m x 9m
- Holding Nursery under shade nets (65m x 45m)
- Clonal Tree Bank
- Seedbed Stump nursery
- Seed Stand of selected KVTC genetic material

Further to the development of clonal material KVTC has initiated a seed exchange program with Precious Woods of Costa Rica. In 2013 KVTC received 10kg of seeds from Costa Rica as a first step towards this exchange program.

#### **7.1.2 Land preparation**

The land preparation is done mainly with the aim of reducing the fuel load from un-utilisable timber from the previous rotation, the fuel reduction is done so as to ease access for different operations in the second rotation and also reduce severity in case of fire incidents.

KVTC uses controlled fire to burn and reduce all fuel loads, un-utilisable timber, tree braches and non-teak materials as well.



#### 7.1.3 Mark for pitting

Before the actual pitting, the whole compartment is marked out with square grids of 3m x 3m x 3m every 54 metres, three metres tall poles which are visible are used to mark each point. During pitting a 50m rope specially marked after every 3m will be laid between these square grids and the pitting is commenced.

#### 7.1.4 Pitting

Holes with dimensions of 25x25x25cm in a 3m x 3m espacement are prepared before the start of the rains.. A thorough site audit is carried out prior to planting operations to ensure the prescribed espacement is achieved.

#### 7.1.5 Planting

Stumps or seedlings are manually planted once pitting has been completed. Historically planting starts shortly after the first rains in December and continues, depending on the rainy season, until March. In recent years it appears that the rains start later and most planting has been performed in March and April.

#### 7.1.6 Blanking

The survival and mortality rate of the trees is visually determined for a specified area approximately 3-4 weeks after planting. Based on this assessment, dead trees are replaced with new seedlings to ensure that the compartment is fully stocked as per regime.

Prior to the next rainy season a survival count (10% sample) is performed and if survival is <80% then another blanking operation will be performed.

#### 7.1.7 Singling

Due to the nature of teak trees, growing buds are present on almost all internodes on the stem. Some of these buds tend to shoot secondary leaders which, if left unattended, lead to a multi-stemmed tree. Each tree is inspected and all but the dominant leader is removed to ensure that each tree has only one stem in which all future growth is concentrated. Follow-up operations are performed to remove any new shoots that may develop after singling.

#### 7.1.8 Pre-plant weed control

In order to achieve a clean and competition free environment for plants at the initial stage of growth, a complete chemical treatment (glyphosate) for areas where grassy weeds are dominant or Triclopyr in areas where net veined non grassy weeds are dominant and in most cases a cocktail of both is used, shortly before planting.

### 7.1.9 Fertilising

Fertiliser is applied just after first thinning in areas in site class 4 and 5. At present the generic fertilizer regime at KVTC could be described as per below:

- 200kg /ha of Nitrogen fertiliser or
- 750kg CAN/ha

## 7.2 Tending of teak

### 7.2.1 Pruning

Branches are removed to prevent the formation of knots. The pruning regime is based on height growth, where, depending on the stability of the tree, all branches up to the big branches that formed in the previous dry season are removed. Pruning is repeated annually until a height of 7.5 meters.

Teak vigorously produces epicormic shoots, especially after pruning and thinning operations. These shoots are removed in an operation called hand pruning. Hand pruning is repeated up to two times a year, depending on the severity of epicormic shoot production.

### 7.2.2 Weeding.

Teak is a pioneer species sensitive and susceptible to weed suppression. As part of the KVTC weed control strategy, a combination of three activities are performed to control weeds: manual slashing and circle weeding as well as chemical weeding during the first four years and thereafter only when required.

#### 7.2.2.1 Slashing.

All weeds are slashed to within 15cm from the ground level and regrowth cut off from the base. Slashing operations are performed two to four times per annum.

#### 7.2.2.2 Manual Weed (Circle)

All the young stands receive a circle weeding – removal of all weeds around 1.0m diameter from the tree base by use of manual hoe, before herbicide application. This takes place once or three times depending on the intensity of the weeds during the season.

#### 7.2.2.3 Chemical Weeding

Herbicides are frequently used in addition to manual weeding as it is more economical due to a longer lasting effect. Glyphosate and Triclopyr are the herbicide typically used and is applied with knapsack sprayers using low drift nozzles. Chemical weeding is once per year.

## 7.3 Thinning

Thinning is performed to aid in the achievement of desired tree growth and size requirements. The actual felling operation is preceded by mark for thinning, which is the selection and marking of poorer trees, i.e.

deformed, diseased and suppressed. The distribution of trees in the compartment is also taken into consideration to allow for an even espacement, based on the regime, after thinning.

Mark for thinning is guided by the management regime, which is dependent on site potential and desired tree specifications. The current regime for most of KVTC compartments is as follows:

- First Thinning is done when average height reaches 10-12m and typically compartments are thinned down to 500spha
- Second Thinning is done when a compartment reaches a Basal Area of 18-20m<sup>2</sup>/ha and thinning is done down to a Basal Area of 12-14m<sup>2</sup>/ha or around 250spha
- Third Thinning is only done in premium compartments that show superior growth and that reach a Basal Area of 18-20m<sup>2</sup>/ha after second thinning but before age 15. This thinning operation typically thins down the stand to 150spha.

The regime described above is a general regime however each stand is assessed on its specific characteristics and the forest management team adjusts the regime if and when necessary.

## **8 YIELD REGULATION AND PRODUCTION HARVESTING OPERATIONS**

### **Commercial species**

Teak (*Tectona grandis*) is the only commercial species at KVTC. About half the teak harvested is being processed at the industrial complex at Mavimba. The other half is sold to local sawmillers.

### **8.1 TEAK**

#### **8.1.1 Calculation of cutting cycle and annual allowable cut**

The annual allowable cut is determined through the Microforest system by the harvest scheduler. The annual allowable cut is the utilisable volume that can be harvested each year without compromising the long term sustainable timber supply. This is expressed as utilizable cubic metre (m<sup>3</sup>) per year and takes into consideration the current stands with their unique parameters and management regimes as well as potential future stands. The optimum sustained volume is an indication of business sustainability and maximum volume production.

The allowable cut for the next 10 years for KVTC is described in the schedule of production in Section 8.1.3

#### **8.1.2 Division of the forest into harvesting units**

In order to optimise utilisation of harvesting and transport resources, it is necessary to divide the forest into harvesting units. In this process the tactical harvesting plan is developed. This is carried out through a process of optimisation to that aims to group the harvesting areas in close proximity to each other in a specific area. Variables that are considered for this are the harvesting systems required, roads and depot construction and maintenance requirements, the schedule of timber production and compartment age.

In the annual harvesting plan areas are classed according to wet and dry areas in terms of access. The objective is to provide extraction systems for the number of wet weeks to keep the harvesting equipment productive and ensure constant timber supply to the sawmill. These areas are chosen by evaluating weather, slope, soil and road infrastructure. The areas are then consolidated together by examining which classes are dominant, without potentially affecting production in the wet season and allowing the mill intake to consist of an evenly distributed log class distribution throughout the year.

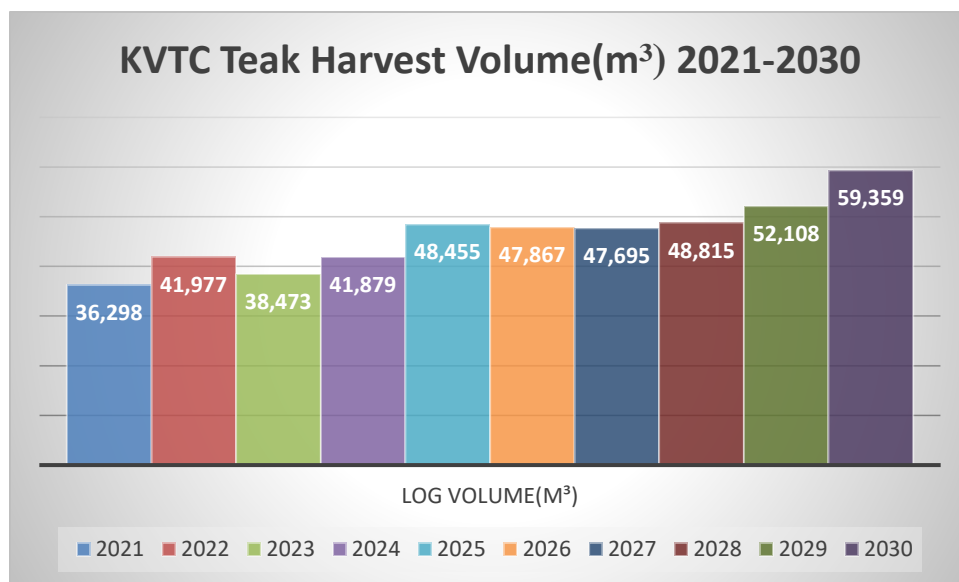
Not more than 50% of a plantation block and not more than 10% of the total plantation area will be clear-felled within one calendar year. This is done to maintain the mosaic pattern as well as geographic age class distribution of the plantation.

### 8.1.3 Schedule of timber production

A schedule of the harvesting and thinning of compartments over a full rotation (or more if required) of the working plan unit is generated by Microforest. The following parameters are considered:

- Age of stand
- Management regime
- Volume of stand
- Product dimensions
- Maximum utilisation of machines and transport alternatives on an annual basis
- Optimisation of the road network
- Cost benefit analysis

**Chart 1: Merchantable volume supply of teak timber from KVTC plantations from 2021 to 2030**



### 8.1.4 Teak harvesting

#### 8.1.4.1 Pre- harvesting activities

Prior to the harvesting taking place a compartment harvesting plan is drawn up.

The following aspects are considered:

Harvesting system based on environmental and economic factors

Felling direction

Extraction routes

Areas of special interest and riparian zones

Resource requirements

Harvest planning is undertaken through the Microforest system and all harvesting operations are reconciled to a compartment plan.

#### 8.1.4.2 Type of machinery

Machinery requirements form part of the tactical harvest plan which is determined by the medium term harvest plan. Current equipment in use at KVTC is:

- Felling is done by chainsaw.
- Skidding / Extraction is done manually and with John Deere skidders
- Loading is done by 3 wheel Bell Loggers
- Hauling is done by 15t trucks operated by contractors

#### 8.1.4.3 Harvesting activities

All harvesting operations take place by employing the industry best practices conforming to environmental, social and economic criteria set by the forestry industry and through the ISO 14001, ISO 45001 and IFC Industry Standard processes.

All harvesting operations are planned and controlled by KVTC staff.

#### 8.1.4.4 Felling operations

Felling, de-branching and topping are conducted by means of a motorised chain saw. Due to the high safety risk associated with chainsaws, all operators are trained and competent in using this specialised equipment.

Felling directions and safe working distances shall be observed.

Chainsaw felling remains the most viable option to KVTC as a result of the limited annual allowable cut, volume per hectare and tree size mechanized harvesting operations are not financially viable.

Chainsaws offer a cost effective and fuel efficient method and with chainsaw camps properly arranged and laid out environmental impact can be minimized.

Due to absence of tracked or wheeled equipment in the felling operation the impact on soils is minimized.

Chainsaw operators are regularly trained and only certified operators are allowed to work on KVTC estates.

#### 8.1.4.5 **Extraction/skidding operations**

The extraction system depends on the soil, topographical conditions of the compartment and timber piece size. Due to the dimensions of the 1<sup>st</sup> thinning material being relatively small and the volumes low, manual extraction is used by carrying the utilisable logs to road side where they will be loaded and transported. Extraction of material from 2<sup>nd</sup> and 3<sup>rd</sup> thinnings as well as clearfell operations are done through a combination of manual and mechanized skidder or logger extraction.

