

# Forest Management Plan

## For

# BUGAMBA AND RWOHO

## CENTRAL FOREST RESERVES

### For the period 2006-2026



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**Kampala, 2006**

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This forest management plan is based on Section 28 of the National Forestry and Tree Planting Act, 8, 2003 that provides for a legal framework to prepare management. It describes all forestry matters relating to Bugamba and Rwoho Central Forest Reserves and states the activities that ought to be undertaken in the reserves.

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## FOREWORD

Present day forest plantation management poses special problems, which include involving local communities with no previous experience in forest management. They are nevertheless very important stakeholders if the land is to remain under government ownership and tree crops planted there on to survive and be economically productive. It is the expressed policy of the NFA that no communities will be left out in the management of the forest reserves be they natural or plantations.

Bugamba and Rwoho Central Forest Reserves are specifically classified as plantation development forests. The NFA, the private sector and the communities are therefore obliged to undertake the establishment of plantation forest in these reserves. It is therefore necessary that partnerships to achieve this objective are nurtured.

Whereas these are plantation development forests, there are specific management challenges that have to be considered as plantations are established. Rwoho CFR for example contains tree species *Terminalia laxiflora* that has not been reported to occur in other protected areas, i.e. it is not found in any national parks or forest reserves but occurs only in Rwoho. This needs a high degree of responsibility and scientific integrity on the part of the NFA managers. They have to ensure that the species survives and continues to regenerate *in situ*.

Modern plantation establishment requires that natural belts and areas of ecological and high value biological interests are preserves and maintained in their natural state. There are guidelines on how this should be undertaken and the NFA should guide its partners in making sure that these green-belts and protected. It may also be necessary that enrichment planting is undertaken with indigenous species to enrich production of these green belts.

The stakeholders in Rwoho and Bugamba consist of large and medium scale planters; each category has to be catered for. It is our hope that NFA staff will take care of everybody's interests.

## **ACKNOWLEDGEMENTS**

The Forest Management Plan for Bugamba and Rwoho (2006-2026) has been written by a team including forest supervisors Kasimbazi Lemmy R, Otim Sam, Slyvia Nabukwasi, Swaga Aaron, Wasombe Robert, and Harriet Kabasindi; Forest Sector Managers Asimwe Paul and Micheal Aboneka; Southern Plantations Manager David Mununuzi and South Western Range Manager Patrick Musiime.

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Others include Plantations Development Coordinator Kikangi Israel and Acting Field Operations Director Nsita Steve. Carbon project related information was provided by UNIQUE Forestry Consultants. The Environmental Impact Assessment was done by Environmental Assessment Consults Ltd. Stakeholder input was obtained from surrounding communities and the Environment Officers for Ntungamo and Mbarara districts.

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## ACRONYMS

|                |   |
|----------------|---|
| CBO            | Community Based organisation                                  |
| CCBA           | Climate Community Biodiversity Alliance                       |
| CFM            | Collaborative Forest Management                               |
| CFR            | Central Forest reserve  |
| D3&D4          | Vegetation Classification Symbols used by Langdale Brown 1964 |
| DFS            | District Forestry Services                                    |
| FD             | Forest Department   |
| FMP            | Forest Management Plan  |
| FR             | Forest Reserve  |
| FSC            | Forest Stewardship Council                                    |
| G              | Gram  |
| G. o. U        | Government of Uganda  |
| Ha             | Hectare   |
| Kg             | Kilogram  |
| L.N.           | Legal Notice  |
| LC             | Local council   |
| M              | Metre   |
| M.o.U          | Memorandum of Understanding                                   |
| M <sup>3</sup> | Cubic metre   |
| MAI            | Mean Annual Increment   |
| MWE            | Ministry of Water and Environment                             |
| NEMA           | National Environment Management Authority                     |
| NFA            | National Forestry Authority                                   |
| NGO            | Non-governmental Organisations                                |
| NPK            | Nitrogen Phosphate Potassium                                  |
| NTSC           | National Tree Seed Centre                                     |
| PSP            | Permanent Sample Plots  |
| WPA            | Working Plan Area   |

## EXECUTIVE SUMMARY

Bugamba and Rwoho Central Forest Reserves occur in Rwampara, Isingiro and Ruhaama counties of Mbarara, Isingiro and Ntungamo districts respectively. Bugamba is 1,210 Ha and Rwoho 9,000 Ha. They are central forest reserves owned by the government of Uganda and administered by the NFA.

The topography is mid altitude hill ranges from 1,400 metres to 1800 metres above sea level. The area is drained by numerous streams some of which drain in Mishumba river in Rwoho, which itself drains into the Kagera river that is part of the Nile river system.

The parent rock is the Karagwe-Ankolean system made up of phyllites, argillites and arenites. The minimum temperature at Mbarara, 30 km north of Bugamba is 13.7°C and the maximum is 26.6°C. Annual rainfall for Bugamba is 987 mm and falls on 105 rainy days whereas it is 865 mm and falls on 74 rainy days in Rwoho Central Forest Reserve.

The forested areas in both reserves are dominated by *Albizia-Markhamia* tree species, which occur in valleys. As a result of its seral stage, the forest is associated with numerous bush species such as *Carrisa edulis*. Planting of conifer species started in 1956 at Bugamba and 1964 in Rwoho and *Eucalyptus grandis* was used in fire lines. The potential of saw log production has been confirmed by high volume production of tree species such as *Pinus caribaea* var *caribaea* with over 600 m<sup>3</sup>/ha. The area is in low rainfall zone, but its high altitude means that its evaporation is relatively low. This ensures that soil moisture is available for a long period.

With Mbarara town and other small towns in the region urbanising rapidly, the market for saw timber is available for any amount of saw timber, which can be produced. The communities, who are close to the reserves, have been catered for by setting aside areas for their use to plant trees for own benefit.

Fire is the main threat to the productivity of the plantation and fire protection shall be given top priority in allocation of funds and personnel. The surrounding communities depend on the plantation for fuel wood and construction poles. As the plantation occurs on steep terrain, establishment of tree crops and harvesting of mature timber will ensure that they don't cause soil erosion. Opportunities for carbon markets exist and planting of fast growing species will ensure carbon sequestration.

At the start of the last century, the area was well populated with lot of people and cattle. However, they lost their herds to rinderpest and other cattle diseases and the few that survived migrated northwards to Mbarara.

There will be three management circles namely:

1. Sawlog production circle;
2. Biodiversity cnservation circle and
3. Community use of forest land circle.

About 2,100 Ha will be used by local communities, medium scale and large private tree planters under licence. NFA will plant and maintain up to 4000 Ha during the period of this plan. The area of the natural forest will be divided into (1) Strict nature reserve; (2) buffer zone and (3) production zone. The latter will be used to raise broad leaved “hardwood“ timber trees using *Newtonia*, *Maesopsis*, and *Entandroparigma* species. The rest of the production area outside the natural forest will be planted with *Pinus caribaea*. The annual planting program will be 400 Ha for the NFA and 210 Ha for the communities and private tree planters. A road density of 3% of planable area will be aimed at.

Prunning to improve the quality of timber will be carried in three phases up to 10 m high up the pruned trees. Thinning is another operation which will be done in two phases aiming at a final standing trees of 400-500 trees per Ha. This is necessary because it is the final crop that is profitable and the more volume that can be finally cut the more the revenue.

All the activities shall be carried out in such a manner that they are not harmful to the environment. The community has been allowed 380 Ha round the boundary of Rwoho Central Forest Reserve. This will make them important stakeholders. All the activities will be monitored to ensure that principles of good forest management are followed.

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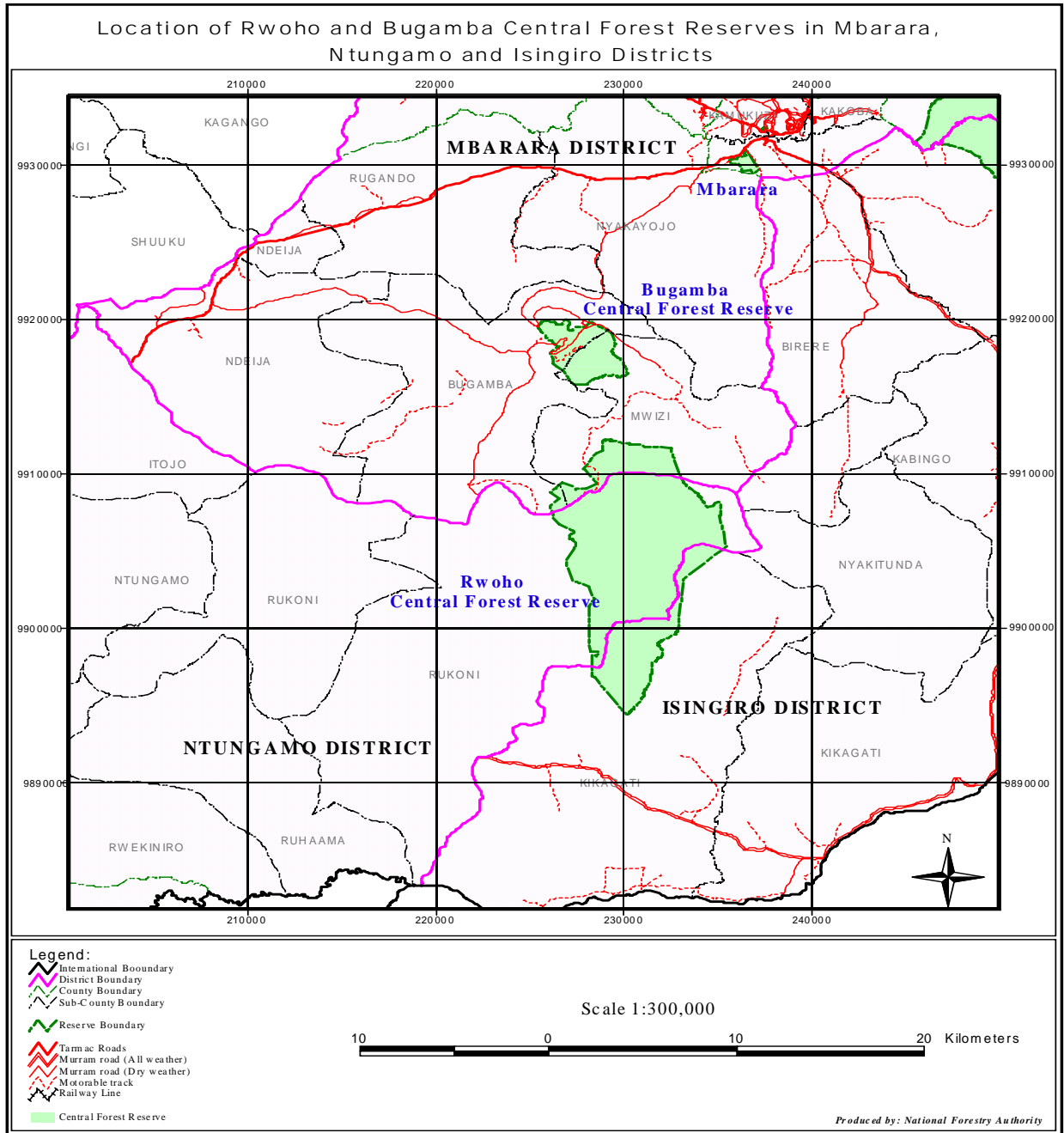
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# 1. PYHSICAL DESCRIPTION

## 1.1 Location, Boundaries and Area

Bugamba and Rwoho Central Forest Reserves are located in Rwampara county of Mbarara District, Isingiro county of Isingiro District and Ruhaama County of Ntungamo District in South-western Uganda. The map below gives the location of the two reserves.



The exact positions of the boundaries are shown on Boundary Plans nos. 1622 for Bugamba and 1606 for Rwoho Central Forest Reserve. Most of the boundaries are artificial, consisting of straight lines which originally ran between earth cairns. Natural boundaries are marked on the oushern side of the Bugamba CFR by the Katokye stream, on the Northern and Southern boundaries of Rwoho by two tributaries of the Mishumba River. It has been established that the south-eastern boundary of Rwoho CFR was straightened by cut lines and it is not by the river tributaries as mentioned in the 1964 to 1973 and 1985 to 1990 Work plans.

**Table. 1: Area of the Bugamba and Rwoho Central Forest Reserves.**

| RESERVE | AREA IN HA |
|---------|------------|
| Bugamba | 1 210      |
| Rwoho   | 9,073      |
| Total   | 10, 283    |

Bugamba Central Forest Reserve lies totally within Rwampara County, 30 kilometres to the South West of Mbarara, covering the ridges and gullies extending from Karamurani Ridges to Rubingo valley. Rwoho Forest Reserve is situated on the boundary of Rwampara and Isingiro Counties and lies to the South of Bugamba Central Forest Reserve. The Reserves cover much high land and many valleys including most of the Western watershed of the Kyezo valley.