Manual extraction causes minimum impact on the ground and has the minimum impact on the environment due to absence of combustion engines. However manual extraction is only suitable for specific compartments with small diameter logs.

John Deere Skidder Extraction is suitable for areas with larger dimension trees can minimize ground impact due to its specially designed forestry tyres and has efficient fuel usage. Due to the articulated design the skidder offers excellent manoeuvrability and minimizes the damage to vegetation and remaining trees. The working environment on the machine offers maximum protection and comfort to the operator.

#### 8.1.4.6 **Loading operations**

Loading is performed by using mechanized loaders (Bell Loggers) and in specific compartments the smaller A/B Class logs are loaded using manual labour.

Bell Loggers represent a low fuel consumption, excellent manoeuvrability in field and have low ground pressure and meets all international criteria for environment, health and safety in forestry operations.

#### 8.1.4.7 **Hauling operations**

Medium sized trucks (+/-15t carrying capacity) are used to transport timber from roadside to the sawmill.

Trucks have been selected in order to be suitable for KVTC's forestry roads and to minimize damage to both private as well as public roads. In particular the public roads around KVTC are difficult to pass during the rainy season and trucks larger than 15t carrying capacity would not be suitable.

#### 8.1.4.8 **Post-harvesting activities**

All harvesting operations are subjected to a post-harvest check list to determine if the harvesting operation has conformed to the company's policies and procedures. Any non-conformances will be investigated and corrected through the company's' internal action request system.

#### 8.1.4.9 **Environmental considerations in harvesting**

Operational guidelines are developed in the form of policies and procedures through the ISO 14001 process whereby all operations are subjected to an impact assessment and evaluation. The impacts are mitigated through procedures. Non conformities will be investigated through the internal action request and resolved.

All logging operations are undertaken in accordance to international harvesting best practise guidelines and specific criteria used for selection of harvesting equipment as well as harvesting procedures are as follows:

- Roads, skid trails and landings are placed outside Riparian Management Zones and wetlands and are to be established prior to the harvesting starts
- Landings are to be positioned in areas with good drainage with a slight slope to direct runoff;
- Harvesting machinery was selected to minimize soil disturbance (eg. compaction and rutting)
- In case slopes exceeding 30 percent would have to be harvested cable extraction systems would be deployed (currently this is not applicable at KVTC)
- Slash and debris should be stacked along the contour to prevent erosion along erodible channels
- Logging equipment should not be washed near streams and replacement of oils/hydraulics or fuel should not take place in sensitive areas whilst used fluids are to be managed carefully
- Logging equipment should be selected based on economic use of fuel and lubricants

Other requirements and operational procedures are covered in the *“TEAK Harvesting and Transport Manual”* which is kept and maintained by the Chief Forest Manager.

## **8.2 NATURAL WOODLAND**

It has to be stressed that the company is currently not engaged in harvesting Miombo species from its forest land. The below sections are written on the basis that harvesting might commence in the future.

### **8.2.1 Species requiring protection**

Trees proclaimed as protected trees by law will be protected and shall not be utilized.

Trees that are red listed on the IUCN Red list will be protected on a voluntary basis even if felling would be allowed under Tanzanian Law.

In the Forest act of 2002, trees from non-commercial forests or natural areas are ranked according to class of importance and value. Due to the over exploitation and scarcity of some of the species in the country, KVTC has identified several of these species from class 1 and 2 that need special management and research attention.

Individual trees identified within the property of KVTC for their aesthetic and genetic potential are protected. These trees are recorded into the Area of Special Interest (ASI) register in the ISO 14001 system. These protected trees will be used as seed trees to promote the growing of saplings for enrichment planting projects and education of local people.

### **8.2.2 List of species and developmental stage for harvesting**

KVTC will develop its harvesting of miombo species by focusing on the better known species as per the attached list below. New ways of processing and efficient marketing of the lesser known species will allow KVTC to increase the species on the list with time.

**Table 4: Overview of Common Miombo Species and their Classification**

Common	Swahili	Specie	Class
E.A. Blackwood	Mpingo, mugembe	Dalbergia melanoxylon	1
Snake bean tree	Msekeseke	Swartzia madagasearensis	1
African Teak	Mninga	Pterocarpus angolensis	1
African Mahogany	Mkangazi	Kyaya nyasica	1
Iroko	Mvule	Melicia excelsa	1
Pod Mahogany	Mkongo	Afzelia quanzensis	2
Albizia	Mduruasi	Albizia versicolor	2
Wild Syringa	Mkarati	Burkea africana	2
Afrormosia	Mbanga	Pericopsis angolensis	2
Wild Kapok	Msufimwitu	Bombax rhodognaphalon	4
Opilia Celtifolia		Opilia spp	5
Marula	Mng'ongo	Sclerocarya birrea	5
Terminalia	Mkulungo	Terminalia sambesiaca	5
Reserved			
Valuable			

### 8.2.3 Calculation of cutting cycle and annual allowable cut

Compared to teak, the volume growth of miombo woodland is much lower. The growth rate for each species differs and the interaction between the site, climate and genetics leads to substantial variation over the KVTC areas. Some information is available on the general growth rates of several miombo species, but specific, time range data and related studies are lacking. Due to the general lack of data, KVTC has performed destructive sampling to determine the growth rate of a number of miombo species that will be selectively harvested. Analysis from the growth data provides the MAI (m<sup>3</sup>/ha/year) and the optimum rotation length – indicators of the volume that can be sustainably harvested without impacting future volume supply.

**Table 5: MAI and Rotation length for several miombo species**

Species	MAI over the rotation.	Length of rotation
Brachystegia spesmiformis	3.46 m <sup>3</sup> /ha/yr	135
Brachystegia boemii	1.37 m <sup>3</sup> /ha/yr	65
Pseudolachnostyus maprouneifolia	0.73 m <sup>3</sup> /ha/yr	50
Burkea africana	2.7 m <sup>3</sup> /ha/yr	95
Dalbergia melanoxylon	1.37 m <sup>3</sup> /ha/yr	125
Pterocarpus angolensis	1.13 m <sup>3</sup> /ha/yr	35
Afzelia quanzensis	2.58 m <sup>3</sup> /ha/yr	75
Swartzia madagascarensis	1.81 m <sup>3</sup> /ha/yr	110
Total		

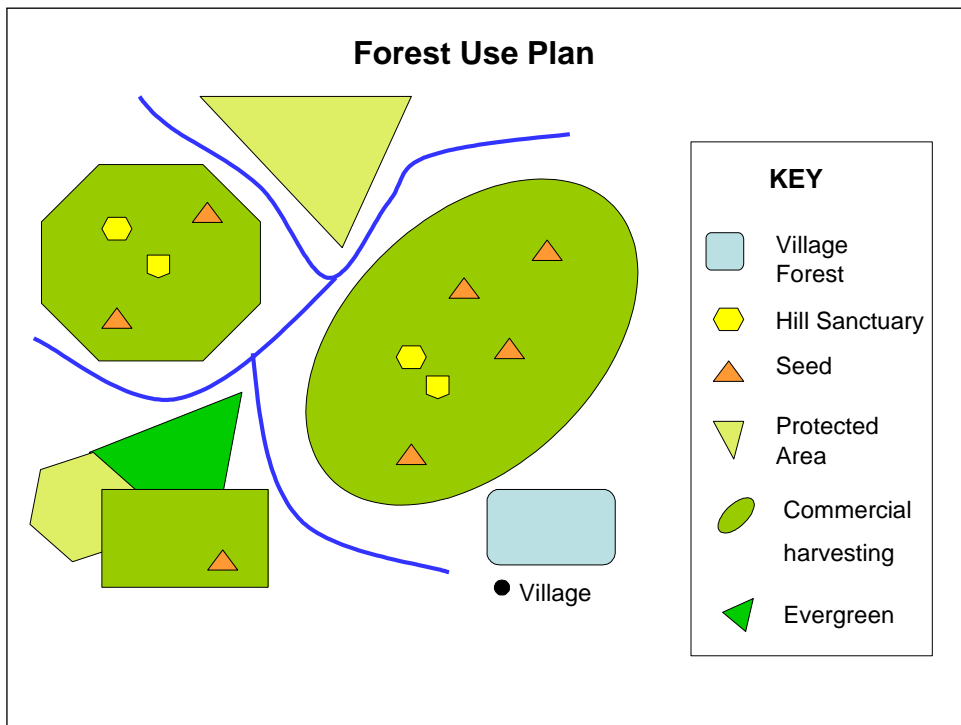
### 8.2.4 Division of the forest into harvesting units



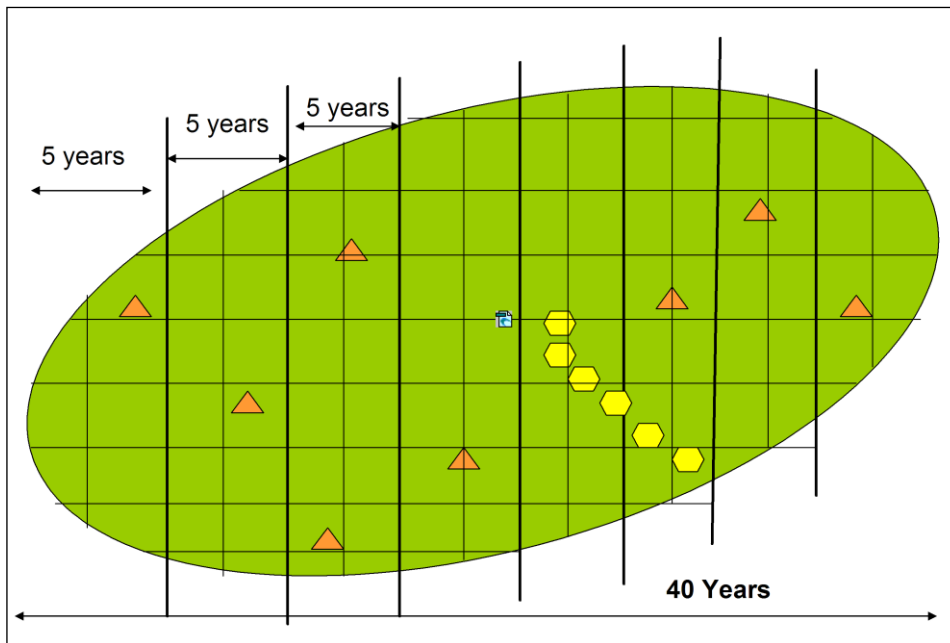
The miombo woodland is divided into homogenous management units taking the following parameters into consideration:

- Protected areas such as evergreen forest and riparian zones
- Hill sanctuaries and inaccessible areas
- Teak plantations and wildlife corridors
- Areas of special interest and protected trees
- Topographical features – especially geology
- Condition of the woodland – determined by impacts such as previous logging and wildfires

After the woodland is divided into homogenous management units, each management unit is broken up into harvesting areas. The harvesting area size is based on the sustainable harvest potential, which is calculated from the woodland survey (Section 8.2.3) and the growth assumptions for each specie (Table 7).



**Figure 11: Division of woodland into homogenous units**



**Figure 12. Homogenous woodland units divided into harvest units**

### **8.2.5 Miombo harvesting**

After approval of the harvest planning for a specific natural woodland unit, a map indicating each individual tree to be felled is generated. The chainsaw operator uses this map, together with a GPS to locate the exact tree (which is already marked with a unique number). Felling, de-branching and topping are conducted by means of a motorised chain saw.

### **8.2.6 Extraction/skidding operations**

Extraction will depend on the soil and topographical conditions of the area. In most cases, logs will be extracted to the nearest road with a skidder fitted with a combination grapple and cable system. At roadside, logs will be stacked with a three wheeled loader. .