## **1.2 Legal status**

The two Central Forest Reserves are managed by the National Forestry Authority (NFA), on behalf of the Government of Uganda based on the National Forestry and Tree Planting Act 8/2003. The reserve was gazetted in 1939 under East Rwampara Reserves (LN No. 257 of 1939; LN No. 275 of 1940). Legal Notice No. 11 of 5th January 1963 left Forest Department in control of Rwoho CFR. The present constitution of the Reserve is contained in Statutory Instruments of 1998 No. 63 supplement No. 23 (Forest Reserves – Declaration Order).

No rights exist within the Forest Reserve save for the domestic use of forest produce subject to the management plan. Section 33 of the National Forestry and Tree Planting Act says in part;

*“Subject to the management plan, a member of a local community may, in a forest reserve or local community forest, cut and take free of any fee or charge for personal domestic use in reasonable quantities, any dry wood or bamboo”*

## **1.3 Topography and Altitude**

Rwoho and Bugamba Central Forest Reserves are located in a series of rounded ridges at an altitude of 1,400 (Mishumba Valley) to 1,800 (Rugarama and Karamurani Hills) meters above sea level. The sides of the ridges are very steep, sometimes more than 45 degrees. The narrow valleys between them have almost level floors, of less than 10 degrees slope where drainage is impeded.

The main block of Rwoho has a large flat-topped ridge running from north to south down its western side, and a very large valley - the Mishumba-running parallel to it, down the eastern side.

#### 1.4 Geology, Drainage and Soils

The underlying rock in both reserves are weathered phyllites, argillites and arenites of Karagwe-Ankolean age, capped above 1,800 m by a sheet of laterites, which frequently contains clay and often stained by iron salts. Peat is commonly found overlying the clay, in valleys.

Soils on the ridges are deep and fertile. On the flanks of the ridges, the soils are 0.5 to 1.0 m deep, well drained and dry out only during severe dry seasons. Narrower ridges and steep slopes contain extremely thin gritty soil or none at all; landslides and erosion in some cases expose the bedrock. The valley bottoms contain deep, dark soils, which are permanently moist even in the dry seasons.

All rivers within the Central Forest Reserves drain southwards into the Kagera River and from there into Lake Victoria. The narrow valleys between the ridges have almost level floors of less than 10 slopes where drainage is impeded. There are streams in almost every valley and in some there are permanent ponds with a slow flow of water through them. The eastern block of Rwoho drains northwards into the Rugaaga River, and into the Mburo-Nakivali swamps.

#### 1.5 Climatic conditions

The minimum average daily temperature for Mbarara town for the period 1960-1993 was a 13.7°C and the maximum average daily temperature for the same area was 26.6°C. Analysis of the trend showed an increase of about 2°C over the period. The temperature for Rwoho plantation is expected to be slightly different due to differences in altitude. The monthly rainfall figures from Bugamba show that there are two annual peaks in March/April and September to November, with the driest period occurring from June to August.

The geographical pattern of the rainfall within the management plan area is also of great importance. Rwoho CFR lies in the middle of an area of comparatively low rainfall which increases to the East and West, decreases to the Northeast. The strongest winds blow during the months of June and August and are from the South and East. The mean annual rainfall and average number of rain days per annum (1974-1983) is tabulated below:

**Table 2: Mean Annual Rainfall (Bugamba and Rwoho CFRs)**

| Station | Mean Annual Rainfall (mm) | Average number of rain days per annum |
|---------|---------------------------|---------------------------------------|
| Bugamba | 987                       | 105                                   |
| Kikunda | 812                       | 73                                    |
| Rwoho   | 917                       | 75                                    |

**Source:** Working plan for Bugamba and Rwoho 1985-1990 by Owen and others 1985.

#### 1.6 Vegetation and existing crop

The area is occupied by two vegetation communities (Langdale-Brown et al., 1964) classified as types D3 (*Albizzia-Markhamia* forest, 45 km<sup>2</sup>: 50%) and the other classified as type Q4 (*Themeda-Chloris* grass savanna, 45 km<sup>2</sup>: 50%) which occurs on hill tops, ridges and hillsides where it is maintained by frequent outbreaks of fire. The forest is partially degraded, mainly because of its proximity to communities and

easy access from all sides. Grazing affects more than 50% of the area. A detailed description of the vegetation is contained in J. Lang-Brown's Working Plan for the period 1964 to 1973.

### **1.6.1 Natural Forest**

Natural forests occur in the valleys with abundant species occurring in almost pure stands in some places, e.g. Rwanduuru valley is *Markhamia lutea* (Mushambya), whose large yellow flowers are a feature of the forest. In other valleys, e.g. Rwa-baranda *Celtis africana* is dominant. *Celtis* has not previously been reported in this area, and it is likely that it was favoured by the removal of the *Markhamia spp.*

The following species are also found in the forest: *Bridelia bridellifolia*, *Pittosporum*, *Spathycalyz*, *Teclea nobilis*, *Carissa edulis*, *Oclea chrysohulla*, *Toddalia asiatica*, *Croton machrostachys*, *Eugenia bukobensis*, *Ehretia silvatica*, *Veronica amygdalina*, *Prunus africana*, *Polyscias fulva*, *Clausena inegalalis*, *Allophyllus sp.*

Some very large trees of such genera as *Albizia* have been seen in the less accessible valleys of Rwoho CFR. All forests in the valleys are highly degraded. Trees are small and natural regeneration is rare.

Colonizing forest appears in many places on the forest edge. A thicket of *Acanthus* and young *Markhamia* may be seen growing up and suppressing trees of the adjacent *Hyparrhenia* grassland, such as *Erythrina abyssinia*, *Acacia sieberiana* and *Combretum ghasalense*. Swamp forest is found growing around small swamps in the valley bottoms dominated by *Mitrogyna rubrostipulata* and *Syzygium guineense*, while papyrus and other *Cyperacea spp* grow on the water.

### **1.6.2 Plantations**

Plantation establishment started in 1964 in Rwoho and in 1956 in Bugamba with *Pinus radiata*. Later other species like *P. oocarpa*, *P. patula* and *P. caribaea* were introduced. Rwoho has the largest area of immature crop estimated at 800 ha ranging from 5 to 12 years. The crop has been tended (thinning and pruning) since 2003. The species planted are mostly *Pinus oocarpa*; *Pinus caribaea* and small areas of *Eucalyptus grandis* and *Cupressus lusitanica*. No assessment of this crop was done and the priority here is to split this crop into compartments.

The current plantation area of Rwoho CFR consists of 12 compartments covering about 1,580 ha. Plantable area is comprised of 1548 ha. Existing fire lines and roads consist of respectively 6.6 ha and 19km (FD, 2001). The current plantation area of Bugamba CFR consists of 13 compartments covering about 1,210 ha. Plantable area is comprised of 960 ha. Existing fire lines and roads consist of respectively 80.9 ha and 25km. (FD, 2001). In total there are about 100,000m<sup>3</sup> of mature crop in both Rwoho and Bugamba CFRs of which 70% are found in Bugamba. A summary of the mature standing crop as of 2005 is presented in tables 3 and 4.

**Table 3: Age and standing volume of existing plantation, Rwoho CFR (Source: FD 2001, NFA, 2005a, NFA 2005b).**

| Compartment no. | Year of planting | Crop condition | Species  | Volume m <sup>3</sup> /ha overbark | Stocked area (ha) | Standing volume (m <sup>3</sup> ) overbark |
|-----------------|------------------|----------------|--|------------------------------------|-------------------|--|
| 2               | 1970             | V. Good        | P. oocarpa                                       | 395                                | 16                | 6,318                                      |
| 3               | 1971             | Good           | P. caribaea                                      | 242                                | 15                | 3,623                                      |
| 4               | 1972             | Good           | P. caribaea                                      | 424                                | 20                | 8,473                                      |
| 5               | 1973             | Fair           | P. patula  | 297                                | 10                | 2,970                                      |
| 6               | 1974             | Good           | P. caribaea                                      | 462                                | 25                | 11,560                                     |
| 9               | 2004             | Good           | P. oocarpa                                       | New crop                           | 6                 | New crop                                   |
| 6, 8,9          | 2005             | Good           | P. caribaea                                      | New crop                           | 92                | New crop                                   |
| 11              | 1992-95          | Fair           | P. oocarpa, P. patula, C. lusitanica, E. grandis | Immature crop                      | 300               | Immature crop                              |
| 12              | 1996-2000        | Fair           | P. oocarpa, P. patula, C. lusitanica             | Immature crop                      | 430               | Immature crop                              |
| Total           |                  |                |  |                                    | 86                | 32,945                                     |

Bugamba has 130 ha of crop left totalling a volume of 75,000m<sup>3</sup> (580m<sup>3</sup>/ha). This crop is mostly *Pinus caribaea* in a good condition. The crop of 37 and 38 years in compartment 12 and 11 has an average of over 639 m<sup>3</sup> per hectare.

**Table 4: Age and standing volume of existing plantations in Bugamba CFR (Source: FD 2001, NFA, 2005a, NFA 2005b).**

| Compartment no. | Year of planting | Crop condition | Species                | Volume m <sup>3</sup> /ha overbark | Stocked area (ha) | Standing volume (m <sup>3</sup> ) overbark |
|-----------------|------------------|----------------|------------------------|------------------------------------|-------------------|--|
| 1               | 1995             | Fair           | P. oocarpa, E. grandis | Immature Crop                      | 29                | Immature Crop                              |
| 6               | 1998             | Fair           | P. oocarpa             | Immature Crop                      | 82                | Immature Crop                              |
| 7 & 9           | 2005             | Good           | P. Caribaea            | New Crop                           | 81                | New Crop                                   |
| 11              | 1967             | V. Good        | P. caribaea            | 659                                | 44                | 28,925                                     |
| 12              | 1968             | V. Good        | P. caribaea            | 619                                | 47                | 28,850                                     |
| 13              | 1969             | V. Good        | P. patula              | 308                                | 14.2              | 4,386                                      |
| 13              | 1969             | V. Good        | P. caribaea            | 488                                | 25.5              | 12,452                                     |
| Total           |                  |                |                        |                                    | 130.2             | 74,613                                     |

## 2 SOCIO-ECONOMIC ENVIRONMENT

### 2.1 Total economic value of the forest

No valuation of the reserve has been done and as such there are several attributes that are under reported. However the potential total asset portfolio includes but is not limited to timber stocks, natural forests and woodland biomass, non-timbers assets held by the wood as carbon, non wood and non timber products such as minerals, water catchments and hydrological services by the forest, provision of habitats for both plants and animals. The area has also been providing grazing ground for the population.

### 2.2 Potential timber and non-wood supplies

Timber supplies will come from standing crop that ranges from five to 12 years. There are 800 ha of this crop in Rwoho. In Bugamba, there are 130 ha of mature crop and the available land at Bugamba can produce as much as 556,800m<sup>3</sup> in one rotation while Rwoho can produce 181,4240m<sup>3</sup> if all the plantable area is planted with tree crops.