### **8.2.7 Hauling operations**

At roadside, logs will be loaded with a three wheeled loader onto medium sized trucks and transported to the sawmill.

### **8.2.8 Post-harvesting activities**

All harvesting operations will be subjected to a post harvest check list to determine if the harvesting operation has conformed to the company's policies and procedures. Any non conformances will be investigated and corrected through the company's' internal action request system.

### **8.2.9 Industrialisation and marketing of the products**

Natural woodland products could be marketed alongside the teak and be processed at the facility at Mavimba. With the wide range in quality and value of miombo timber, value adding is critical to ensure adequate volumes can be handled to make processing profitable. Finished products will consist of sawn timber.

## **9 OTHER GOODS AND SERVICES**

KVTC's road network is accessible to the public and KVTC does not limit use of its roads to the local community.

KVTC believes that through its conservation programs it is playing an active role in fighting deforestation, conservating biodiversity and maintaining rainfall patterns in the Kilombero Valley

KVTC is continuously monitoring is Carbon Footprint and is making a positive contribution to fighting global warming. During 2019 KVTC absorbed 28,619 tons of CO<sub>2</sub>

## 10 MARKETS AND UTILISATION

### 10.1 Products

- Sawlogs
- Sawn timber: air dried and kiln dried
- Value Added Products: laminated panels, flooring, decking, doors

### 10.2 Industrialisation

In 2007 the process towards developing a wood processing Industry based on thinning and early volumes from KVTC plantation was started. This process resulted in the decision to construct a fully integrated timber processing plant that could produce a variety of products ranging from rough squares, sawn timber, kiln dried timber as well as value added products such as finger jointed and edge glued products as well as solid products such as flooring and decking. The factory was constructed during 2008 and 2009 and was commissioned in August/September 2009

KVTC processes half its annual cut at Mavimba and adding maximum value to the product by producing a mix of rough squares, air dried and kiln dried timber, solid as well as engineered (glued) teak products. The rest of the logs are sold to sawmills next to KVTC's industrial complex.

The processing complex comprises an area of approximately 300x400m<sup>2</sup> which covers several processing areas:

- Log Sorting, Sawing and Wet Sorting
- Timber Drying
- Cross Cutting and Timber Packaging
- Value Added Products Production

The factories currently employ approximately 160 people, excluding contractors on the harvesting and transport side of the business.

Total investment in the development of the processing plants and the supporting infrastructure was around \$9m

.

**Table 5: Volume input and product output from processing plant 2021-2025 (as per company budget)**

	2021	2022	2023	2024	2025
<b>Harvested logs (m<sup>3</sup>)</b>	36,300	42,000	38,500	42,000	48,000
<b>Logs sold (m<sup>3</sup>)</b>	18,900	22,300	20,300	25,300	25,000
<b>Logs processed (m<sup>3</sup>)</b>	17,400	19,700	18,200	16,700	23,000
<b>KD sold (m<sup>3</sup>)</b>	1,860	1,960	1,700	1,580	20,100
<b>AD sold (m<sup>3</sup>)</b>	5,855	6,210	5,790	5,200	6,620
<b>VAP sold (m<sup>3</sup>)</b>	210	210	210	210	210

### 10.3 Marketing including demands and constraints

The market demand for teak has remained strong over the years and teak markets have shown to be resilient in times of recession. Prices continue to develop favourably. Current market demand is estimated to be around 4.5 million m<sup>3</sup> of teak annually. Global teak requirements are estimated to be 10 million m<sup>3</sup> per annum by 2030. Expectations are that medium term market demand will stay firm.

By far the largest market for teak is India and it is estimated that India consumes around 90% of the world teak supply with the majority of this material being used for domestic consumption. Due to the development of India and the growing middle class there is a market for any type of teak in India irrespective of age and quality. Due to its structure of taxation and protection of the local processing industry the Indian market prefers the import of rough squares or round logs

Other markets in the Far East are Vietnam, China and Indonesia where the majority of the teak is being used in the garden furniture industry and is being re-exported to Europe and the USA.

Markets in Europe and the USA are mainly for finished products such as boat decking, garden furniture and to a lesser extend flooring products.

Natural forests supply >15% of the current market demand, most from Myanmar but this supply is expected to drop to 5% by 2030. The balance supply is coming from planted stands in Asia, Africa and in the more recent years from South America. Prices for teak products vary greatly and are mainly related to the wood quality of the teak. In general natural teak gives better characteristics than plantation grown teak although improved silvicultural practices and genetic improvements are used by teak growers try to improve the quality of plantation teak. The main influences on pricing are:

- Wood quality
- Dimension
- Hardness
- Stability

- Oil content
- Texture / Grain
- Color
- Knot types and frequency

## **11 ROAD OPERATIONS**

### **11.1 General road network**

All roads at KVTC have to conform to a minimum standard as set out in the ISO 14001 & ISO 45001 policies and procedures.

All new roads are subjected to an environmental scoping assessment before construction.

Roads are divided into:

#### **Main roads**

Roads required for access to secondary roads. These roads that require frequent maintenance to facilitate large volume traffic by trucks transporting harvested timber.

#### **Secondary roads**

These are the narrower roads into the compartments or around areas divided into smaller management units.

#### **Servitude roads**

Servitude roads are also referred to as main roads; the only difference is that these roads are situated off KVTC property and act as access to the plantation through e.g. village land. Servitude roads are maintained by the company.

### **11.2 Road requirements**

Road requirements are based on the environmental, social and economic requirements of the company.

In the past roads were built to facilitate management and access to plantation areas for establishment, maintenance and fire protection.

As the amount of traffic on KVTC roads is increasing, as well as the weight carried over the roads, a program to upgrade both road surface and in particular bridges is being implemented

### **11.3 Standards for construction and maintenance of roads**

Standards are prescribed in the roads procedures in the ISO 14001 & ISO 45001 system.

All roads shall subscribe to a basic standard which will be a cost effective way for developing the infrastructure as well as facilitate upgrading at time of harvesting.

Road densities shall not exceed 18m/ planted ha and slope more than 5 degrees (7 degrees maximum under special conditions with management approval).

KVTC has a 5-year road maintenance plan where the total road network is divided into  $\pm$  50km road sections which are upgraded yearly, the upgrade includes grading/blading and compaction.

All drains and culverts are installed to meet the requirements for water drainage.

After every harvesting operation is completed, all the side drains of the road network used are manually re opened and pothole filling done wherever needed. The road sections which are covered by grasses are mechanically slashed by a tractor mower two to three times a year.

Once a year all road network at KVTC receives a manual slash, all vegetations growing 2.5m from the side drains both sides of the road are manually slashed and the debris removed clear of the side water way.



## **12 ENVIRONMENTAL CONSERVATION MEASURES**

### **12.1 Buffer zones**

Buffer zones are created for the movement of animals, birds and amphibians to allow movement between larger, protected habitat refuge areas.

Compartment and buffer design is assessed prior to conversion through the comprehensive pre felling process (Section 12.4).

### **12.2 Wildlife conservation**

Wildlife is an integral part of the overall biodiversity of the Kilombero Valley. The company maintains a no hunting policy. KVTC deploys approximately 22 trained village game scouts on its property. The Game Scouts are recruited through surrounding villages and have received both government as well as KVTC specific training.

### **12.3 Use of chemicals and pesticides**

The use of chemicals and pesticides is controlled and a process of authorisation has to be followed which is contained within the ISO 14001 system. Only chemicals and pesticides on the company's chemical/pesticide approved list may be used. All chemicals and pesticides have to be legally registered within Tanzania and conform to the chemical and pesticides policy guidelines of the Forest Stewardship Council (FSC).

Chemical and pesticide spillage emergency procedures are in place and reviewed periodically.

Chemical, Pesticide and fuel usage is monitored through the ISO 14001 process and reported in the regular environmental reports.

### **12.4 Biodiversity conservation**

Biodiversity issues are described in the ISO 14001 system. All operations are rated (in the aspect register) and procedures developed to quantify, manage and measure the company's effects on biodiversity.

As referred to earlier, comprehensive pre felling studies were conducted prior to conversion to teak. This process entailed the study of animal movement routes, identification of species present (fauna and flora) and recommendations by local and scientific specialists. The resulting information was captured to the GIS system which allowed the conceptualisation of recommendations and the implementation of a practical system of corridors and conserved habitats over the entire landscape. Over time, implementation of these recommendations has led to the teak blocks developing as a mosaic into the landscape.

The KVTC board of directors decided in March 2009 that no further conversion of miombo woodland would take place.

#### Studies conducted prior to conversion:

Evergreen (plant) studies

Biodiversity studies

Biodiversity base line studies:

Biodiversity survey

Butterfly survey

Bird Survey

Mammal studies

Miombo forest studies

Water quality and flow rate

## **12.5 Soil and water conservation**

Soil and water management and impacts are described through the ISO 14001 system. Field operations are rated and procedures developed to minimise the company's effects on erosion and pollution of catchment areas.

Roads are built in accordance with best operating practices. Drains are not permitted to flow directly into streams and waterways. Roads, bridges and culverts are checked annually.

Chemical use is controlled.

The following water monitoring is undertaken:

An assessment of the rainfall in Ulanga and Kilombero as well as the office area in Ifakara and Mavimba is carried out daily (6 sites).

Monitoring of stream quality in and around the land holdings is performed twice per year.

Stream flow is monitored through the Rufiji catchments office in Ifakara and information shared.

Erosion is contained if and when necessary.

KVTC follows the prescription of the Environmental Management Act of 2004 whereby buffer zones around permanent water bodies are maintained as follows:

Permanent Rivers: No plantations or other manmade structures or activities will take place within 60m of the low water mark of permanent rivers.

Some plantation areas do not comply with this criterion due to the fact that these plantations were either planned or established prior to the gazetting of the Environmental Management Act. The company will aim to achieve dispensation for those areas that are in breach with the EMA however failure to achieve this management will excise those areas on clear fell and will not re-establish those areas that fall within the prescribed buffer zone.

In addition to the buffer zones around permanent rivers and water bodies KVTC applies different criteria for seasonal water bodies which is shown in the below section.

Seasonal Rivers and Streams: those rivers and streams that carry water for a period of six months or more of the year will have a buffer zone applied as per Table 8 below

Table 6: Water protection Buffer Zones

<b>Width of Water course</b>	<b>Protection</b>
Up to 10 meters	10 meters from the centre of the river or stream
10-20 meters	20 meters from the centre of the river or stream
20 meters +	50 meters from the centre of the river or stream

Natural Drainage Channels: these channels are defined as streams carrying water less than six months of the year and only during the rainy season. No buffer zones are applied to these channels.

Wetlands: areas that show signs of being permanent or semi-permanent wetlands will not be planted. Identification of those areas are done through identification of indicator grass species.

## 13 MONITORING AND RESEARCH

### 13.1 Previous Research Studies

KVTC has conducted numerous research studies within all fields related to the management of teak and miombo woodland. Continuous monitoring, following on baseline studies allows the tracking of changes over time. This allows for improved management prescriptions to be implemented and transparent reporting to stakeholders.