### 2.3 Markets, growth statistics and yield

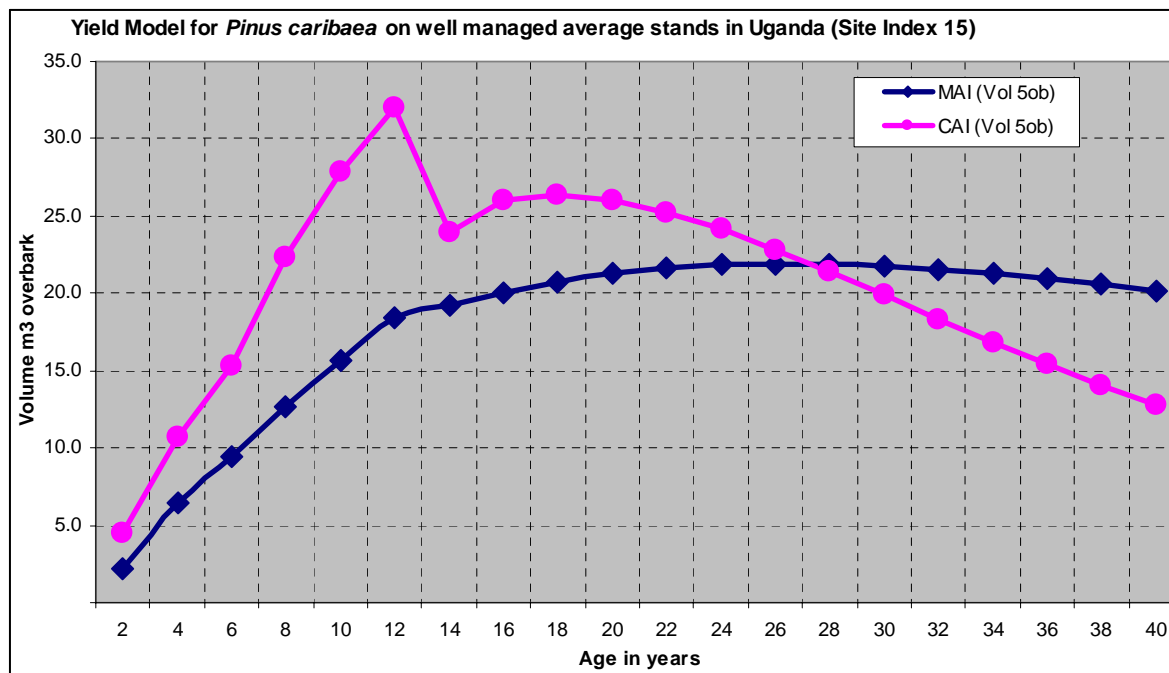
The role played by Rwoho and Bugamba in the forest industry is its ability to supply saw logs to the market. The market for most of the sawn timber from Rwoho and Bugamba is Kampala (300 km away). The local demand for forest products is growing as the urban areas of Mbarara and stability of the neighbouring country (Rwanda and Congo) has created opportunities for supporting a sizeable forest industry. A dam to be put in Kikagati could offer market for utility poles. There are also more dams to be built in the country that will mean additional demand for both saw logs and utility poles.

*Pinus caribaea* being the major species it is known to exhibit excellent early fast growth. It has a small conical crown, small branches, termite resistant, develops a thick bark within three years, which considerably reduces damage impact by fires. It tolerates a wide range of sites including poor sites. It performs well on high altitudes between 800m and 1700m above sea level. The mean annual increment is expected to be about 21 m<sup>3</sup>/ha/year at year 20 as shown in Figure 1.

*P. oocarpa* has similar characteristics to *P. caribaea* except that it is more adapted to higher altitudes than the latter and has a thinner bark.



**Figure 1: Yield and growth of *Pinus caribaea* on average sites in Uganda (D.O. Elungat 2005)**



**Figure 1**

The growth conditions in Rwoho and Bugamba permit different yield for different species. For example the table below shows some of the MAI for different species over the indicated periods.

**Table 5: Mean annual increment of selected tree species in Rwoho and Bugamba (FD, 1985).**

| Species                                 | Merchantable over bark volume in m <sup>3</sup> /ha | Mean annual Increment (MAI) in m <sup>3</sup> /ha/year |
|---|---|--|
| <i>Cupressus lusitanica</i> (1956-1973) | 205   | 12.1   |
| <i>Pinus patula</i> (1959-1974)         | 249   | 13.9   |
| <i>Pinus caribaea</i> (1963-1973)       | 358   | 21.1   |
| <i>Pinus radiata</i> (1960-1964)        | 198   | 9.2  |

## 2.4 Stakeholders and Partnerships

Local communities' dependence on the reserve is visible from the products they depend on and where they are derived from the forest. The main requirements by different stakeholders include water for people and animals, fuel wood for domestic use, local herbal medicines for humans and animals, timber for local and big business people, poles for domestic and commercial construction, grass for grazing animals, poles for tool handles, weaving materials, soils and sand for building, mushrooms and vegetables for domestic use and charcoal for sale in urban areas. The managerial implication of community and stakeholder requirements is that we have to cater for them in planning and implementation.

Forest legislation and other statutory provisions bind NFA to consult and coordinate activities with other institutions e.g. National Environment Management Authority (NEMA), Uganda Wildlife Authority (UWA) and District Forestry Services

(DFS). The Local Government Act 1997 and Decentralization Policy/System also require NFA to liaise with District Local Governments, also reflected in the National Forestry and Tree Planting Act 8/2003 Sections 54(2) (a) to (f).

Until 2004, the reserves of Rwoho and Bugamba were managed by the Forest Department of the Ministry of Water, Lands and Environment. This government institution was restructured and this mandate transferred to NFA. Effective commencement of management by the NFA was in 2004.

Although there are many stakeholders in the area, the management of the reserve is the responsibility of the NFA. However the National Forestry and Tree Planting Act, 8, 2003, requires that the NFA manages the reserves in close collaboration and consultations with the different stakeholder categories.

## **2.5 Threats and conflicts**

Protection of Rwoho and Bugamba against fire, conversion of her land uses and against losses to encroachers and unlawful logging is taken seriously. For the planted areas, detailed annual fire plans are made and followed.

However, there was a period when the country public systems failed due to political upheavals. Then, the forests were not well protected. People entered into the forest and cultivated it, illegal logging took place and fires were not checked. The result was burnt up crops, reduction of tree cover and conversion of the reserve to grazing land. Full control was restored in the early 1990s but financial capacity to reforest the degraded areas was not available.

The managerial implication of this is that fire protection, and boundary patrol systems need to be re-established for a better protection of the reserves. One way is to enlist the support of communities.

## **2.6 Community use of forest products**

The forest is situated in a part of the country with a medium population density (160 people per km<sup>2</sup> in 1991). There is therefore pressure on the forest for firewood, building poles, grazing and other non timber forest products.

The main requirements by different stakeholders include water for people and animals, fuel wood for domestic use, local herbal medicines for self and animals, timber for local and commercial business, poles for domestic and commercial construction, grass for grazing, poles for tool handles, weaving materials, soils and sand for building, mushrooms and vegetables for domestic use, charcoal for sale in urban areas and many more.

## **2.7 Infrastructure**

Currently there are 25 km and 19 km of road within Bugamba and Rwoho CFRs respectively. This is equivalent to a road density of 0.3 km/ha. This is too low and given the area the road density should be at least 3% of total area. This would mean nearly 306.3 km of roads. Since some areas are under conservation, not all the road need be constructed. Moreover some of the road would double as the fire line.

## 2.8 Staff and labour

The current staffing of the two reserves consists of one Sector Manager and four Forest Supervisors. This number is adequate for all the forest operations to be undertaken during the period of this management plan. Moreover, contract labour is readily available and additional responsibility will be devolved to communities under the collaborative forest management.

## 2.9 Revenue and expenditure

### Expenditure

Previous expenditure records cover the costs of labour. For example the total expenditure from 1978 to 1983 for labour was Uganda Shillings 3,918,827 while revenue for the same period was Uganda Shillings 168,029 giving a disparity of Uganda Shillings 3,750,798 (FD 1985). This was partly due the low production as the crop was actually mature. The anticipated revenues and expenditure are detailed in the management costings but selected components are indicated for staff salaries (Table 6) and plantation establishment (Table 7).

**Table 6: Staff Salaries**

| Staff Designation | No. | Salary/annum |
|-------------------|-----|--------------|
| Sector Manager    | 1   | 12,360,000   |
| Supervisors       | 4   | 24,720,000   |
| Total             | 5   | 37,080,000   |

**Table 7: Estimated Plantation establishment costs by NFA**

| Activity                   | Annual target area (ha) | Cost/ha      | Total cost for 10yrs |
|----------------------------|-------------------------|--------------|----------------------|
| Crop establishment         | 400                     | 340503       | 1,362,012,000        |
| Crop protection            | All                     |              | 1,900,000            |
| Road construction Rwoho    | Grade I 12.5Km          | 5,000,000/Km | 62,500,000           |
| Road construction          | Grade II 83.3Km         | 2,000,000/Km | 166,600,000          |
| Road construction          | Grade III 250Km         | 1,000,000/Km | 250,000,000          |
| <b>Sub total for Rwoho</b> |                         |              | <b>1,843,012,000</b> |
| Road construct Bugamba     | Grade 1 3Km             | 5,000,000    | 15,000,000           |
| Road construct Bugamba     | Grade II 20.2Km         | 2,000,000    | 40,400,000           |
| Road construct Bugamba     | Grade III 60.6Km        | 1,000,000    | 60,000,000           |
| Subtotal Bugamba           | 345.8Km                 |              | 116,000,000          |
| <b>Total WPA</b>           |                         |              | <b>1,959,012,000</b> |

**Table 8: Expected revenue for the next 10 years**

| Source of revenue                          | Quantity (m3)  | Expected Amount       |
|--|----------------|-----------------------|
| Mature crop at Bugamba                     | 123513         | 9,263,475,000         |
| Mature crop at Rwoho                       | 32944          | 2,470,800,000         |
| 2 <sup>nd</sup> thinning at Rwoho          | 36500          | 2,737,500,000         |
| Final felling <i>E. grandis</i> at Bugamba | 8,700          | 400,200,000           |
| <b>Total</b>                               | <b>201,657</b> | <b>14,871,975,000</b> |

### 3 ENVIRONMENTAL CONSIDERATIONS

#### 3.1 Biodiversity status

The wildlife resources composition of the reserves of Rwoho and Bugamba is not well documented. Historical documentations were mainly concerned with zoological pests. Among the heritage documented to date are small mammals, birds and butterflies and moths.

**Table. 9: Summary zoological biodiversity values for Rwoho and Bugamba CFRs (Forest Department 1996)**

| Criterion                                     | Birds    | Mammals                 | Butterflies   | Moths | Overall  |
|---|----------|-------------------------|---|-------|----------|
| Total no. of species known                    | 63       | 13                      | 103   | -     | -        |
| No. of restricted range species (< 5 forests) | 0        | 1                       | 8   | -     |          |
| Species unique to forest                      | None     | None                    | <i>Colotis pallene</i><br><i>Henotesia ubenica</i><br><i>Spialia diomus</i> |       | 4        |
| Uganda endemics                               | None     | <i>Crocidura selina</i> | <i>Euphaedra peculiaris</i>   |       | 2        |
| Albertine Rift endemics                       | None     | None                    | None  |       | 1        |
| Species diversity (score & rank)              | 4.7(45=) | 8.8(3)                  | 7.4(19=)  |       | 12(36=)  |
| Species rarity value (score & rank)           | (45)     | 6.5(13)                 | 5.3(18=)  |       | 6.6(24=) |

Large mammals included buffalos, baboons and occasional elephants. These did considerable damage in the beginning of the plantation establishment in the area. However, human pressure and grazing threatened these animals, so much so that the present threat to the young crop consists of mainly domestic animals.

#### Conservation of Biological Diversity

Of the 65 forests investigated for biodiversity, Rwoho ranks 41st in overall importance with a score of 12.0. It is the 3rd in small mammal richness, with a score of 8.8; but the 51st in bird richness, with a score of 7.4. In terms of rarity value, it ranks 27th for trees with a score of 7.4; 52nd for moths, the 13th for small mammals with a score of 6.5; the 45th for birds and the 18th for butterflies with a score of 5.3. The forest supports one tree species, and two butterflies species, which do not appear anywhere else in Uganda's Protected Area System. It also supports two mammals and one butterfly, which are regional endemics, and 5 trees/shrubs, one small mammal and 8 butterflies of restricted range.

#### 3.2 Ecological function (watershed, carbon sequestration)

The reserve serves an important watershed role. It is the source of the river Mishumba that flows through the drier South East to river Kagera. River Kagera flows into lake Victoria to emerge as river Nile.

##### 3.2.1 Potential markets for environmental services

A few thousand hectares of timber plantations remain in Uganda. To meet the growing demand of wood resources in the country and to reduce the pressure on the remaining natural forests in the region Uganda has to substantially expand its wood resources.

There is a potential to allow for involvement of private and community based investors in the establishment of commercial plantations in the Forest Management Pan area. Both softwoods (mainly pine) and mixed broad-leaved native species will be promoted for environmental services through sale of carbon credits to willing buyers within the framework of the Emission Reductions Purchase Agreement.

The conservation market for biodiversity and environmental services that allows for the sales and purchase of endangered species credits to offset negative impacts to endangered species and their habitat are emerging. Investment forums have been created to finance protection of endangered species habitat on private land.

Payment for Carbon credits is one of the environmental services. Other areas include water and biodiversity. The implication of this trend for the Rwoho and Bugamba is that it is now possible to monetize the biodiversity and water and carbon sequestration values of the forest and sell them.

### **3.3 Wetlands, River/stream banks**

The two forest reserves have many streams that supply water to the neighbouring communities who occupy the lower parts of the area. It is important that stream banks are protected by leaving 20m band of natural vegetation, which includes the forest, on either side of the stream, i.e. 40m along the valleys will not be cleared for plantation establishment of exotic tree species. However such areas may be used to raise indigenous timber trees such as *Entandrophragma excelsa*, *Newtonia buchananii* and *Maesopsis eminii*.

### **3.4 Vulnerable/ ecologically fragile areas**

The fact that the land earmarked for plantation establishment occurs on some of the steep slopes, up to 45° in some places, makes it ecologically fragile. In the past landslides were quite common as can be seen in compartment 5 at Bugamba. Establishment of plantation forest trees prevented soil erosion and landslides. The old local community testify to the fact that planting trees on steep slopes is the best land use option compared with cattle grazing which was the practice prior to 1956 when the first crop of trees was established. However, it is vital, that strips of natural vegetation are left between planting lines and that alignment of planting rows should follow the contour lines and not up and down the slope. Spot hoeing rather than line hoeing should be practiced because the fragile thin soil may be eroded. Fire protection is also important, not only for tree crop protection, but also against exposing the topsoil to the force of erosion.

### **3.5 Social-cultural sites**

The social-cultural sites are found all over the area in Bugamba and Rwoho, they are marked by *Ficus natalensis* trees that are traditionally used to mark gates of cattle kraals. The people who used to occupy these sites moved to Kashari and Nyabushozi counties, to the north of the Forest Reserves, and nobody has ever claimed the ownership of such sites. It should be noted that the Banyankore who used to be in that area were more interested in cattle than plots of land.

### **3.6 Problems and issues**

The following are potential environmental concerns in the areas as identified during the preparation of the management plan. The managerial implication of all these

positive and negative impacts on the environment are that people need to be taken into account and mitigation measures suggested. A detailed EIA report is attached.

### **Current Environmental Problems**

- Annual Fires: Set by hunters for honey and wild animals, grazers, from neighbourhood gardens and slash and burn.
- Grazing: By animals owned by communities living in the area, leading to erosion and trampling of the soils.
- Charcoal Burning: High demand for fuel and charcoal from the nearby communities and urban centres.
- Illegal cutting and felling of logs: Impoverished communities and business interests fuel the practice. Over 15 pitsaws were confiscated between 1991 and 1996, having been found to be illegal.
- Potential Environmental Problems when plantations work is undertaken
- Erosion: disturbance of the forest under storey and soil occurs, increases susceptibility to soil erosion.
- Slope Stability: road cuts across sloping land and clearing of vegetation on slopes can result in landslides.
- Structure: compaction and loss of organic matter may lead to changes in soil structure, reduced infiltration, and water holding capacity, aeration and root penetration, also laterization.
- Species composition: species diversity in the planted area will be decreased.
- Weeds: weed invasion may increase on opening area for plantation development.
- Slash: logging debris can be a fire hazard and can impede regeneration of preferred tree species.
- Dust: Logging activities and log transport on stone dirt roads can generate large amounts of dust in dry season conditions.
- Wildlife habitat: large mammals will reduce in number as they pose threat to planted trees.
- Extremes of flow: soil infiltration and water holding capacity of plantation area may be reduced, leading to runoff and some flooding.
- Contamination: pollution from petroleum products, herbicides and organic wastes associated with logging operations.
- Local economic and social customs: impacts on labour market and labour availability for food production; a shift to a more cash-based economy, alteration of daily living patterns and political power structure changes can occur.
- Land tenure and traditional forest uses: hunting, gathering and traditional exploitation of forest resources may be disrupted; limited access to forest resources by local populations of people.

## 4 HISTORY OF MANAGEMENT

The objectives of management for Rwoho and Bugamba over the years have been to grow softwoods cheaply for:

- ◆ the production of utility sawn timber by the end of the century,
- ◆ to protect water supplies arising from the reserves,
- ◆ to preserve an area as the strict nature reserve, and
- ◆ to conserve indigenous flora and fauna.

The reserves had been managed from Mbarara District Forest Office and local offices at Kikunda and Rwoho. The latest Working Plan covers 1st July 1985 to 30th June 1990 and prescribes for the extensive planting of Pines, the mode of harvesting of the planted area and the area to be planted. The protection of the natural forests in valleys as Nature reserves was stressed. The Working Plan is aimed at plantation management.

Since 1992, with the support of the EC-financed Natural Forest Management and Conservation Project, approximately 30 km of boundary were re-demarcated by cut lines, all of which were successfully planted with marker trees (*Eucalyptus*, *Ficus* and *Erythrina spp*) at 50 m intervals.

Old records to be found in the District Commissioner's Office in Mbarara show clearly that a large area in central, south and east Rwampara, and what is now west Isingiro, i.e. the area covered by this plan, was well populated at the beginning of the century, and possessed scattered forests, mainly in the valleys. History records that in the 1920s there was a progressive abandonment of these areas due to rinderpest, a cattle disease which killed a lot of cattle and made the cattle farmers move to Kashari County to the north of the area.

The exodus may well have been hastened by failures of the rains. There is still clear evidence of former occupation in the form of groves of *Eucalyptus* and *Ficus natalensis* trees in the middle of Rwoho CFR. The migration took place northwards towards Mbarara, around 1930 the county headquarters at Mwizi was abandoned, together with an administrative rest house there and at Rwoho Village; the road between them fell into disuse, and The Catholic Mission at Rukarabo was closed. By 1940 there were only a few villages left near the northern boundary of the reserve, which was further north than it is now, and only two villages on the top of the hills which form the county boundary. Later these were all abandoned.

The current population around the reserves of Rwoho and Bugamba is 141,383 distributed in four subcounties of Mwizi (26,136), Bugamba (28,822), Rukoni (44,401) and Kabuyanda (42,024). Bakiga, then Banyankole and Banyarwanda dominate the ethnic groups.

## 5 MANAGEMENT CIRCLES AND OBJECTIVES

A well managed Rwoho and Bugamba CFRs will contribute to a “sufficiently forested, ecologically stable and economically prosperous Uganda.”

To achieve this Rwoho and Bugamba CFRs will be managed on a sustainable basis producing timber and non-timber forest products and environmental services in co-operation with local, national and international stakeholders.

### 5.1 Management Circles

Bugamba and Rwoho Central Forest Reserves shall consist of three management circles.

- A. **Sawlog production management circle** will cover all the plantable area in Bugamba and Rwoho CFRs, Private Sector Planting, Community Planting, existing plantation area, and the wooded area outside the nature reserve. The area available for this circle is about 7,000 Ha in Rwoho CFR and another 1,000 in Bugamba CFR.
- B. **Biodiversity conservation and protection management circle.** This will cover areas of Rwoho located in the northern half of the reserve and where remnants of the former natural forest still occurs. It will also include all wetland and valley bottoms. The area available for this circle is about 2,977.4 Ha in Rwoho CFR and another 210 in Bugamba CFR.
- C. **Community and private sector management circle.** This will cover areas of Rwoho that will involve community and private sector participation in the implementation of the management objectives. They include those areas designated as Community planting through a Collaborative Forest Management Agreement, existing plantation area, allocations to private tree planters and the wooded area outside the nature reserve.

**Table: 10 Management Circles by area (see also map below)**

| CIRCLE                              | DETAIL   | AREA (HA) |
|-------------------------------------|--|-----------|
| Sawlog Production Management Circle | All Plantable Area in Bugamba CFR  | 1,000     |
|                                     | All areas in Rwoho CFR designated as Carbon Block 1                              | 402.4     |
|                                     | All areas in Rwoho CFR designated as Carbon Block 2                              | 334.1     |
|                                     | All areas in Rwoho CFR designated as Carbon Block 3                              | 319.2     |
|                                     | All areas in Rwoho CFR designated as Carbon Block 4                              | 325.0     |
|                                     | All areas in Rwoho CFR designated as Carbon Block 5                              | 410.8     |
|                                     | Community Planting Areas adjacent to Carbon Blocks 1, 2, 3, 4 and 5 in Rwoho CFR | 346.7     |
|                                     | Other Community Planting Areas (Non- Carbon) in Rwoho CFR                        | 58.1      |
|                                     | Existing Plantation Area in Rwoho CFR  | 1480.4    |
|                                     | All areas allocated to private tree planters in Rwoho CFR                        | 2406.0    |
|                                     | All Wooded areas outside the Nature Reserve in Rwoho CFR                         | 931.8     |



*Bugamba and Rwoho CFRs Forest Management Plan*

| <b>CIRCLE</b>  | <b>DETAIL</b>  | <b>AREA (HA)</b> |
|--|--|------------------|
|  | <b>Total Area for Sawlog Production Management Circle</b>                                      | <b>8,014.5</b>   |
| Biodiversity conservation and protection management circle | All areas designated as Valley and wooded areas in Bugamba CFR                                 | 210.0            |
|  | All areas in Rwoho CFR designated as Strict Nature Reserve in Rwoho CFR                        | 1,302.0          |
|  | All areas in Rwoho CFR designated as valley and wet-land but outside the strict nature reserve | 743.6            |
|  | All Wooded areas outside the Nature Reserve in Rwoho CFR                                       | 931.8            |
|  | <b>Total area for Biodiversity conservation and protection management circle</b>               | <b>3,187.4</b>   |
| Community and private sector management circle             | Community Planting Areas adjacent to Carbon Blocks 1, 2, 3, 4 and 5 in Rwoho CFR               | 346.7            |
|  | Other Community Planting Areas (Non- Carbon) in Rwoho CFR                                      | 58.1             |
|  | All areas allocated to private tree planters in Rwoho CFR                                      | 2,406.0          |
|  | All Wooded areas outside the Nature Reserve in Rwoho CFR                                       | 931.8            |
|  | <b>Total area for Community and private sector management circle</b>                           | <b>3,742.6</b>   |

## 5.2 Management objectives

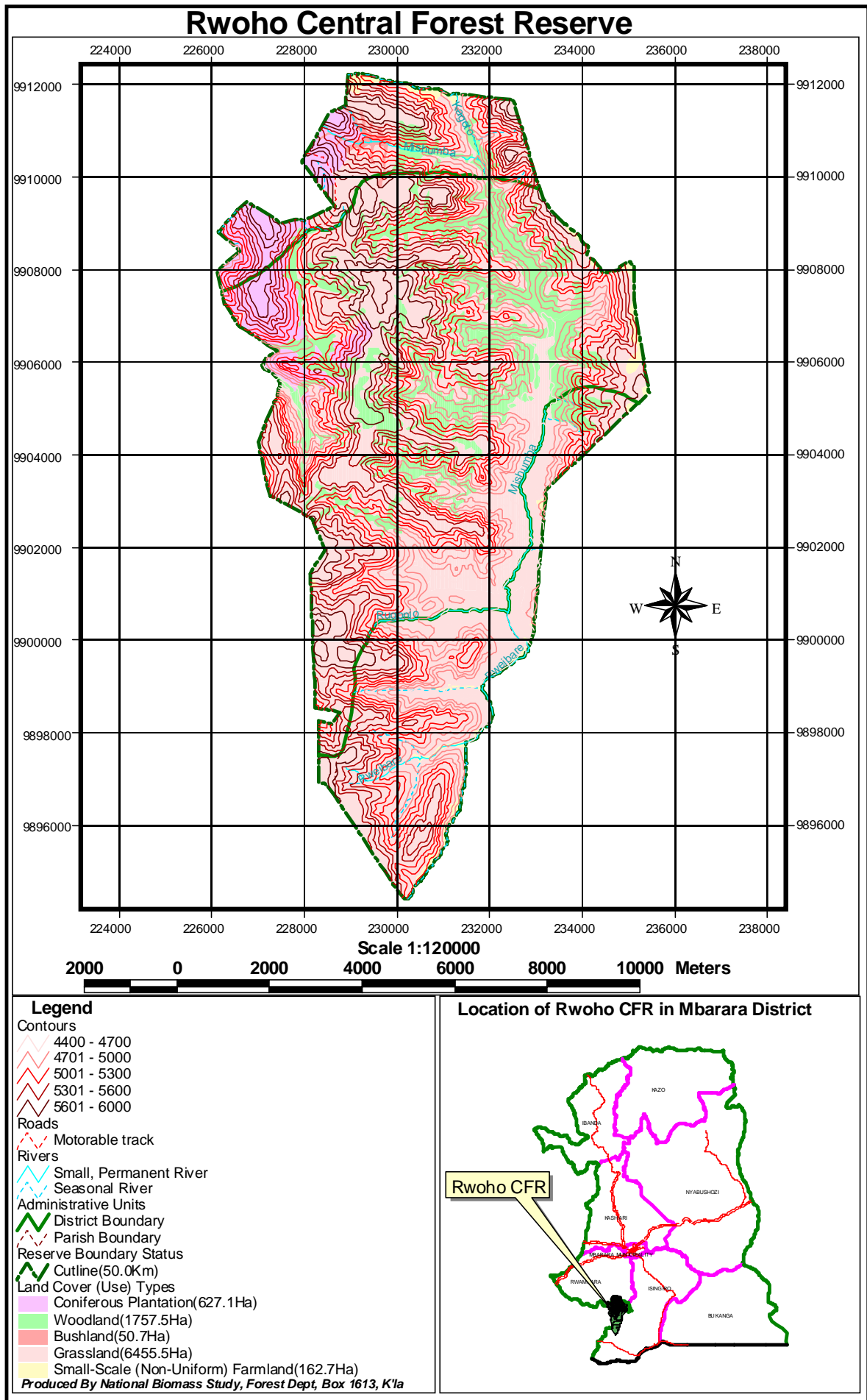
The forest will be managed according to internationally recognised standards in particular those of the Forest Stewardship Counsel (FSC) and The Climate, Community & Biodiversity Alliance (CCBA). The management will integrate community-based groups and respect their livelihoods needs. Details of the management objectives as linked to the resources being targeted per management circle are tabulated below.