**Table 8: Studies and projects performed at KVTC**

<b>Report name or study</b>	<b>Performed by</b>
<b>Miombo</b>	
Sustained forestry and harvesting on Miombo woodlands	Wildhorus Ltd
The establishment of the Miombo restoration research sites at KVTC	Wildhorus Ltd
Development of a system for evaluating the conservation value of the field layer flora	Wildhorus Ltd
Preliminary report on Miombo growth in the kilombero valley	Wildhorus Ltd
The edge effect of teak plantations on surrounding Miombo woodland	Frontier (Tz)
Literature review of the silviculture of suitable indigenous species for enrichment planting	Wildhorus Ltd
Edge effect & Permeability internal report 04	Frontier (Tz)
Miombo research information sheet	I-TOO
Classification of Miombo forest based on satellite images	I-TOO
KVTC-SAT-Inventory 2005	I-TOO
Indicators and tools for Miombo management	I-TOO
Field guide to trees and shrubs of KVTC	KVTC
<b>Wildlife</b>	
Habitat selection of large mammals in evergreen forests, Miombo woodland and teak plantations	Frontier (Tz)
Large mammals and teak plantations in the Kilombero valley	Frontier (Tz)
The impacts of KVTC activities on wildlife	Wildhorus Ltd
Teak edge effect and permeability biodiversity and special variation descriptions	Frontier (Tz)
Permeability of the new fence design	Frontier (Tz)
2012 Natural Woodland Study	Frontier (Tz)
<b>Hydrological</b>	
Hydrological effects of the teak plantations of KVTC	David F Scott

**Social**

Community use of non-timber forest products	Frontier (Tz)
Archaeological scoping assessment and heritage management practices for KVTC	Mary Leslie & John Kimaro
Archaeological heritage guidebook for protection and management of KVTC sites	Mary Leslie
The impact of KVTC on the livelihoods and hydrology of surrounding local communities	Sokoine University
KVTC field guide to non-timber forest products	Fran Sykes Reading University
Significance of forests in Tanzania (a KVTC study)	Fran Sykes Reading University
Community Voices (Social Survey) 2011/2012	Keystone, KVTC, Frontier

**Commercial studies**

Assessing biodiversity in Miombo earmarked for teak plantations -2002	Frontier (Tz)
Assessing biodiversity in Miombo earmarked for teak plantations -2003	Frontier (Tz)
The ID and mapping of evergreen forest within areas earmarked for conversion to teak in 2004	Wildhorus Ltd
Pests study 2003	TPCP
Pre felling 2004	KVTC
Teak growth models in Tanzania	University of Stellenbosch
Evergreen report 2005	Wildhorus Ltd
Bio Diversity Report 2005	Wildhorus Ltd
Pre Felling 2007	Frontier (Tz)
External Environmental Audit Processing Plants KVTC (2011)	Green Consultants TZ
Socio Economic Study on the Kilombero River Ferry in Kilombero and Ulanga Districts, Morogoro Region, Tanzania (2011)	Green Consultants TZ
Initial Environmental Audit KVTC Forestry Operations	Green Consultants TZ
Analysis of Export Process of Certified Teak (2012)	Audace Ikuzo / University of Brussels
Feasibility Study into a Public Private Partnership Model for the Kilombero River Ferry (2012)	TIRDO

Tanzania Teak Market Research (2012)

Willem van  
Zwieten

### **Monitoring**

Long term monitoring of large mammal movements	Frontier (Tz)
Social Economic Impact of KVTC Operations	KVTC
Habitat Quality Monitoring (Birds and Butterflies)	Wildhorus Ltd
Water quality monitoring at KVTC (mini SASS)	Wildhorus Ltd
Silviculture self assessments Doc.	KVTC
KVTC Pre-felling sites Audit	Frontier (Tz)
Baseline Biodiversity Survey In Miombo Woodland	Frontier (Tz)
Forest cover changes using satellite imagery dated 2002 and 2004	I-TOO

### **13.2 Current research activities and sites**

Research is divided between the plantation and woodland research. Currently there are no research projects taking place in natural woodland.

Commercial research projects are as follows:

#### **Permanent Sample Plots**

- In order to collect sufficient time series data on the growth of teak for use in the development and calibration of growth and yield models, KVTC has established a comprehensive system of PSP's. PSP are established to cover the range of growing sites and ages present at KVTC. An 11.28 metre circle plot (0.04 of a hectare) is established in the selected area in a compartment; the site should be as homogenous as possible. All trees are marked individually with a permanent marking paint. All trees are measured for DBH and 4 pairs of 4 trees each are assessed for height. The height pairs are selected for their height classes e.g. small, medium, large, and very large within the PSP plot. These plots are assessed on a yearly basis and the data electronically captured.
- Spacing trials
- Fertiliser & Herbicide trials
- Clonal trials
- Soil Sampling & Mapping
- Heartwood Sampling
- Bark thickness sampling
- Stem taper sampling
- Utilisable height sampling

### 13.3 Monitoring effects of logging and/or other forest management activities

Monitoring of the effects of logging and other forest activities are described through the ISO 14001 procedures. All aspects and impacts are regularly evaluated by relevant staff members. These are mitigated through a series of procedures and programmes. Annual Environmental Management Programmes (EMP's) are implemented for aspects with the biggest impacts.

### 13.4 Cooperation with research organisations

#### 13.4.1 I-TOO

KVTC and an EC (European Commission) funded research project on Indicators and Tools for Restoration and Sustainable Management of Forests in **East Africa - I- TOO** - entered into a public-private research partnership. The aim of the research was to create day to day management systems for Miombo forests, and to integrate those into the management plans of KVTC; thereby improving management achievements.

The objective of this research was to develop cost efficient, satellite-based forest inventory tools to assess the site specific production potential and degree of forest degradation. The research entailed the following:

- **Development of a Miombo forest classification key**

Miombo forests were classified according to their production potential, based on site quality, degree of forest degradation, infrastructure and marketability.

Terrestrial site and stand inventories will serve to develop an identification key for satellite image (SPOT4) interpretation. Subsequently, correlations between the terrestrial information and the information visible on the satellite image will be enhanced in an iterative process so as to improve image interpretation.

- **Natural regeneration of Miombo Forests and its management implication**

The regeneration status and dynamics will be assessed. Particular focus will be placed on the high value timber species and the most abundant Miombo tree species. Inventory procedures will be developed and applied to assess whether enrichment planting is necessary, appropriate and cost efficient; or whether remaining seed trees and temporary fire protection can ensure sufficient regeneration.

- **Miombo stand improvement experiments**

These experiments are performed to test intervention tools and assess costs and returns. The study design can be used in other areas to assess the feasibility for Miombo forest rehabilitation. Based on this study, extension manuals can be developed, enabling forest users to assess the rehabilitation potential and project returns of their forestry operations.

*The I-TOO project was completed in 2007*

#### 13.4.2 Sokoine University research interests

A research partnership was initiated in 2005 between KVTC and **Sokoine University of Agriculture**, Faculty of Forestry and Nature Conservation. The Department of Forest Biology carried out research on forest site productivity estimates for teak.

After completion of several MSC projects cooperation with SUA is currently not active but an MoU to resuscitate the cooperation is being drafted.

#### **13.4.3 Frontier Tanzania**

The Frontier Tanzania Savannah Research Programme was a collaboration between The Society for Environmental Exploration (United Kingdom) and the University of Dar es Salaam. Frontier carried out a number of pre felling and monitoring studies on behalf of KVTC and assisted in monitoring and impact assessment.

Frontier Tanzania discontinued its operations in the Kilombero Valley in 2012

#### **13.4.4 Forestry Development Trust**

KVTC works together with Forestry Development Trust (FDT).The Forestry Development Trust was established by the Gatsby Foundation in 2013 with a long term vision of developing the forestry commercial sector in Tanzania. Currently KVTC works closely with the Forestry Development in its research program. KVTC maintains research plots established by FDT on its plantations in terms of an MoU entered into by the two institutions. Eucalyptus and pine research trials were established. Data is collected by FDT staff and shared with KVTC. On completion of the research project, KVTC will have a wealth of knowledge on the potential of these species in the area.



## 14 FACTORS THAT INFLUENCE FOREST MANAGEMENT

### 14.1 Bio-physical conditions

Situated in the Kilombero Valley, an area exceptional in biodiversity richness, KVTC is committed to developing and complying with all National Forestry Policies.

KVTC participated in developing a national forestry standard for Tanzania, a process that was facilitated by the Forestry and Beekeeping Division within the Ministry of Natural Resources and Tourism and WWF. KVTC will maintain and continue to manage its operations by application of the 10 principles contained within FSC through the ISO 14001 and FSC Controlled Wood certification scheme. KVTC has no FSC certification.

The company's original environmental policy was developed during November 1995 and is updated on a regular basis. KVTC's knowledge base has grown from comprehensive studies into the impact of its forest conversion. The present KVTC environmental policy is derived from the following ongoing initiatives and driven by the ISO 14001 system which requires continuous improvement to the systems that reduce impacts on the environment.

- KVTC is committed to the implementation of the International Standards Organisation (ISO) 14001 forestry world standard. The company received its ISO 14001 certification in 2004.
- An observation report on the potential for sustainable forestry and harvesting of Miombo woodlands within the land holding of KVTC was carried out including interviews with local timber users on the use of *Brachystegia bohemii* and *Brachystegia bussei*.
- The establishment of Miombo restoration research sites at KVTC to create the appropriate methods for miombo enrichment with the goal of returning the high value species felled during the sustained harvesting.
- Development of a system for evaluating the conservation value of the field layer flora at KVTC and to use the tool for making pre plant decisions.
- The edge effect of teak plantations on surrounding Miombo woodland. The objective was to assess the habitat utilisation of five taxa groups at specific distances from teak plantations and miombo forests.
- Review of the silviculture of suitable indigenous species for enrichment planting.
- Frontier report on the edge effect and permeability. Two principle studies were undertaken:
  - 1) The edge effect of pure teak stands on surrounding native woodland.
  - 2) The permeability of teak to large animals
- Classification of Miombo forest based on satellite images derived from the SPOT 4 satellite.

- KVTC-SAT-Inventory. Based on the results of the remote sensing, KVTC investigated the potential to differentiate forest types and to delineate dense forests with a high silvicultural management potential.
- Indicators and tools for Miombo management. The study dealt mainly with the ecological and silvicultural features of the miombo forest.
- Habitat selection of large mammals in evergreen forests, Miombo woodland and teak plantations
- Large mammals and teak plantations in the Kilombero valley. The aim of the study was to contribute to the Environmental Impact Assessment of the company, the development of a methodology for surveying large mammal populations in miombo woodland.
- The impacts of KVTC activities on wildlife. A stakeholder meeting was held in September 2002 with relevant local wildlife experts who provided input into the planning and environmental management procedures of the company.
- Teak edge effect, permeability biodiversity and special variation descriptions. The aim was to assess habitat utilisation at various distances from the edge of the compartments.
- Permeability of the new fence design. The aim of the study was to evaluate the permeability of the new fence design which comprises of an electric fence at a height of 1.5m.
- Hydrological effects of the teak plantations of KVTC. The terms of the study was to assess the optimal width of streamside hydrological reserves for different streams and to evaluate the impact of teak on the surface hydrology in the Kilombero Valley.
- Community use of non timber forest products. The aim was to provide KVTC with an assessment of the value of the wooded areas around participating villages.
- Archaeological scoping assessment and heritage management practices for KVTC. Sites of special cultural, ecological or religious significance to the local community and the country of Tanzania as a whole have been identified by KVTC and will remain protected by the employees of the company.
- Archaeological heritage guidebook for protection and management of KVTC sites.
- Long term monitoring of large mammals. Five habitat sites are studied over time to assess the impacts of teak plantations on large mammal populations.
- Social Economic Impact of KVTC Operations. KVTC carries out a social impact study of its operations in the participating villages on an on-going basis.
- Habitat Quality Monitoring (Birds and Butterflies). KVTC developed a system for monitoring the habitat quality of the miombo woodland using birds and butterflies which enables the company to measure its success in achieving management goals related to miombo.