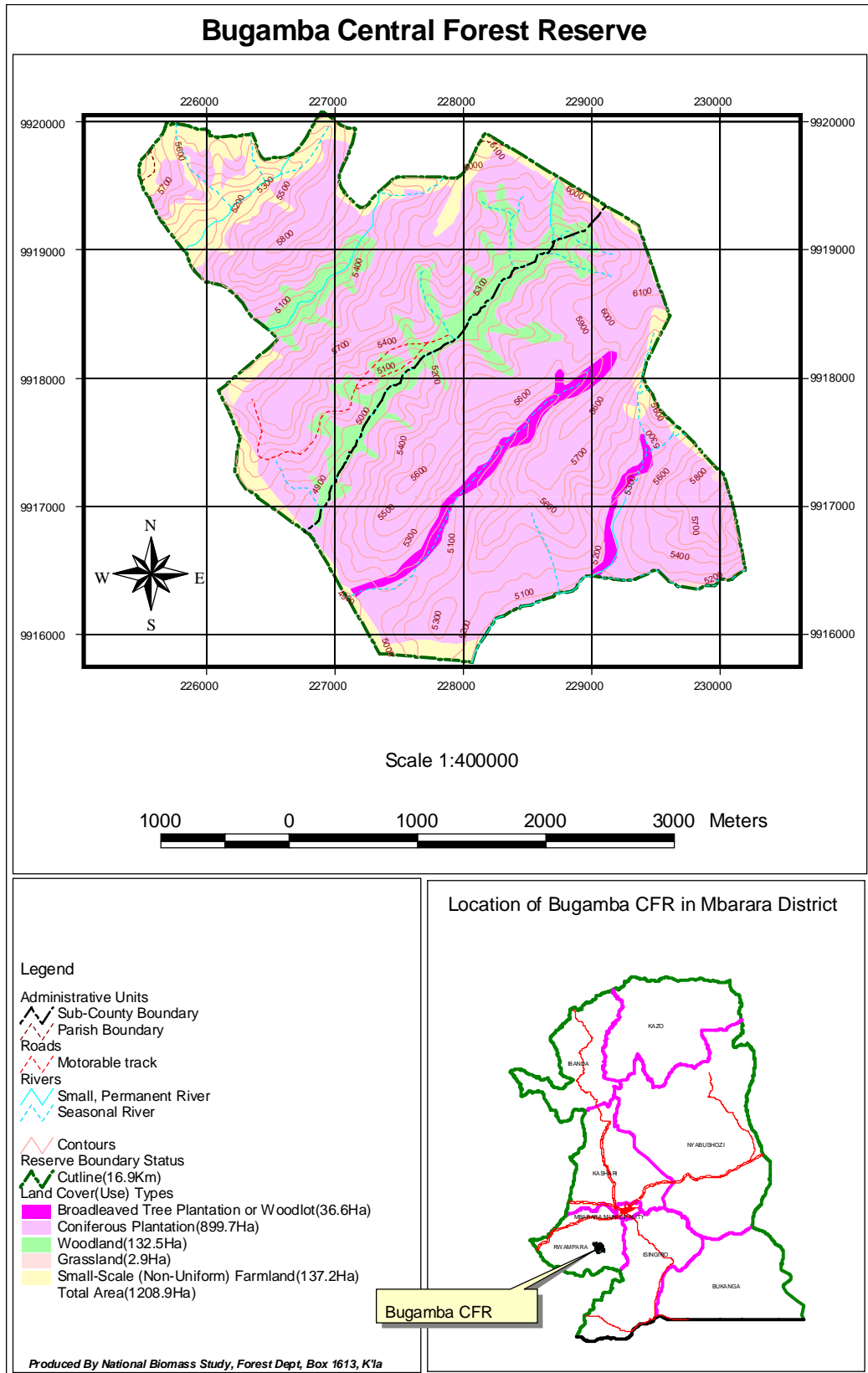
**Table: 11 Management Objectives per management circle and resources targeted**

| <b>MANAGEMENT CIRCLE</b>                                   | <b>RESOURCE TARGETED</b> | <b>TAR-</b> | <b>OBJECTIVE FOR EACH RESOURCE</b>   |
|--|--------------------------|-------------|--|
| Sawlog Production Management Circle                        | Timber                   |             | To increase the area planted for timber production   |
|  | Carbon                   |             | To generate Kyoto and where necessary non-Kyoto compliant carbon offsets in Rwoho CFR      |
|  | Financial                |             | To turn the cash flow from negative to positive and to maintain it as a positive cash flow |
|  | Protection               |             | To maintain forest health and protect the forest   |
|  | Community livelihoods    |             | Integrate community forest needs into forest management activities                         |
|  | Research                 |             | Establish and maintain research plots  |
| Biodiversity conservation and protection management circle | Biological Diversity     |             | To maintain and where possible enhance the biological and nature conservation values       |
|  | Watershed                |             | To retain and enhance soil and water quality   |
|  | Protection               |             | To maintain forest health and protect the forest   |

*Bugamba and Rwoho CFRs Forest Management Plan*

| <b>MANAGEMENT CIRCLE</b>                       | <b>RESOURCE TARGETED</b> | <b>TAR-</b> | <b>OBJECTIVE FOR EACH RESOURCE</b>  |
|--|--------------------------|-------------|---|
|  | Community livelihoods    |             | Integrate community forest needs into forest management activities                                |
|  | Timber                   |             | To increase the area planted for timber production  |
|  | Research                 |             | Establish and maintain research plots   |
| Community and private sector management circle | Timber                   |             | To plant and raise trees on land allocated to communities in accordance with acceptable standards |
|  | Biological Diversity     |             | To promote natural forest regeneration  |
|  | Protection               |             | To protect natural forest from illegal activities   |
|  | Community livelihoods    |             | To support community livelihood activities compatible with forestry                               |





## 6 PLANNED MANAGEMENT ACTIVITIES

### 6.1 Sawlog Production Management Circle

The Sawlog production management circle will cover all the plantable area in Bugamba CFR and will cover all areas of Rwoho designated as carbon blocks (for the Nile Basin Reforestation Project), community planting, existing plantation area, allocations to private tree planters and the wooded area outside the nature reserve. The area available for this circle is about 7,000 ha in Rwoho CFR and another 1,000 in Bugamba CFR.

#### **To increase the area planted for timber production, the following activities will be undertaken in Rwoho and Bugamba CFRs:**

- All the area classified for planting shall be fully planted by the 10<sup>th</sup> year of this management plan. These areas include all areas designated as carbon areas, community planting areas, private tree planting areas and existing plantation areas. The area involved here is about 7,000 Ha.
- Management of these areas is detailed below but in any case the timber volumes produced from Rwoho and Bugamba CFRs shall be monitored to make sure that they are within the range expected of the area planted.
- Community and private planting activities will be monitored to ensure that the area licensed to them is planted in accordance with the license offer conditions.

#### **To generate Kyoto and where necessary non-Kyoto compliant carbon offsets in Rwoho CFR**

- All the activities necessary for the generation and delivery of the first 261,221 (two hundred and sixty one thousand, two hundred and twenty one) ERs generated by the Project as set out in Schedule 2 of the ERPA and the optional 150,000 (one hundred and fifty thousand) ERs generated by the Project Activity once the Contract ERs have been transferred to the Trustee in accordance with the same ERPA with the IBRD shall be undertaken in Rwoho CFR.
- A PDD shall be prepared and registered with the UNFCCC
- All verifications for “Uganda Nile Basin Reforestation Project” shall be undertaken

#### **To maintain forest health and protect the forest, the main activities shall be to:**

- Control the occurrence or spread and increase in populations of weeds, pests, insect and fungal attack
- Monitor and manage fire through strict adherence to the fire safety and rules, to procure and utilise equipment and to enlist the cooperation of adjacent communities in fire management.

**To Integrate community forest needs into forest management activities**

- The staff will supervise the plantation activities of areas allocated to communities
- The staff will involve community members in the plantation activities of the forest

**For research purposes,**

- Research plots shall be established and assessed every five years.

**6.1.1 Existing plantations**

Plantations consist of mature, young and new plantings. The mature crop will be harvested from 2006 to 2011. The young crop will be thinned and pruned as per tending schedule and will be clear felled at age 20. The new plantings are those of less than 3 years. These will be weeded and tended as per schedule of operations in the guidelines.

**6.1.2 New planting**

This consists of 4,000 ha of new planting by NFA and 2,100 ha by the private sector. The private sector consists of local community and medium/ small-scale investors who will establish commercial plantations mainly of conifer species.

The annual planting programme will be 400 ha by NFA, and 210 ha by the private sector for the first ten-year period. Thereafter NFA will plant 200 ha annually in order to establish all aged plantation for sustained production.

**6.1.2.1 Compartments**

These will be demarcated in advance of planting at Rwoho and will be in the region of 30 to 50 hectares. The boundaries will follow natural features such as ridge tops or rivers or permanent artificial features such as roads and fire lines. They will be serially numbered. At Bugamba existing compartment will be retained.

Compartments will be homogenous in species composition and year of planting. If however variability within a compartment is unavoidable, division into sub compartments will be necessary. Each sub compartment must be homogenous in age and planting stock, and every effort should be made to simplify boundaries and maximize the area. Sub compartments will be identified by the number of the compartment in which they are located, with letters suffixed in alphabetical sequence. Sub-compartment boundaries may be changed but only at time of clear felling in order to prevent discontinuities within stand histories.

**6.1.2.2 Road construction**

There will be three classes of different road widths that will be constructed. A width of 7m will be for class one (primary roads), 5m for class two (secondary roads) and 4 m for class three (tertiary roads). Class one roads will be all-weather murrum while class two roads will join from the primary roads and both will be constructed ahead of planting. Class three will be fully opened during harvesting but can act as fire-breaks and compartment/ sub compartment boundaries.

This being a hilly terrain, all roads will be carefully surveyed and aligned in such a way that steep gradients are avoided to minimise erosion. Adequate side drains, culverts and bridges will be constructed to minimise impact of water runoff.

**Table 12: Required road system**

| Plantation | Plantation area (ha) | Road class 1 (km) | Road class 2 (km) | Road class 3 (km) | Total km | Total (ha) | Road intensity (%) |
|------------|----------------------|-------------------|-------------------|-------------------|----------|------------|--------------------|
| Rwoho      | 5,000                | 12.5              | 83.3              | 250.0             | 345.8    | 150.4      | 3                  |
| Bugamba    | 1210                 | 3.0               | 20.2              | 60.6              | 83.8     | 36.5       | 3                  |
| Total      | 6,212                | 15.5              | 103.5             | 310.6             | 429.6    | 186.9      | 3                  |

**Width:** Width for forest roads will be 5 m, to be increased or decreased, depending on purpose. A width of 7 m for class I roads, 5 m for class II roads and 4 m for class III roads will be left unplanted along these road traces during road alignment. Class II and I will be all weather and constructed ahead of planting while, class III will be completed during harvesting. The planned ratio of intensity of road classes **I, II and III** is 0.25%, 1.7% and 5% respectively.

**Gradients:** The maximum gradient for forest roads will normally be 1/15 (6°), but in plantations gradients of 1/9 (10°) with the load and 1/12 (7.5°) against the load shall be used for distances not exceeding 400 m, if cheaper and shorter alignments are thereby secured. In most forest areas, avoidance of soft ground is generally more important than gradient and alignments shall make the best use of well-drained ridges and firm murrum outcrops.