- Water quality monitoring at KVTC (mini SASS). KVTC has implemented a permanent monitoring system to assess the quality of the water flowing in and out of the company's leased land. This is an annual assessment with samples assessed twice a year, once in the dry season and once in the rainy season.
- Silviculture self assessments document. This is a manual which defines all the key elements of good silvicultural practices at KVTC. It is a hand book which is utilised by the operational staff and used to assess operations against the standard.
- Baseline Biodiversity Survey in Miombo Woodland. Base line studies took place in both open and closed miombo. The study areas were selected on and off KVTC in order to assess the future changes and protection
- Forest cover changes using satellite imagery dated 2002 and 2004. A base line satellite photo was used to produce a forest mask of an area encapsulating forest on and off KVTC. A second image was taken 26 months later in order to evaluate and identify changes on both KVTC land areas and off KVTC. The process will be monitored every 2-5 years in order to assess the long term changes in and around KVTC.
- In November 2011 KVTC was certified by SGS Tanzania to the OSHAS18001 (now migrated to ISO 45001).

#### **14.2 Social conditions**

Currently, the company has a very efficient way of distributing social fund money to villages. Apart from the annual social fund, villages provide services such as security patrols and boundary clearing, which earns additional revenue to be spent for projects in the villages.

KVTC and each neighbouring village also make an annual village contract. In this contract, a bonus scheme rewards villages that prevent uncontrolled wild fires, poaching and illegal logging of both teak and indigenous species.

KVTC has an HIV/AIDS programme involving company employees, contractor employees and associated villages. KVTC also a weekly radio program on Ulanga FM radio that it uses for community education purposes.

#### **14.3 Employment policies and issues**

KVTC ensures that all employment practises by the company and its contractors adhere to government legislation as a minimum standard. Audits through FSC Controlled Wood, ISO14001 & ISO 45001 certification programs and local government authorities such as the Occupational Safety and Health Authority are used to verify KVTC commitment to a fair workplace. KVTC does not have any FSC certification.

#### **14.3.1 Health and occupational safety**

The company has a health and safety policy document where all operations are described with their respective risks as well as procedures to be followed. The policy has been translated into Kiswahili to ensure that everyone within the organisation as well as contractors and their workers understand what is required.

The rates paid to contractors include allowances and statutory overtime to ensure compliance with all health and safety regulations and company policies.

#### **14.3.2 Training initiatives**

KVTC has an active training programme to ensure all employees are trained in their posts. The company also promotes employees part time studies for self-development.

#### **14.3.3 Trade unions**

The company recognises that workers have both obligations and rights under the Labour relations act. KVTC has its own labour relations policy which conforms to the national standard.

Employees of KVTC have the right to join a union. Currently all unionised workers belong to Tanzania Plantation Agriculture Workers Union (TPAWU).

#### **14.3.4 Employee welfare**

A company provident fund was introduced at KVTC for pension provision for its members upon their retirement at a specified age.

The company has supported the establishment of a Savings and Credit Society (SACCOS) at the workplace and has a system of terminal benefits which mature at retirement.

#### **14.3.5 Savings and Credit Cooperative Society (SACCOS)**

KVTC's workers' Saving and Credit Cooperative Society (SACCOS) was established in May 2001 in order to provide members with an opportunity to invest their savings and to gain access to soft credits. Mitiki SACCOS provides loans to members ranging from small loans for school fees and agricultural inputs to larger loans for house construction as well as farming implements.

Membership of Mitiki SACCOS is on a voluntary basis and a total of 80 staff are currently registered. KVTC has contributed 3,000,000 to Mitiki SACCOS as starting capital. At present SACCOS shares and reserve stand at 23 million and 175 million Tanzanian Shillings respectively.

Mitiki Workers SACCOS is registered with registration no MGR 313 and operates under Tanzania Co-operative Act No 20 Of 2003. Its managing its affairs based on the relevant law and its regulation. The Society

has a board responsible for policy of the society, employing staff when the need arises. Every member has a say through ballot box by electing Board members and passing resolutions through General Assembly.

#### **14.4 Communication systems**

Currently communication systems that are available to the company are

- Postal services
- Cell phones
- E mail and internet connection.
- 2 way radio system with repeater

.The cellular network is reliable but the footprint does not cover the entire area of the company's operations. Postal services are reliable but slow.

The company introduced a cellphone tower network based internet service to assist its operations with a improved flow of information. The company 2 way radio system facilitates communication on the plantation especially during the dry season when the potential of fire is a risk.

#### **14.5 Resource use conflicts**

There is 6630 square km of land in the Kilombero valley, a large portion of this area is covered by water or water bodies, national forest reserves and game reserves and is a proclaimed RAMSAR site. Some portions are inaccessible mountain areas unsuitable for agriculture.

Currently the Idete Prison has objected to KVTC developing part of its landholding as a result of a security concern on the adjacent landholding. A total area of approximately 650ha cannot be developed whilst this dispute remains unresolved. Despite best efforts by the company and frequent correspondence the prisons Department has been reluctant to work towards an amicable solution.

KVTC maintains a policy of no hunting.

KVTC uses a system of Village Game Scouts to patrol its land holding to ensure no poaching of game and timber resources.

The participating villages assist KVTC with patrols which address the issue of poaching and other illegal activities.

KVTC actively promotes the growing of trees, teak as well as miombo through schools and educates local village people with regards to the benefits.

## **15 FOREST PROTECTION**

### **15.1 Security and Vigilance Plan**

#### **15.1.1 Demarcation, signage, and maintenance of boundary lines of management area**

All boundary beacons are inspected on an annual basis and missing beacons are replaced.

Boundaries are maintained through a contract with the participating villages and the vegetation is cleared along the boundary to demarcate the area.

Signs are erected at the entrances of the plantation on the main road indicating the company's name and logo as well as the block.

#### **15.1.2 Measures for monitoring and patrols**

A contract is entered into with the participating village for the patrolling and security of the designated areas. A monthly report is used to communicate any breaches to the office.

Areas are checked for poaching of timber, natural resources and animals. Encroachment control of people as well as controlled access is checked.

If any breaches occur such are handled by the contracted village executive.

### **15.2 Integrated Pest Management Plan**

Currently the main pests affecting the teak at KVTC are baboons. The company employs about 25-30 baboon chasers to keep baboons out of compartments with young trees. A regular visit is undertaken by a forestry pest and disease specialist. Reports are maintained in the monitoring file at KVTC.

Pest and disease emergency procedures are maintained through the ISO 14001 system, this includes the legal requirements for report outbreaks and control.

The Silvicultural self assessment document contains images of potential diseases in order for the timely identification and controls to take place.

### **15.3 Fire Management Plan**

The fire management plan is updated annually. The purpose of a Fire Management and Protection Plan is to draw together all the relevant information and set up procedures for preventing and containing fire events.

1. The principal elements of this plan are:

- Updated special “fire management” maps showing compartment numbers and/or other stand designations, high risk areas, road and access lines, fire lookout and water point locations.
- Fire orders and standing instructions, including standby rosters, equipment to be used by staff/contractors, restriction of movement on the plantations or assistance away from place of normal duty and roles of non-plantation staff;
- Information on the tools, equipment and personnel available and their location;
- Details of communication systems;
- The composition and training of fire crews;
- The role of education and publicity programmes;
- The maintenance programme for forest roads;
- The programme for the preparation of fire trace lines and firebreaks;
- Procedures and authorities for controlled burning;
- Levels of standby to be maintained at each hazard level;
- Procedures to be followed when a fire is reported
  - a) outside the plantations but possibly threatening the plantations and
  - b) inside plantation areas;
- Recommended procedures for bringing wild fires under control by involving associated villages;
- Mopping-up and patrol procedures;
- The investigation of cause of fire and the submission of fire reports, and where appropriate, a follow-up session (post-mortem) on lessons to be learned from each incident.

#### 15.4 Fire Prevention

It is the duty of all KVTC employees, forest contractors and associated villages to do whatever possible to prevent uncontrolled fires from entering KVTC land, to prevent unauthorised fires from starting on KVTC land and to avoid prescriptive fires becoming uncontrolled.

**Sources of uncontrolled forest fires include:**

- ❖ Cultivation – Farmers light some fires to burn debris in their farms. Sometimes, these fires are uncontrolled and are left to spread thus becoming wild fires.
- ❖ Pastoralists – Cattle herders burn dry grass to allow sprouting of new green grass for their animals. These fires are often uncontrolled and destroy vegetation on large tracts of land.
- ❖ Hunting for Animals and Honey – Hunters often light fires while looking for animals, as well as clearing the forests for better visibility while hunting. Honey hunters use fires to scare bees. These fires are left to spread without control.
- ❖ Fishing – Fishermen light fires to dry their catch. Sometimes, they just leave fires unattended which then spread to nearby forests.
- ❖ Smokers – Smokers throw away their burning cigarettes without putting them out which may cause forest fires.

- ❖ Arson – Misunderstanding between forest staff, villagers, management, etc can cause people to burn plantations as revenge in their conflicts
- ❖ Forest Workers – Can cause fires while working in the forest through late and unsupervised controlled burning of firebreaks, debris burning and cooking.
- ❖ Vehicles – Defective vehicles exhaust pipes of heavy vehicles can cause forest fires.
- ❖ Lightning strikes may cause fires under certain conditions

#### *Cooking or warming fires*

- ❖ Warming or cooking fires may only be lit away from vegetation, such as grass, trees and bushes. This means that fires may only be lit in well-cleared open areas at villages, on wide roads or properly cleared areas. All staff (including contractor employees), are required to ensure that any cooking or warming fires seen near vegetation are immediately put out.
- ❖ No cooking or warming fire may be lit away from residential areas without the permission of the Contractors and/or responsible person.
- ❖ Anyone giving permission to light a cooking or warming fire must personally ensure that it is in a safe place, that it is always attended and that it is put out before when people leave the site.

#### *Smoking*

- ❖ Smoking is prohibited in plantation areas or near petrol cans.
- ❖ Those working in or near plantations may only smoke when given permission by their supervisor. Permission may only be given to smoke in well-cleared areas such as wide roads or firebreaks.
- ❖ Smoking out bees is forbidden unless authorised by a Plantation Manager. Any authorised bee smoking must be carried out under supervision of the person authorising.

#### *General*

- ❖ No fires of any kind may be lit on dry, windy days. If any doubt exists higher authority must be consulted (CFM).

#### *Putting fires out*

- ❖ It is the duty of all employees, forest contractors and all workers, and people living on the associated villages, no matter what time of day or night, regardless of what else they may be doing, to respond to a fire call and to assist in putting out any fire within or near KVTC boundaries.

#### *Controlled Burning*

- ❖ No burning of new sites is allowed without completing a pre burn questionnaire. Authority from the Plantation Manager on whose plantation the fire is to be lit is required.

## **15.5 Fire Breaks**

There are basically three kinds of firebreaks at KVTC:

- ❖ Natural firebreaks such as public roads, rivers, streams, dams/ponds, buffers/corridors and wet swamps.
- ❖ Boundary firebreaks that are 6 metres wide established around a block or compartment. This is done by scriffing 3 meters and slashing 3 meters
- ❖ Internal roads cleared 10 metres wide.

It is the responsibility of the Chief Forest Manager (CFM) through his Plantation Managers and Silviculture Contractors (with reference to Forest Operations Procedures) to ensure the following:



- ❖ Establish all firebreaks as required;
- ❖ Controlled burning
- ❖ Scruff and completely clear 3 metres wide tracer lines for all company boundaries which will act as plantation fire breaks. This is to be done by associated villages and must be inspected by Plantation Managers (Appendix 3.7 – Village Contract).
- ❖ Clean by hand all bridges and culverts before fire season. This cleaning must include removal of all inflammable material on the road or overhanging the road.
- ❖ Keep updated maps of the Fire Plan in the GIS for each respective plantation. CFM should display one copy in his office. Maps should be updated annually by Planning Department.

## 15.6 Controlled Burning

All fire orders are described in the fire plan.

- ❖ Controlled burning applies to burning of:
  - Open area between fire break and company boundaries
  - Prescribed burning under trees
  - Buffers and corridors between compartments
  - Clear felled compartments
- ❖ Controlled burning is the responsibility of the Plantation Managers
- ❖ No controlled burning may be done by anyone without the authority of the CFM
- ❖ Controlled burning must never take place on paydays or on the two days after payday.
- ❖ Controlled burning must never take place on Saturdays or Sundays.
- ❖ Controlled burning should only be started between 6:00 am and 10 am and be extinguished by 12 am or else started between 4:00 pm and 6:30 pm and extinguished by 7 pm.
- ❖ Before any controlled burning is done, woody material must be removed from tracer lines around the plantation.
- ❖ The contractor must personally supervise all controlled burns. The contractor must ensure that the fire is completely extinguished through thorough mopping up before leaving the site. Some members of the crew must be left behind to patrol the area.
- ❖ A notice has to be given to the nearest Fire tower at the time of starting and finishing burning and also details on exactly where the controlled burn is to take place.
- ❖ The pre burn checklist must be completed before any fire is lit, this will ensure adherence to prescriptions, consultation with respective managers and also that factors such as weather has been taken into account.
- ❖ The Plantation Manager must re inspect any controlled burn the day following the burn.

## 15.7 Public Relations

A good relationship between the KVTC staff, forest contractors/ workers and villagers will form a good pillar in preventing fires resulting from incendiarism as well as good cooperation for fighting out fires whenever they happen.

## 15.8 Education through Extension

Continuous education of the local community on the dangers and negativities of fires (property loss, life loss, etc) during dry season can lead to reduced fires being left to become unmanageable.

## **15.9 Use of Laws**

The last resort is the use of applicable legislation to prevent illegal/careless fire burning. The National laws and District Council bylaws on prevention of fires are sufficient to deter people from burning unnecessary and uncontrolled fires. This will be implemented through the involvement of the local village government.

## **16 INFORMATION MANAGEMENT SYSTEM**

### **16.1 Description of information management system**

There are currently 4 information systems in the company

#### **16.1.1 Microforest Management system**

The Microforest management system has an integrated approach to management information and is linked with the Geographical Information System (GIS) component of land base management. The system is internet based with a central server provided by the supplier. Data is captured in real time and it is possible to access the system from any internet connection.

##### **(a) Plantation Manager**

Plantation manager has the following functionalities

###### **➤ Plantation Editor**

The objective of the Editor is to provide users with tools to manage a wide range of aspects within any plantation. It allows users to alter any parameter through direct editing or by event driven actions.

###### **➤ Operational planning and Control**

The objective of the operations planning and control module is to provide a system for planners and operational managers to phase and store a complete annual plan of operations. Once operations are completed, it is captured to the system allowing a multitude of reports to be generated. Data for previous years can be easily accessed when historical information is required.

###### **➤ Enumeration**

The enumeration module allows the capturing, analysis and updating of sampled compartment and tree data. The enumeration results are used for estimating timber and biomass yields and analysing the growing stock. The growth & yield simulator (GYS) is used by the enumeration module.

##### **(b) Harvesting Scheduler**

The harvesting scheduler uses pre-programmed models to project future yields. It is a flexible system that allows for parameters to be adjusted and different scenarios to be produced. Based on the current growing stock and taking into consideration possible future plantings, the sustainable harvest and rotation age can be determined.

##### **(c) Tactical planning**

Tactical planning is the short term 3-5 year plans developed within Microforest by using the harvesting scheduler and plantation manager and considering all aspects such as roads, compartment and open areas.

Tactical plans are contained within Microforest Management System

(d) Strategic planning

Strategic planning is the long term plan which is developed within Microforest by using the harvesting scheduler and plantation manager. This plan is projected over 30 to 50 years and is used in the business plan.

**16.1.2 Epicollect5**

**Epicollect5** is a mobile & web application for free and easy data collection hosted by Imperial College London. Its being used mainly in managing and monitoring operations in the out-grower support program.

**16.1.3 Accounting System**

Pastel is an electronic accounting application that is used for managing the accounts within the company; it is flexible with customised features that insure that the basic accounting needs are fulfilled. It provides an integrated holistic view of the company through financial management reports.

**16.1.4 Geographical Information System**

Arc View is a high end spatial GIS software program , with spatial editing, attribute table query builder and map layout functions. It has the ability to display large amounts of spatial data with associated attribute data. ESRI products provides a user friendly means to visualise, explore, query and analyse data geographically.

**16.1.5 Payroll**

Arutti is a software package that allows Accounting Department to manage their Payroll preparation through a database system where all computations on salaries, allowances, overtime, taxation and pension contributions are stored and maintained.

**16.2 ISO 14001 Environmental Management system**

KVTC Is certified compliant to the ISO 14001:2015.

ISO 14001 is an environmental management system that gives a clear commitment to environmental management of the organisations environmental impacts.

In addition to setting the framework for monitoring, reporting and mitigation of all impacts, the system benchmarks KVTC with international standards. The system drives continual improvement in terms of environmental management, with compliance to the law as a minimum requirement. and uses compliance to the law as a minimum criterion to manage from.

Annual compliance audits are conducted by ISO 14001 appointed organisations to assess compliance to the ISO 14001 standard.

**16.3 ISO 45001:2018 Occupational Health and Safety System**

KVTC is certified according to the ISO 45001:2018 standard .

ISO 45001:2018 is the International Occupational Health and Safety Management Standard, and is intended to address occupational health and safety (OH&S) rather than product safety.

ISO 45001:2018 provides a framework to the effective management of OH&S including compliance with the legislation that applies to your activities and identified hazards.

KVTC adopted the ISO 45001:2018 standard in order to assist the company to eliminate and minimize the health and safety risks associated with the Forestry Industry. ISO 45001:2018 assists KVTC in eliminate and minimize risks both to its employees and any other stakeholders that is associated with KVTC activities, i.e. contractors.

Implementation of ISO 45001:2018 has provided KVTC with a clear management structure with defined authority and responsibility, clear objectives for improvement, with measurable results and a structured approach to risk assessment. This includes the monitoring of health and safety management failures, auditing of performance and review of policies and objectives.

#### **16.4 Stand and sub-compartment registers**

These are contained within Plantation Manager in the Microforest Management System.

#### **16.5 Harvesting registers**

These are contained within Plantation Manager in the Microforest Management System.

#### **16.6 Accounting registers**

These are contained within the Pastel Management System

#### **16.7 Fire management registers**

These are contained within the Fire Management plan and fire report files.

#### **16.8 Pest management registers**

These are contained within Plantation Manager in the Microforest Management System.

#### **16.9 Open area register**

These are contained within the GIS system and will be incorporated into Plantation Manager in the Microforest Management System.

Open areas in Microforest are treated in the same manner as compartments. Open areas are named / numbered and contain attributes that identify the open area as a uniform entity for management purposes.

### **16.10 Road maintenance registers**

These are contained within the Roads Management plan which will be incorporated into Plantation Manager in the Microforest Management System.

Roads in Microforest are treated in the same manner as compartments. Roads are named / numbered and contain attributes that identify the road as a uniform entity for management purposes. Roads can also be divided into smaller sections or segments, which in turn can be combined to form routes.

### **16.11 Inventory registers**

Financial Inventory register is contained within the Pastel Management System.

Plantation Stock inventory is contained with in Plantation Manager in the Microforest Management System and standing volume simulations are performed with the Harvesting Simulator.

### **16.12 Record storage and retrieval**

Records are stored at the main office.

General Records are filed according to category.

Accounting records are maintained by the accounts and administration manager and are filed according to month and type. Accounting and general records are archived and kept for referencing purposes.

Pastel and Microforest records are electronic and periodical backing up procedures are in place.

## **17 MAPS**

### **17.1 Mapping**

Accurate maps of the planted area and other features such as infrastructure, area of special interest and monitoring sites are prepared electronically with the use of a GIS system. A Flint GPS is used to measure areas and downloaded in to Arc GIS for editing. Parameters such as compartment area and road length can be accurately calculated by the GIS system. The systems also allows the printing of maps of any combination of themes

### **17.2 Topographic maps**

Topographical maps are kept on the GIS system in soft copy as well as in the map cabinet in the planning office. All areas under the control of the company are covered by topographical maps. These maps are used for identification of topographical features such as contours, watersheds, roads, villages and steep terrain.

The company also holds a set of aerial photographs which are used to identify land form features such as tree cover and density which assists the site selection process.

### **17.3 Compartments and roads**

Plantation maps are developed to assist the field staff with identification of compartments in the field. Compartment maps contain the compartment and company boundaries with the compartment number and hectares indicated. These maps are produced annually and reflect compartment ages and TUP.

### **17.4 Settlements, camps.**

Maps have been developed depicting village land areas and villages.

### **17.5 Watersheds and drainages**

Watersheds and drainage lines are available and incorporated into maps.

Streams are classified according perennial and non perennial streams and rivers; this information is kept in the GIS system. The information is used for conservation maps.

### **17.6 Ecosystem maps (vegetation cover, soil types, climatic factors)**

Vegetation cover maps and soil maps were produced for the site selection process which aids the selection of potential teak sites.

Soil samples are collected on a 50 metre grid and depicted on a map according to 5 colour scheme classes for each soil class.

A geological survey classification map by the geological survey of Tanzania is available as a scanned copy.

### **17.7 Forest type classification**

Satellite maps derived from spot 4 satellite images were used for developing stratified maps. The stratified maps represent forest type classifications that were used for the site selection process in determining the possible new sites for teak development. Forest type classification maps are also used for identification and

development of the Miombo area classification such as protected area and sustainable harvesting areas for the management plan.

Satellite image and classification maps are kept in soft copy in the GIS system and maps are printed on demand.



**18 ANNEXES**

**18.1 Annexure 1**

Archaeological sites identified and registered

	Middle Stone Age	Late Stone Age	Iron Age	Recent
	> 260 000 years old	> 10 000 years old	> 300BC	
Nakafulu	9	4	32	2
Mafinji	3	0	5	1
Ichima	0	0	3	0
Narabungu	2	9	5	2

## 18.2 Annexure 2. Policies

### Environmental Policy (2020)

#### Preamble

KVTC recognises that its developments and activities in the Kilombero valley will have environmental impacts in the areas managed by the company. The company will manage its operations in such a way as to minimise the negative effects of these impacts. The company will adhere to all applicable legislation. The company will take account of relevant international / regional conventions, treaties and environmental agreements of the country. The company will adhere to the Global Environment Fund and Finn Fund environmental policy as well as to the ISO 14001:2015 management system as well as the FSC Principles and Criteria governing Environmental Management. The company will achieve this aim by identifying negative environmental impacts and institute a programme of continuous improvement in relation to these impacts. In order to achieve this, the company will operate according to the following principles and monitor its performance in respect of them.

#### Policy

KVTC will promote the conservation of biodiversity within its landholding. A significant portion of the land will be managed with the primary objective of maintaining Miombo woodland related biodiversity. Rare, endangered and protected species or areas that have high biodiversity will be identified and protected from damage. A representative network of habitat types will be preserved. Obstacles to the free movement of animals and plants will be minimised.

There will be a process to identify new knowledge in relation to environmental aspects of sustainable forestry in tropical savannahs.

Exotic trees used in plantations will be prevented from spreading out of delineated plantation compartments. The use of fire by the company will be adapted as closely as possible to natural fire regimes.

The company will minimise its impact on the quantity and quality of water resources. Measures will be taken to prevent the pollution of water bodies by materials used in forestry operations. The loss of water quality due to unnatural siltation from company roads, plantation compartments and other company sites will be minimised. The impact on water quantity will be identified and where necessary management practices will be altered to maintain stream flow.