**Bridges and Culverts:** Concrete culverts shall always be used in preference to wooden bridges on all except entirely temporary tracks. Bridges and culverts in plantations shall be designed to take a ten tonne static load plus 25% safety margin. The minimum width will be 3.6 m.

**Curves:** Minimum radius is 10m at the centre line (12 m is preferable) based on the turning radius of a seven tonne truck with a sight distance of 20-50m.

**Camber:** Proper camber shall be constructed and maintained on all roads, except the most temporary tracks, to expedite drainage.

### 6.1.2.3 Fire management system

Firebreaks will be opened along all boundaries where softwood plantations lie adjacent to unplanted areas in order to minimize the possibility of fire spreading into the plantations from external areas. Firebreaks will be 6 m wide and cleared of vegetation at the onset of the dry season in June and December. Controlled burning and hoeing will be used to do clearing. The officer in charge will be responsible for ensuring that all safety precautions are adhered to. Where plantations extend to cultivated lands it is only necessary that good liaison is maintained with the land owner and if necessary, assistance is given to him/her to ensure fire safety of the fields.

Preparation of "Fire safety rules" and procurement of equipment shall be completed for Rwoho and Bugamba by May 2006 and in any case not later than November of each year.

Preparation and implementation of a forest fire and control plan specifying among other things, area covered, access routes and location of water points and proposals for the construction of new water points shall be done by May 2006 and in any case no later than November of each year. Staff training and public education on the dangers of fire and fire suppression measures for local communities will be held every May and November.

#### **6.1.2.4 Site species matching**

Main species to be planted will be *P. caribaea*, *Maesopsis eminii* and *Prunus africana*. *P. caribaea* will be planted on the hill tops and slopes while *Maesopsis eminii* and *Prunus africana* will be planted in the valley bottoms and sheltered sites. Other species albeit on smaller scale will be *Entandrophragma excelsa*, *Newtonian buchananii*, and *Albizzia corriaria*

An area designated as carbon area will be stocked with 75% *Pinus caribaea* an already introduced and tested species in the area. In addition 20% *Maesopsis eminii* and 5% *Prunus africana* will be planted. From the latter species the bark and the timber will be used. Pine will be managed on a 20-year rotation cycle while *Maesopsis* will be managed on 30-40 year rotation. The target diameter for pine is an average of 35 cm DBH and 45 cm for *Maesopsis eminii*. *Prunus africana* will be managed for bark production in a 10-year rotation period. The areas designated as carbon areas will be established in five small scale units of 350-450 Ha each but the plantation will be established in compartments of 25-50 ha each. Around each compartment a fire line of 4 m width will be maintained.

#### **6.1.2.5 Plantation establishment**

Planning is an integral part of plantation development as the activities are weather dependent and must be carried out timely in order to avoid heavy losses and realize impact/effectiveness. The following are some of the major activities that will be undertaken in plantation establishment.

##### **Survey and compartmentation**

The area earmarked for plantation will have to be surveyed first. This will involve dividing it into compartments and sub-compartments. Also areas not to be planted like natural belts roads and firebreaks will be marked off and be separated by boundaries, which will be 10-20 m wide. These boundaries can also be used as roads and firebreaks.

##### **Bush/ initial clearing and ground preparation**

The cleared bush and other debris will be cut down and rotted well ahead of planting. Simple hand tools like machetes will be used since the bush is not heavy and does not require use of bulldozers.

##### **Plant spacing, lining out, marking and pitting**

**Spacing:** Planting distance for pines will be 3.0m x 3.0m such that the number of plants per ha is not less than 1111. This spacing is cost effective where improved seed-orchard seed is used. However, in case of failure to procure improved seed, spacing of 2.7m x 2.7m will be used for Eucalyptus and pines.



### 6.1.2.6 Planting

Most of the planting will be carried out during April-May rainy season or during the September-November rainy season. The later season is more reliable and lasts longer up to the end of January. Most of the planting therefore should be done during this season. It will be carried out when moisture build up has been achieved.

All the planting shall be done as quickly as possible; therefore pitting shall be done before the rains start. The plants shall be taken out to the planting site and planted immediately. When planting has been completed, a stock checking shall be done to check that the stocking is correct, and to see if beating up (replacement planting) is necessary.

In drier areas and steep slopes it is important to form a temporary water basin around the base of the tree to encourage water penetration, whenever it rains. In order to eliminate unnecessary cost of replacement planting (blanking) and at the same time to ensure adequate stocking of the crop, replacement planting will normally be done during the same planting season i.e. in the middle of the season when initial planting is carried out. If, however, there is no surplus of good plants after the major planting, then surplus plants for the next season may be used for planting early during the next rains.

A 10% assessment of survival will be carried out two weeks after planting. Assessments shall be carried out in plots of 5 by 5 trees in size. Survival of 90% or more for any block will be considered adequate under all circumstances and will not be beaten up except for isolated areas. Where survival is less than 90%, replacement planting will be done. In case of failure to carry out replacement planting (beating up) in the same season when planting was done, it will be carried out first in the next season before any major planting is carried out and with the best plants.

### 6.1.2.7 Plantation maintenance

#### Weeding

The first three years are particularly crucial. By the third year the conifer species will begin to close canopy and there is no more need for weeding. However, Eucalyptus may close at 1-2 years depending on the site. Different types of weeding operations can be applied depending on the site. Timely weeding ensures faster initial growth. Weeding is normally by herbicide spray, hoeing and slashing. The frequency and sequence of operations will be varied according to local conditions.

**Table 13: Weeding activities during plantation maintenance**

| ACTIVITY            | REMARKS  |
|---------------------|--|
| Pre-plant spraying  | 5 litres of Glyphosate per ha.                   |
| Spot hoeing         | Covers a radius of 0.5 m from the planted trees. |
| Clean slashing      |  |
| Strip hoeing        | 1 m width within the rows                        |
| Strip slashing      | 2 m width within the rows                        |
| Sprout cutting      | Mainly in savannah areas                         |
| Post plant spraying | 4 litres per ha                                  |

Clean weeding is needed in eucalyptus plantations and is carried out as early as possible to ensure that there are no weeds and that the ground is kept free of all weeds be they grasses or other herbs, coppicing trees and climbers.

Selected agricultural crops like legumes could considerably reduce costs of weeding, improve fertility, aeration through tillage in addition to food and income for farmers but poor supervision of farmers may greatly affect the growth of desired tree crops. Therefore, this practice will not be encouraged in the planted area. Farmers can be allowed to grow crops for one season prior to planting.

### **Climber cutting**

Climbers grow faster than the desired trees and end up strangling them. They will therefore be continuously uprooted whenever they are sighted. The initial high stocking is intended to promote apical growth. However, in later years, thinning will be carried out to promote radial growth.

### **Tending operations**

**Pruning:** Involves removal of live branches from a tree that is meant for timber production and ensures that the proportion of large stems with clear timber is maximised to fetch a premium price on the market. Usually 2-3 m high pruning need to be carried out depending on the desired knot free bole length. The main objectives of pruning are to:

- Produce 'clear wood' that is knot free fetching a premium price on the market
- Improve access within the plantation
- Reduce risk of fire spread by preventing the spread of ground fires into the crowns

Pruning is expensive, therefore only the final crop trees should be pruned.

*1<sup>st</sup> pruning (Rodent) or Low pruning* to 25% of the tree height when trees are about 2-3 years old. This type of pruning is done at an early age and is simply correcting malformations to ensure the development of straight trees. It is more effective when these branches are small. It includes reducing the number of leaders to one where trees have multiple leaders; because the size of the green crown of the tree affects growth, it is important not to remove too many branches at any one time. It is also carried out when rats become serious vermin and are damaging the trees especially by feeding on bark at the base of trees. The objective is to remove lower branches and expose the hiding places at the base of trees, so that rats are exposed to their enemies, large birds.

*2<sup>nd</sup> pruning* also known as **Access pruning** to 2m high of all trees when trees are about 4-6 years old. Lower branches of trees are removed up to 2m, up the stems of trees. The purpose of this pruning is to enable staff to enter the plantation easily and carry out silvicultural operations. No more than half of the green crown should be removed at any one time. In the 2<sup>nd</sup> stage of pruning the tree should be pruned to leave a crown length of 3-4m. Therefore the mean height of the trees should be approximately 6-7m. This should allow the target Diameter Over Stub to be achieved. Pruning should start from the lowest branches and continue up the stem working around the tree.

**Table 14: Pruning of conifer plantation trees**

| Table of pruning             | Pruning Height | Age years | No. of trees/ha to be pruned |
|------------------------------|----------------|-----------|------------------------------|
| Access pruning               | 2 metres       | 3-4       | All                          |
| 1 <sup>st</sup> high pruning | 4 “            | 6-7       | 600-700                      |
| 2 <sup>nd</sup> high pruning | 7 metres       | 9-10      | 600                          |
| 3 <sup>rd</sup> high pruning | 10 metres      | 12-13     | 500                          |

The 1<sup>st</sup> and 3<sup>rd</sup> prunings are aimed at producing clearwood in conifers. The branches, most of which grow around the stem in clusters called whorls, need to be pruned. After pruning, the branch stubs occlude (or grow over). To hasten occlusion, the branch stubs left after pruning should be short, but not so short as to damage the branch collar. Cutting the branch too close to the stem not only damages the branch collar but also increases the size of the wound and delays occlusion. The wounds from pruning bigger branches take longer to occlude than small ones. Generally, there is a 1.5cm occlusion scar before the wound is fully healed, but once the branch stubs have occluded clearwood is produced. The appearance of the whorls on the bark will persist long after the branches have been pruned but clearwood will continue to be produced. When these branches are removed, the diameter of the pruned stem determines the size of the 'defect core', which is the inner cylinder of the tree containing the branch stubs and occlusion scars as well as any bends in the pruned stem.

Minimising the diameter over the stubs of the defect core maximises the volume of clearwood available. The size of the defect core is a compromise between producing as much clearwood as possible while not penalising the growth of the tree by pruning too much or too early.

The 3<sup>rd</sup> high will be up to about 10 m, which will enable production of standard knot free timber from the first two logs. Preferably, all prunings will be carried out at the beginning of the rainy season and will not cover trees destined for 2<sup>nd</sup> thinning. Pruning of stems with a diameter less than 10 cm shall be avoided. The area will be slash-weeded before pruning.

### **Thinning**

Thinning aims to focus the stand increment on the best performing tree and to provide them with sufficient crown space to achieve the desired dimension as quickly as possible.

During the first thinning at age 4-6 years, about 30% of the trees will be removed leaving 700-800 trees per ha to be left to grow on to the second thinning. The second thinning at age 10-12 years is a commercial thinning and will generate some logs, which can be processed into timber for sale. This will help recover some of the costs that go into establishment and protection. *Pinus caribaea*, and *P. oocarpa* have small conical crowns, especially *P. oocarpa*. Therefore 400 to 500 trees/ha will be removed during the second thinning leaving about 300 to 400 trees per hectare.

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This thinning regime will have no deleterious effect on height or diameter growth on the final crop for harvesting at 20-25 years.

**Table 15: Thinning Schedule for Conifers**

|                | <b>AGE (YEARS)</b> | <b>NO. REMOVED</b> | <b>NO. LEFT STANDING</b> |
|----------------|--------------------|--------------------|--------------------------|
| First Thinning | 4-6                | 311                | 800                      |
|                | 10-12              | 300-400            | 400-500                  |

This means that commercial volume available is estimated at between 35 and 50m<sup>3</sup> per hectare at second thinning.

1<sup>st</sup> thinning will be carried out at the age of 4-6 years.

2<sup>nd</sup> thinning will be carried out at the age of 10-12 years

During the first thinning good distribution of the remaining stems will be a key consideration. The objective of this thinning regime is to achieve good, straight sawlogs of average DBH of about 30-45 cm.