The company will maintain the productivity of its resource base. Soil erosion caused by forestry activities will be minimised. The nutrient status of forest soils will be maintained over successive rotations.

The company will minimise its use of chemicals and fuels, using them in a responsible way and preventing their spread into surrounding areas. Waste materials will be dealt with in an appropriate manner. Chemicals will only be used as part of an integrated approach to problem management. Chemicals will be stored, transported and used in a manner that minimises the risk of pollution. Waste chemicals, fuels and oils will be recycled or disposed of at a site designated for that purpose. Rubbish will be removed from the plantation system and disposed of at an appropriate site.

Harvesting and transport operations will be planned and executed according to industry best operating standards to ensure minimal impacts to the environment

The processing plant and related infrastructure will be managed in accordance with regulations as set by guiding documents and a comprehensive Environmental Impact Assessment.

The company will monitor developments in the understanding of environmental aspects of its operations and where necessary incorporate these into its environmental management programmes.

The company will identify the needs and expectations of relevant interested parties, external and internal issues affecting Environmental Management system and address them as per company procedures.

There will be a process to organise the results of company led monitoring for management review.

Regular management review will ensure that new knowledge is incorporated into forest management practices.

## **KVTC OCCUPATIONAL HEALTH AND SAFETY POLICY (2020)**

### **19 PREAMBLE**

KVTC recognises that its developments and activities, can have an impact on the Health and Safety of its employees, contractors and visitors. The company will manage its operations in such a way as to minimise Health and Safety risks.

The company will achieve and uphold this policy by continuous measurement of accident and incident rates and by identifying risks and opportunities. Continual improvement will be instituted in relation to these risks.

The company will operate according to the following principles and monitor its performance in respect of them.

#### **1.11. Policy**

1. KVTC will meet all laws and regulations covering Health and Safety of employees and their families. KVTC also subscribes to OHS ISO 45001:2018 standards, IFC Industry Guidelines and FSC Health and Safety related principles.
  - a. Health and Safety guidelines will be accessible to all in company employment.
  - b. Company Management and those employed by the company will be familiar with the contents of the company's Health and Safety guidelines.
  - c. Company management will assess risk to workers with regard to tasks and equipment and take reasonable measures to reduce or eliminate such risks.
  - d. Safety Training will be carried out, appropriate to the tasks and the equipment used as prescribed by the law.
  - e. Workers will be provided with safety equipment appropriate to the tasks and equipment used, as prescribed in the company procedures.
  - f. The company will take reasonable measures to ensure the use of safety equipment by its employees and contractor employees as prescribed in the company procedures.
  - g. The Company will record all work-related accidents and deaths of employees, the causes thereof and record actions taken to prevent similar accidents in the future and implement such preventative actions.
  - h. The company will identify the needs and expectations of relevant interested parties, external and internal issues affecting OHS Management system and address them as per company procedures.
2. KVTC will take reasonable actions to improve the general standard of health and social services in communities directly associated with KVTC.
  - a. The company will assist educational outreach programmes focused on important basic health care issues.
  - b. The company will participate in appropriate economic development in order to assist and achieve sustainable self-help projects.

## LOCAL COMMUNITY RELATIONS POLICY (2020)

### 20 PREAMBLE

KVTC recognises that it operates in the Kilombero valley in order to enhance the quality of life of all its stakeholders. The company will ensure that local stakeholders will be treated in an equitable manner in relation to other stakeholders. The company will adopt policies that promote the realisation of significant benefits in the Kilombero valley. The company will endeavour to ensure that local communities do not suffer losses as a result of the company's activities. The company will adhere to the FSC Principles and Criteria related to Community Relations.

### Policy

- 1) KVTC will adopt a position of good neighbourliness towards local communities.
  - a. The company will have regular communication with all local communities.
  - b. The company will assist local communities in their development in consultation with the communities.
  - c. The company will agree the precise location of its boundaries with neighbouring communities.
  - d. The company will permit the use of Non-Timber Forest Products by the local community when it can be shown to be sustainable and adequately regulated.
- 2) KVTC will develop an in depth understanding of the local communities and their needs.
  - a. The company will carry out a social impact evaluation of its activities.
  - b. There will be a process to ensure that this social impact evaluation is kept up to date.
  - c. Cultural, religious and historical sites will be identified in discussion with the local community and procedures to ensure access and to protect them during forest operations will be developed.
- 3) The company will respect the established customary rights of local communities and develop procedures to ensure that disputes concerning customary rights are dealt with in a manner that is acceptable to all parties.
  - a. A dispute resolution procedure will be agreed with the local communities prior to the existence of a dispute.
  - b. When a dispute exists no forestry activities shall take place in the disputed area without the agreement of the affected community.
- 4) The company will compensate local communities for any damage inadvertently caused to their customary resources or rights in the Forest Management Unit.
  - a. The level of the compensation will be agreed with the affected party.
- 5) KVTC will endeavour to strengthen the local economy.
  - a. The company will give priority to local workers, (areas in which the company operates) for all positions, for which they are qualified.
  - b. The company will in as far as possible source its services and supplies locally.
  - c. The company will make a portion of its production available to local entrepreneurs for local processing.

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Irvine Kanyemba  
*Chief Executive Officer*

## **KVTC LABOUR RELATIONS POLICY (2020)**

### **Preamble**

KVTC recognises that its activities have an impact on the lives of its employees. The company will in accordance with the law of the country as a minimum standard treat all our employees fairly, respect their dignity, well being and diversity. KVTC's objective is to be consistent and fair to all stakeholders. The Company will work towards full compliance with the ILO Fundamental Conventions and with the UN Declaration of Human Rights and adhere to the FSC Principles and Criteria related to Labour Relations.

### **Policy**

In order to achieve the above the company will operate according to the following principles and monitor its performance in respect of them.

1. KVTC will comply with the labour laws of Tanzania.
  - a. A mechanism for annual legal review of policy will be introduced and annually reported to KVTC's Board of Directors.
2. KVTC will take into account its impact on employees, contractors and the local communities affected by its operations and take steps to mitigate any risks.
3. KVTC will not employ forced labour of any kind.
4. KVTC will not employ harmful child labour.
5. KVTC will pay wages that meet or exceed industry legal national minima and are sufficient to meet basic needs.
6. KVTC will treat employees fairly in terms of recruitment, progression, terms and conditions of work and representation, irrespective of gender, race colour, disability, political opinion, sexual orientation, age religion, or social or ethnic origin.
  - a. Employees will be protected from arbitrary dismissal by the institution of a disciplinary procedure that will ensure that employees receive a fair hearing and have the right to representation.
  - b. A policy of no sexual harassment will be followed in the workplace.
7. KVTC will allow consultative work-place structures and associations that provide employees with an opportunity to present their views to management.
8. The rights of workers to organise and voluntarily negotiate with their employers shall be guaranteed as outlined in Conventions 87 and 98 of the International Labour Organisation (ILO).



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Irvine Kanyemba  
CHIEF EXECUTIVE OFFICER

## **KVTC CONSERVATION LAND POLICY (2020)**

### **PREAMBLE**

KVTC was founded on the principle that the commercial utilization of a small area of land can benefit the conservation of much larger areas of land. KVTC has implemented this principle by planting up to 30% of its landholding to teak whilst setting aside the balance of the land for conservation purposes.

The company believes that maintaining open land in its natural state through voluntary land conservation is good policy and that open natural zones of vegetation are a long term benefit to the company as well as the surrounding communities.

Air, water and biodiversity resources are limited resources. By conserving tree canopy, natural vegetation, wetlands, streams and rivers and actively protecting biodiversity, these limited resources are conserved. The maintenance of conservation land reduces the releases of greenhouse gasses, protects soils, provides a refuge for biodiversity and combats the change in rainfall patterns as a result of deforestation.

In addition to the environmental benefits resulting from conservation land there are also economic benefits to the company. Enhanced biodiversity on company land will improve the growing conditions for teak and will enable the company to enter the eco-product markets. Conservation land could also provide additional benefits to communities were the use of non-forest timber products can occur sustainably.

The company will operate according to the following principles and monitor its performance in respect of them.

### **Policy**

1. KVTC will meet all laws and regulations covering Conservation and Land Protection. KVTC also subscribes to the ISO14001 and FSC standards regarding land conservation and environmental protection.
  - a. No evergreen or riverine forests will be converted to teak plantations and will be conserved to maintain its biodiversity value.
  - b. High Conservation Value Areas<sup>1</sup>(HCVA) will be identified. These sites will not be converted to teak plantations and will be conserved
  - c. Management Plans will be developed for conservation areas, and the specific needs of HCVA will be specifically included. Implementation and review of these plans will occur **continuously**.
  - d. Conservation areas and HCVA are frequently monitored for indicators of conservation attributes to maintain and enhance biodiversity. Where necessary management actions will be adapted to achieve conservation goals.
  - e. The design and layout of plantations has been and will be done in such a way that it promotes protection, restoration and conservation of natural forests and does not increase pressure on natural forests. Wildlife corridors, streamside zones and mosaic stands of different age and rotation have been considered in the layout of the plantations.

- f. Any change to the final plantation layout (as achieved in 2011) will only be done after consultation with Conservation Organizations and will ensure that FSC requirements are included
2. KVTC maintains strict rules on activities allowed and disallowed on Conservation Land, and only activities which do not impact on the long term sustainability of the land Where required the enforcement of these rules will be maintained with the use of conservation guards.
- a. Collection of Non Timber Forest Products<sup>2</sup>, which excludes uses that fall in the category of prohibited or non-sustainable activities, such as:
    - i. Thatch grass collection
    - ii. Bee keeping
    - iii. Medicinal plant collection for non-commercial use
    - iv. Household hunting as allowed under Tanzanian law.
    - v. Spiritual and cultural site visits.
  - b. Prohibited Activities:
    - i. Unsustainable or unauthorized Logging
    - ii. Charcoal production from natural woodland
    - iii. Grazing of cattle or other livestock
    - iv. Farming
    - v. Collection of fuel wood
    - vi. Camping
    - vii. Open Fires
    - viii. Hunting

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I KANYEMBA  
CEO

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**1. High Conservation Value Areas** are defined according to the FSC Principle and Criteria as:

- a. Areas containing globally, regionally or nationally significant concentrations of biodiversity values and/or large landscape level areas where viable populations of most/all naturally occurring species exist in natural patterns of distribution and abundance
- b. Rare, threatened or endangered ecosystems;
- c. Areas that provide basic ecological services in critical situations (e.g. water quality or flow, protection against erosion or natural disasters such as cyclones or hurricanes, pollinators);
- d. Areas fundamental to meeting basic economic or bio-physiological needs of local communities or critical to local community cultural identity.

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**2. Non-Timber Forests Products** are defined according to international standards as:

- a. Any commodity obtained from the forest that does not necessitate the harvesting of trees and this includes game animals, fur bearers, nuts, seeds, berries, mushrooms, oils, foliage, medicinal plants, peat, fuelwood etc....

## **ETHICS POLICY (2019)**

### **Purpose**

This policy provides the framework and guidelines on the company's approach to ethical behaviour during the conduct of its business. In the case of KVTC employees, it should be read in conjunction with the company's Staff and Administrative Instructions (SAI).

### **Scope**

The policy applies to all the company's directors, employees, contractors and their employees, consultants, agents and representatives.

### **Policy**

It is the policy of KVTC to adhere to all laws and ethical standards applicable in all jurisdictions it conducts its business. The company will conduct its business lawfully and will do so with honesty and integrity. This will apply regardless of business, market, political, cultural or any other pressures or inducements. KVTC will expect and demand the highest level of ethical conduct underpinned by the guidelines listed below.