**Table 16: Activities involved in plantation establishment, their frequency and scheduling.**

| YEAR  | OPERATION   | REMARKS   |
|-------|---|---|
| 1     | Survey and compartmentation                                 |   |
|       | Bush clearing and burning                                   | Manual  |
|       | Lining out and marking                                      |   |
|       | Pitting   |   |
|       | Seedlings procurement                                       |   |
|       | Pre -planting spraying                                      | 5 litres of glyphosate such as 'Mamba' or 'Round up' per hectare            |
|       | Planting  |   |
|       | Spot hoeing/Strip hoeing                                    | Three times   |
|       | Slashing/ Strip slashing                                    | Three times   |
|       | Sprout cutting  |   |
|       | Post-planting spray   | 4 litres of 'Mamba' or 'Round up' per hectare                               |
| 2     | Spot hoeing   | Twice   |
|       | Slashing  | Twice   |
|       | Post-planting spraying                                      | 3 litres of 'Mamba' or 'Round up' per hectare                               |
| 3     | Slashing  | Twice   |
|       | Climber cutting   | Once  |
| 4     | Slashing  | Twice   |
|       | Climber cutting   | Once  |
| 5-6   | Slashing, Climber cutting, Marking for pruning and Thinning | Pruning to 2m high of the tree height and Thin leaving 700-800 stems per Ha |
| 10-12 | Marking for Thinning (commercial)                           | Thin leaving 400-500 stems per Ha   |
| 1-22  | Fire protection   | Per year till clear felling   |
|       | Roads construction (approx. cover=3% of total area)         |   |
|       | Roads maintenance   | Every 5 years   |

### 6.1.2.8 Protection

#### Fire Protection

Fire protection will be carried out every dry season. The most severe dry season is December to March (Central, East, North) and June to August (South-west and West), depending on locality. The external boundary will be clean hoed during the dry season. Controlled burning around the plantation will be carried out at the beginning of the dry season. Funds allowing, a simple fire tower needs to be constructed at one of the highest points and has to be guarded during the dry season. People surrounding the plantation have to be sensitised about the dangers associated with fires and how to handle fires. The plantation area has to be patrolled during the dry season.

#### Protection against vermin and domestic animals

There is normally no serious threat from wild animals except for bush bucks browsing on tender shoots of pines, which can easily be controlled. Therefore, the planted area has to be protected from grazers employing a patrol person or sensitizing the grazers.

**Protection against Pests and Diseases**

There are no serious threats anticipated on pines except for the blue gum *Chalcid* wasp attacking *Eucalyptus* that is poorly sited and stressed. Forestry Resources Research Institute (FORRI) is currently carrying out follow up studies regarding this disease.

**6.1.3 Harvesting**

In forecasting yields from final fellings, it has been assumed that a sawmill will be installed in this area. To accommodate this development there is a build up to full production in 2007 when the mill will be fully operational.

The youngest existing stands will mature in the year 2026

**Table 17: Proposed planting and logging plan, Rwoho CFR (2006-2037)**

| Cpt   | Planting year | Crop condition | Species                      | Expected final felling vol m3/ha ob | Area | Expected standing vol m3 ob | Harvest year (thinning) | Harvest year (final felling) |
|-------|---------------|----------------|------------------------------|-------------------------------------|------|-----------------------------|-------------------------|------------------------------|
| 2     | 1970          | Very Good      | <i>Pinus oocarpa</i>         | 395                                 | 16   | 6,318                       |                         | 2009                         |
| 3     | 1971          | Good           | <i>Pinus caribaea</i>        | 242                                 | 15   | 3,623                       |                         | 2007                         |
| 4     | 1972          | Good           | <i>Pinus caribaea</i>        | 424                                 | 20   | 8,473                       |                         | 2007                         |
| 5     | 1973          | Fair           | <i>Pinus patula</i>          | 297                                 | 10   | 2,970                       |                         | 2006                         |
| 6     | 1974          | Good           | <i>Pinus caribaea</i>        | 462                                 | 25   | 11,560                      |                         | 2008                         |
| 9     | 2004          | Good           | <i>Pinus oocarpa</i>         | 300                                 | 6    | 1,800                       | 2016                    | 2025                         |
| 6,8,9 | 2005          | Good           | <i>Pinus caribaea</i>        | 300                                 | 92   | 27,600                      | 2017                    | 2023                         |
| 11    | 1992          | Fair           | <i>Pinus oocarpa</i>         | 300                                 | 30   | 9,000                       | 2006                    | 2013                         |
| 11    | 1992          | Fair           | <i>Pinus patula</i>          | 300                                 | 20   | 6,000                       | 2006                    | 2013                         |
| 11    | 1992          | Fair           | <i>Cuppressus lusitanica</i> | 300                                 | 10   | 3,000                       | 2006                    | 2013                         |
| 11    | 1993          | Fair           | <i>Cuppressus lusitanica</i> | 300                                 | 20   | 6,000                       | 2007                    | 2014                         |
| 11    | 1993          | Fair           | <i>Pinus oocarpa</i>         | 300                                 | 40   | 12,000                      | 2007                    | 2014                         |
| 11    | 1994          | Fair           | <i>Pinus oocarpa</i>         | 300                                 | 60   | 18,000                      | 2008                    | 2015                         |
| 11    | 1994          | Fair           | <i>Pinus patula</i>          | 300                                 | 10   | 3,000                       | 2008                    | 2015                         |
| 11    | 1994          | Fair           | <i>Eucalyptus grandis</i>    | 300                                 | 30   | 9,000                       | 2008                    | 2015                         |
| 11    | 1995          | Fair           | <i>Pinus oocarpa</i>         | 300                                 | 80   | 24,000                      | 2009                    | 2016                         |
| 11    | 1995          | Fair           | <i>Pinus patula</i>          | 300                                 | 20   | 6,000                       | 2009                    | 2016                         |
| 12    | 1996          | Fair           | <i>Pinus oocarpa</i>         | 300                                 | 100  | 30,000                      | 2008                    | 2017                         |
| 12    | 1997          | Fair           | <i>Pinus oocarpa</i>         | 300                                 | 100  | 30,000                      | 2009                    | 2018                         |
| 12    | 1998          | Fair           | <i>Pinus oocarpa</i>         | 300                                 | 100  | 30,000                      | 2010                    | 2019                         |
| 12    | 1999          | Fair           | <i>Pinus patula</i>          | 300                                 | 30   | 9,000                       | 2011                    | 2020                         |
| 12    | 1999          | Fair           | <i>Pinus patula</i>          | 300                                 | 70   | 21,000                      | 2011                    | 2020                         |
| 12    | 2000          | Fair           | <i>Pinus oocarpa</i>         | 300                                 | 30   | 9,000                       | 2012                    | 2021                         |
|       | 2006          |                | <i>Pinus caribaea</i>        | 300                                 | 337  | 101,100                     | 2018                    | 2027                         |
|       |               |                | <i>Maesopsis eminii</i>      | 300                                 | 90   | 27,000                      | 2018                    | 2027                         |
|       |               |                | <i>Prunus africana</i>       | 300                                 | 23   | 6,900                       |                         |                              |
|       | 2007          |                | <i>Pinus caribaea</i>        | 300                                 | 429  | 128,700                     | 2019                    | 2028                         |
|       |               |                | <i>Maesopsis eminii</i>      | 300                                 | 85   | 25,500                      | 2019                    | 2028                         |
|       |               |                | <i>Prunus africana</i>       | 300                                 | 21   | 6,300                       |                         |                              |
|       | 2008          |                | <i>Pinus caribaea</i>        | 300                                 | 429  | 128,700                     | 2020                    | 2029                         |
|       |               |                | <i>Maesopsis eminii</i>      | 300                                 | 85   | 25,500                      | 2020                    | 2029                         |
|       |               |                | <i>Prunus africana</i>       | 300                                 | 21   | 6,300                       |                         |                              |
|       | 2009          |                | <i>Pinus caribaea</i>        | 300                                 | 424  | 127,200                     | 2021                    | 2030                         |
|       |               |                | <i>Maesopsis eminii</i>      | 300                                 | 85   | 25,500                      | 2021                    | 2030                         |
|       |               |                | <i>Prunus africana</i>       | 300                                 | 21   | 6,300                       |                         |                              |

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| Cpt | Planting year | Crop condition | Species                 | Expected final felling vol_m3/ha ob | Area | Expected standing vol_m3 ob | Harvest year (thinning) | Harvest year (final felling) |
|-----|---------------|----------------|-------------------------|-------------------------------------|------|-----------------------------|-------------------------|------------------------------|
|     | 2010          |                | <i>Pinus caribaea</i>   | 300                                 | 415  | 124,500                     | 2022                    | 2031                         |
|     |               |                | <i>Maesopsis eminii</i> | 300                                 | 82   | 24,600                      | 2022                    | 2031                         |
|     |               |                | <i>Prunus africana</i>  | 300                                 | 21   | 6,300                       |                         |                              |
|     | 2011          |                | <i>Pinus caribaea</i>   | 300                                 | 114  | 34,200                      | 2023                    | 2032                         |
|     | 2012          |                | <i>Pinus caribaea</i>   | 300                                 | 117  | 35,100                      | 2024                    | 2033                         |
|     | 2013          |                | <i>Pinus caribaea</i>   | 300                                 | 142  | 42,600                      | 2025                    | 2034                         |

**Table 18: Proposed planting and logging plan (2006-2037)**

| Cpt | Planting year | Crop condition | Species                   | Expected final felling vol_m3/ha ob | Area | Expected standing vol_m3 ob | Harvest year (thinning) | Harvest year (final felling) |
|-----|---------------|----------------|---------------------------|-------------------------------------|------|-----------------------------|-------------------------|------------------------------|
| 1   | 1995          | Fair           | <i>Pinus oocarpa</i>      | 300                                 | 3    | 900                         | 2007                    | 2016                         |
| 1   | 1995          | Fair           | <i>Eucalyptus grandis</i> | 300                                 | 6    | 1,800                       | 2007                    | 2016                         |
| 1   | 1996          | Fair           | <i>Eucalyptus grandis</i> | 300                                 | 10   | 3,000                       | 2008                    | 2016                         |
| 1   | 1996          | Fair           | <i>Pinus oocarpa</i>      | 300                                 | 5    | 1,500                       | 2008                    | 2016                         |
| 1   | 1996          | Fair           | <i>Pinus patula</i>       | 300                                 | 4    | 1,200                       | 2008                    | 2016                         |
| 6   | 1998          | Fair           | <i>Pinus oocarpa</i>      | 300                                 | 82   | 24,600                      | 2010                    | 2019                         |
| 7&9 | 2005          | Good           | <i>Pinus caribaea</i>     | 300                                 | 81   | 24,300                      | 2017                    | 2026                         |
| 11  | 1967          | Very Good      | <i>Pinus caribaea</i>     | 659                                 | 44   | 28,996                      |                         | 2010                         |
| 12  | 1968          | Very Good      | <i>Pinus caribaea</i>     | 619                                 | 47   | 29,093                      |                         | 2010                         |
| 13  | 1969          | Very Good      | <i>Pinus caribaea</i>     | 308                                 | 14   | 4,374                       |                         | 2012                         |
| 13  | 1969          | Very Good      | <i>Pinus caribaea</i>     | 488                                 | 26   | 12,444                      |                         | 2012                         |
|     | 2006          |                | <i>Pinus caribaea</i>     | 300                                 | 0    | 0                           |                         |                              |
|     | 2007          |                | <i>Pinus caribaea</i>     | 300                                 | 100  | 30,000                      | 2019                    | 2027                         |
|     | 2008          |                | <i>Pinus caribaea</i>     | 300                                 | 100  | 30,000                      | 2020                    | 2028                         |
|     | 2009          |                | <i>Pinus caribaea</i>     | 300                                 | 100  | 30,000                      | 2021                    | 2029                         |
|     | 2010          |                | <i>Pinus caribaea</i>     | 300                                 | 100  | 30,000                      | 2022                    | 2030                         |
|     | 2011          |                | <i>Pinus caribaea</i>     | 300                                 | 100  | 30,000                      | 2023                    | 2031                         |
|     | 2012          |                | <i>Pinus caribaea</i>     | 300                                 | 100  | 30,000                      | 2024                    | 2032                         |
|     | 2013          |                | <i>Pinus caribaea</i>     | 300                                 | 76   | 22,800                      | 2025                    | 2033                         |

## 6.2 Activities under the Biodiversity conservation and protection management circle

### 6.2.1 General

This will cover areas of Rwoho located in the northern half of the reserve and where remnants of the former natural forest still occurs. It will also include all wetland and valley bottoms. The area available for this circle is about 2,977.4 Ha in Rwoho CFR and another 210 in Bugamba CFR. The following activities will be undertaken under the biodiversity conservation and protection management circle.

**To maintain and where possible enhance the biological and nature conservation values**

- The Nature reserve shall be demarcated and maintained
- Anthropogenic activities (i.e. human related non-permissible activities) shall be controlled to below 10% of baseline. First an assessment of all the human caused threats shall be made and a baseline established. Using the baseline information the activities will be geared towards reduction of the threats.
- One forest wide assessment of major taxa shall be undertaken as part of the national update of the biological diversity update inventory. Species plans for one tree species and three species of butterflies which do not occur anywhere else in Uganda's Protected Area System shall be drawn and implemented. Indicator species shall be measured, flora and fauna described in enough detail to allow monitoring by independent persons or bodies.
- Regular monitoring shall be done in all parts of the conservation area.