#### **Gifts, Favours and Payments.**

- We will not offer or accept anything of value with the purpose of inducing or entering into any business relationship with anyone.
- We will not pay or accept any bribes.
- We will not use KVTC's resources, assets or services directly or indirectly for any personal or improper purpose.

#### **Conflicts of Interest**

- We will avoid any situation which involves or may involve a conflict between personal interests and the interests of KVTC.
- Each individual shall make prompt and full disclosure in writing to the CEO of any issues that may involve conflict of interest.
- KVTC board members should declare to the KVTC Board of Directors any conflicts of interest.

#### **Social Media**

- We will not engage in social media in any way that will damage the reputation of the company.

#### **Integrity and Fairness**

- We will not make any false or fraudulent statements to any parties in connection with preparation of company documents / reports or during audits and inspections.
- We will treat everyone fairly and with respect without regard to race, tribe, religion, gender, marital or family status, disability, age, political affiliation or any other trait.
- We will keep the local communities informed about issues which may affect them.
- We will not take advantage of our position in the company to gain sexual favours from anyone who wants to enter into any business or employment relationship with KVTC.

#### **Confidential Information**

- We will not divulge or use any confidential company information or any other information which might be contrary to the interests of KVTC without prior authorisation from the CEO.

### **Compliance & Review**

Any violation of this policy will result in the offender facing disciplinary action or cancellation of service agreement in the case of non-employees.

Any individual who becomes aware of any violation of this policy shall promptly report to their line manager, any other senior manager or board member.

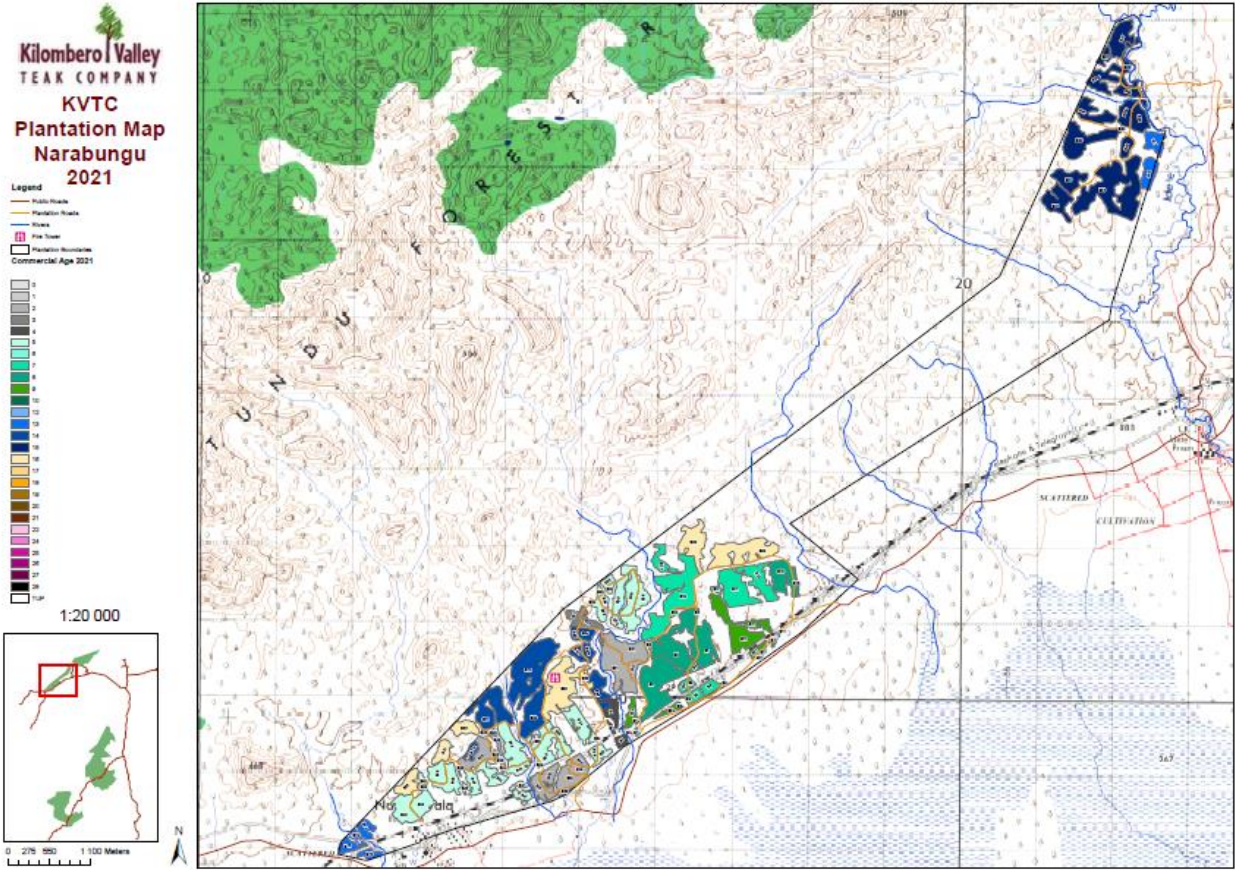
Implementation of the Ethics Policy will be the responsibility of the CEO on behalf of the Board of Directors and will be reviewed annually.

Irvine Kanyemba  
Chief Executive Officer.

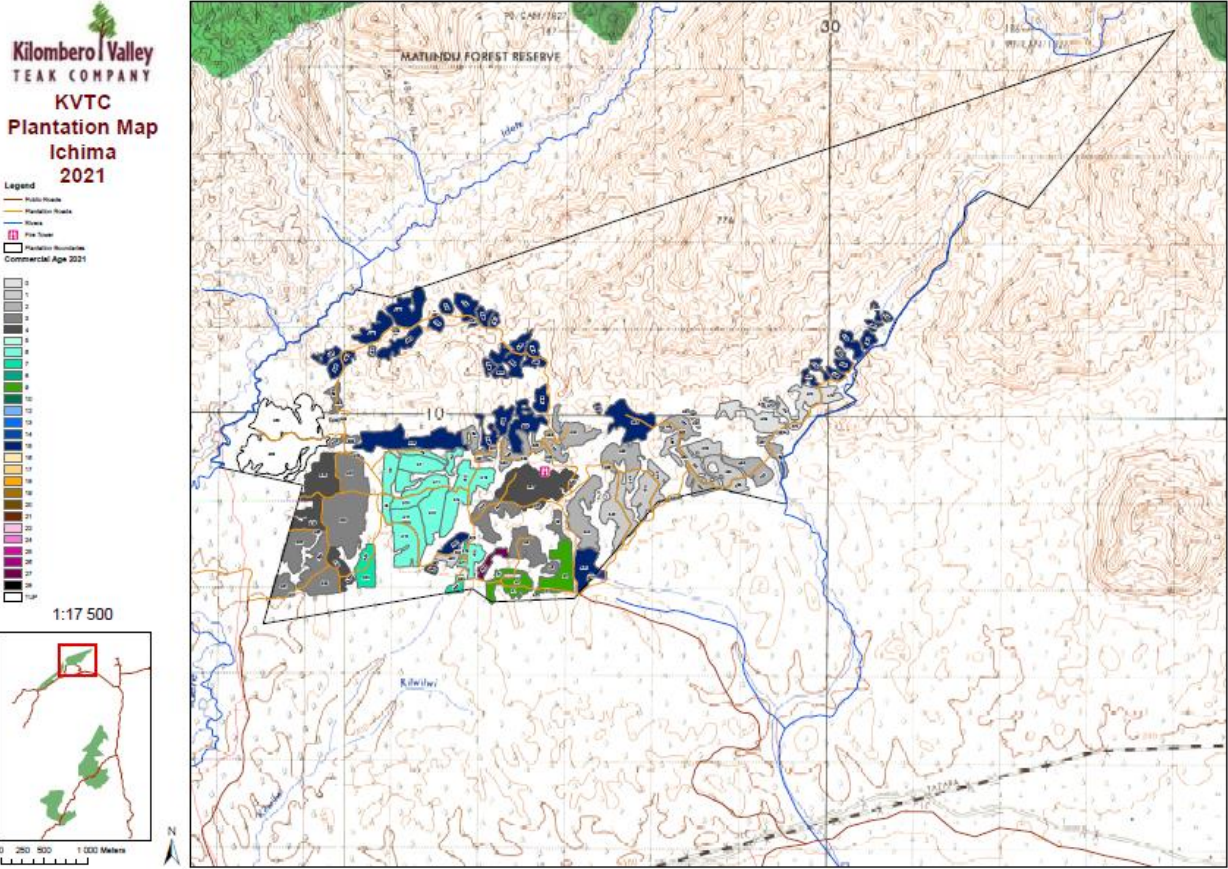


20.1 Annexure 3. Maps

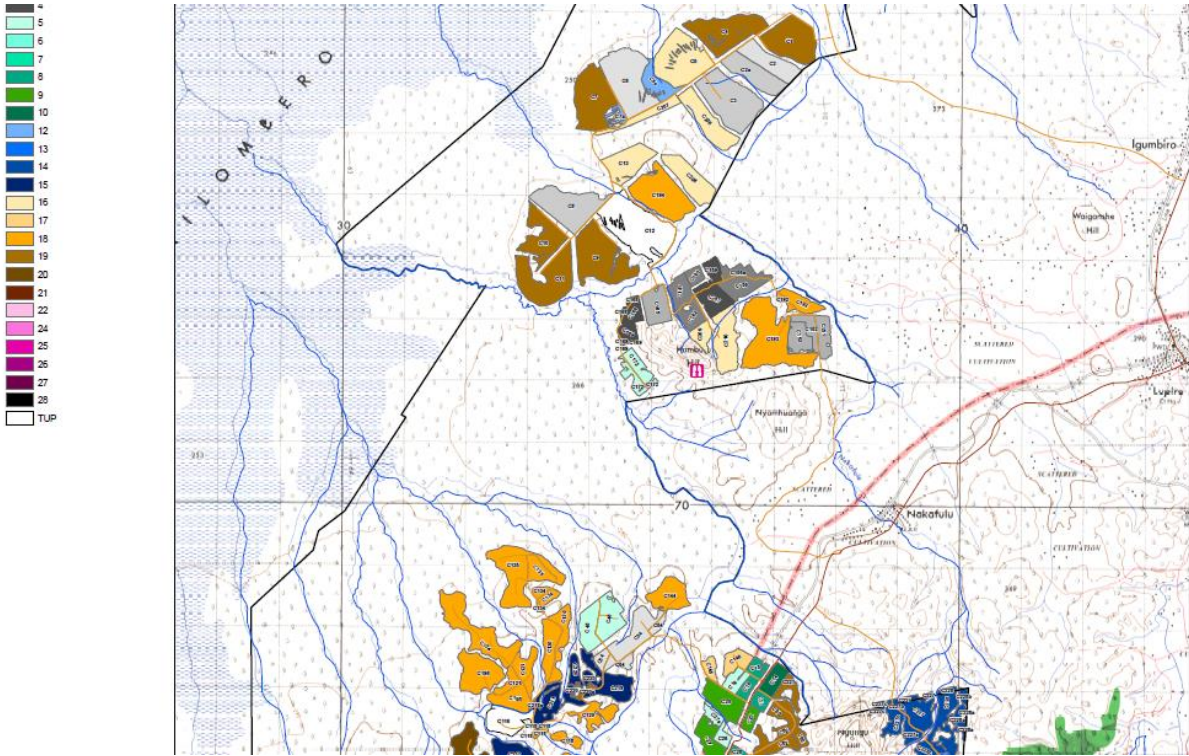
Figure 1: KVTC Land Use Map: Narubungu (2021)



Ichima Land Use Map (2021)



**: Nakafulu Land Use Map (2021)**



### Mafinji Land Use Map (2021)