**To retain and enhance soil and water quality the following activities shall be done:**

- An area of natural forest stand shall be maintained and some restoration (enrichment) planting shall be done. First, an assessment of the stocking (diagnostic sampling) shall be done and species suitable and appropriate to enrich the natural woodland identified. Then the identified species shall be planted in the woodland in areas where canopy opening and gap sizes permit.
- During the establishment of roads, landings, bridges and other forest earth works, care shall be taken to adhere to the guidelines for their establishment and maintenance. Heavy machine use will be restricted to what is prescribed.

**To maintain forest health and protect the forest the main activities shall be to:**

- Control the occurrence or spread and increase in populations of weeds, pests, insect and fungal attacks that are above what is expected of a natural stand.
- Monitor and manage fire in cooperation with adjacent communities.

**To integrate community forest needs into forest management activities by:**

- Supporting communities to protect the natural forest from illegal activities
- Working with communities to promote natural forest regeneration
- Supporting livelihoods of communities through forestry activities which are in line with the National Forestry and Tree Planting Act 2003

**To increase the area planted for timber production within the biodiversity conservation and protection management circle, the following are planned:**

- All the area found suitable for enrichment (restoration) planting shall be fully planted by the 10<sup>th</sup> year of this management plan.



- Timber volumes expected from the biodiversity conservation and protection management circle shall be calculated.

### **Establish and maintain research plots**

- Research plot establishment and assessments within the biodiversity conservation and protection management circle shall be done.

### **6.2.2 Management of natural forests**

The prime function of the natural forests will be the protection of watersheds and the prevention of the spread of fire from adjacent agricultural land into the plantation areas. At the same time a programme of enrichment planting will be undertaken to allow the possibility of sustainable broad-leaved timber supply.

Planting of hardwood will also take place along the edge of the natural forest boundary. This will have the dual effect of clarifying management boundaries and of acting as a buffer zone between natural forest and softwood areas where in the past there has been a great deal of suppression by weed invasion emanating from the natural forest.

All enrichment planting will be undertaken using 2 m striplings at a spacing of 4 x 5 m with the canopy above being opened by girdling of adjacent trees providing they are of no current commercial species. The species used in planting will be *Entandrophragma excelsum*, *Newtonia buchananii*, *Maesopsis eminii* and *Albizia corriaria*.

### **6.2.3 Timber production from natural forests**

The natural woodland areas shall be those areas designated as natural woodland areas and mapped. Designated strict nature reserve areas shall have restricted access and diagnostic sampling shall be undertaken to establish best future crop to promote in natural woodland areas. To obtain a maximum sustainable yield of high quality broad-leaved saw logs, appropriate species shall be tended or planted in the diagnostically sampled areas.

The neighbourhood communities shall manage the rest of the woodland areas for maximum yield of building poles, firewood, charcoal and other non-timber forest products for both commercial use and for subsistence use. Integrated tending operations appropriate for the natural stands (including selection of crop trees from the naturally growing trees) shall be done regularly.

### **6.2.4 Watershed protection**

All areas designated, as wetlands on the map shall be marked on the ground. All areas designated as woodland areas on the map but have streams within them shall also be managed for watershed. The areas for planting in Rwoho and Bugamba will be classified in hydrological terms by end of December 2007. Field testing equipment will be purchased and staff trained to measure and interpret data on surface runoff and erosion susceptibility including water and soil conservation methods and structures prior to planting will be set up.

### **6.2.5 Biodiversity conservation**

The biological biodiversity management activities are aimed at maintaining and where possible enhancing biological and nature conservation values of the nature reserve and other areas sharing the delivery of biodiversity services.

An area designated, as nature reserve, environmental protection area and natural woodland area shall be demarcated on the ground as indicated on the map, attached to this plan, by March 2006.

All anthropogenic activities in the conservation areas that are not under licenses shall be controlled to less than 10% of their base value at the coming into force of this management plan by the end of December 2007. In order to achieve this, a baseline methodology shall be applied to determine the current threat by December 2007. Threat reduction analysis shall be done twice during the period of the plan.

A species plan for the total protection of *Terminalia laxiflora* (Combretaceae) which does not occur anywhere else in Uganda's Protected Area System; and *Grewia pubescens* (Tiliaceae) that is of conservation concern on account of being endemic to the Albertine Rift Region shall be prepared by end of December 2006 and implemented over the period of the plan.

New studies directed at assessing and updating the biological diversity knowledge amongst plants and other selected taxa within the forest for the nature reserve and other conservation areas will be requested every June from universities, research institutions and from other suitably qualified institutions and individuals.

Area of natural forest stand and some selected valley bottoms shall be maintained and where possible enhanced by restoration planting with appropriate species.

## **6.3 Management Activities within the community and private sector working circle**

### **6.3.1 General**

This will cover areas of Rwoho and Bugamba that will involve community and private sector participation in the implementation of the management objectives. They include those areas designated as community planting (under carbon as well as non-carbon planting), existing plantation area, allocations to private tree planters and the wooded area outside the nature reserve.

### **To plant and raise trees on land allocated to communities in accordance with acceptable standards**

- All the area classified for planting under community and private sector management circle should be fully planted by the 10<sup>th</sup> year of this management plan. This area is 3,742.6 Ha.
- The communities shall be assisted to calculate and monitor the timber volumes expected from community and private sector management circle.
- Timber volumes produced should be within the range expected of the area planted.

- All area licensed to private businesses for timber production is planted by the 10<sup>th</sup> year of this management plan.

**To promote natural forest regeneration communities will:**

- stop grazing in CFR through enactment and enforcement of by-laws
- Prevent fires by establishing fire breaks along the boundary, sensitizing the community and patrolling for fire out breaks
- Reduce illegal felling of trees and saplings by conducting joint patrols
- Enhance tree planting in natural forest belts through affirmative (enrichment planting) silviculture
- Regulate use of forest products for domestic purposes by allocating specific days and quantities for extraction
- Domesticate some herbal trees and animals
- Obtain licenses for extraction of forest products
- Enhance public relations through exchange visits, talk shows and newsletter articles
- Sensitise people so as to develop a sense of ownership for the forest
- Create alternative methods to reduce overuse of resources in the natural forest e.g. Improved Energy Saving Devices (IESDs), bee keeping etc

**To protect natural forest from illegal activities communities will:**

- avoid wildfires by making fire lines and participate in fire fighting
- initiate and promote use of improved energy saving devices
- establish private woodlots on-farm
- encourage the practice of zero-grazing
- carry out joint patrols to protect the forest
- advise forest users to get permission in form of license
- compile and submit quarterly reports on illegal activities to NFA
- holding regular workshops with technical people on forest management
- put in place a patrol team to work hand in hand with the NFA.

**To support community livelihood activities compatible with forestry, the NFA shall work with communities to:**

- Sensitise the community about importance and uses of forests
- Sensitise people on government policy and legislation on forests
- Encourage women to establish on-farm herbal gardens
- Oversee inventory and monitor stocking of trees in the CFR to control community harvesting
- Sensitise people on protecting the CFR against damage, for example by fire, grazing etc
- Control movement of children and adults in the CFR to minimize unnecessary and careless damage

- Promote and construct IESDs
- Carry out selective and controlled harvesting of minor forest products like sticks, craft materials etc
- Identify watering sources and discuss with NFA officials on the best way of accessing watering points

**Table 19: Areas for community and private tree planters (2006-2037)**

|                                 |             |            |
|---------------------------------|-------------|------------|
| Large scale commercial planters | 1000ha      | 11%        |
| Medium<br>“ “                   | 720ha       | 8%         |
| Resident community              | 380         | 4%         |
| <b>Total</b>                    | <b>2100</b> | <b>23%</b> |

#### **6.4 Collaborative forest management agreements**

In general, cooperation and collaboration in management of Bugamba and Rwoho Forest Reserves is vital to the successful implementation of this FMP. There are three management circles covering different areas of the reserve. There is therefore need for collaboration of everybody involved namely the community residing close to the reserves, medium and large-scale commercial planters and NFA. Each of these has an important role to play, if the expected benefits are to be achieved.

Both the NFA and private tree planters expect to raise tree crops from which reasonable profit will be obtained at the end of the production period. This will not be possible without close cooperation and collaboration in protection against annual fires, vermin, diseases and theft. Such activities can render the investment in tree planting null, but if all cooperate, there will be mutual gain. It is prescribed that collaborative forest management negotiations be initiated with all the interested members of the community and CFM agreements be signed as the basis of this collaboration.

#### **6.5 Research**

Initial permanent sample plots shall be determined on the management plan map by 30 December 2006 and their location on the ground shall be completed by 30 June 2007. Permanent sample plots (PSPs) shall be regularly measured NFA and results included in the Yield Model for the area under this management plan. An area to be developed into a seedling/seed orchard shall be set aside located and demarcated by June 2007 and it shall be planted by December 2007.

## 7 MITIGATION OF ENVIRONMENTAL AND SOCIAL IMPACTS

The terrain on which these reserves occur is very steep and therefore susceptible to soil erosion and degradation resulting into reduced productivity of the sites. One of the mitigation measures is to ensure that site clearing, pitting and weeding exposes very little area of the soil surface. Common practices such as strip hoeing have to be avoided and be replaced with spot hoeing, which leaves grass patches between neighbouring trees and herbaceous vegetation between planting rows of trees.

All the natural vegetation along steep sides of the streams shall not be cleared and need protection. Exotic tree species shall be planted in a distance of 20 metres on either side of each stream. Such an area may be used to enrich the natural forest with indigenous high value tree species such as *Entandrophragma excelsa*, *Maesopsis eminii* and *Newtonia buchananii*.

Staff of the NFA should regularly inspect the activities of the community and private tree planters to see to it that environmental standards set are observed.

Cattle may be allowed access to watering points within the reserve, but such watering areas have to be well managed to ensure that cattle do not stray into the natural forest along the streams. The community or individuals using such facilities shall be persuaded to fence the watering points so as to stop livestock from wondering all over the area and destroying seedlings by trampling.

Commercial planters and resident communities shall be sensitised to desist from environmentally harmful practices as draining water courses and will be urged to leave a 20m strip on either side of each stream.

Use of herbicides will strictly follow NEMA guidelines to ensure that water sources are not polluted by such herbicides.

Tree planting is an income generating activity and this will provide a menu of livelihoods options that include employment and improved source of income. Community members will be contracted for most of the tree planting activities such bush clearing, lining, pitting and planting. Since the communities will plant their own trees, they stand a chance to earn from harvesting of their own trees. The communities also will earn from sale of non-forest products and services such as carbon credit.

## 8 MANAGEMENT AND LOGISTICS

### 8.1 Organisational structure

The structure of the management of Bugamba and Rwoho management plan area will be similar to one of the NFA. The implementation of the management plan is the responsibility of the Executive Director of the NFA. In the field s/he will be represented by the various line staff concerned with the management of forest resources in general and plantations development in particular. The day-to-day activities will be managed by the field staff posted to manage the forest reserves of Rwoho and Bugamba.

### 8.2 Required infrastructure

The infrastructure requirements include roads and housing for staff. The road requirements are summarised in Section 6 of this management plan. Housing and staff infrastructure needs are presented in the sections below.

#### 8.2.1 Staffing

The management of Rwoho and Bugamba CFRs requires 8 employees as summarised in the table below.

**Table 20: Existing and proposed no. of staff by category**

| Station  | Current Sector Manager | Current Forest Supervisor | Proposed Sector Manager | Proposed Forest Supervisor | Total |
|----------|------------------------|---------------------------|-------------------------|----------------------------|-------|
| Bugamba  | 1                      | 2                         | 0                       | 0                          | 3     |
| Kikunda  | 0                      | 0                         | 0                       | 1                          | 1     |
| Rwoho    | 0                      | 2                         | 0                       | 0                          | 1     |
| Rwoho SE | 0                      | 0                         | 0                       | 1                          | 1     |
| Kirungu  | 0                      | 0                         | 0                       | 1                          | 1     |
| Total    | 1                      | 4                         | 0                       | 3                          | 8     |

#### 8.2.2 Contractors

All operational activities in the two CFRs will be undertaken by private contractors. The NFA staff will monitor their performance and will support them to take over more and more management tasks.

#### 8.2.3 Offices and housing

There is need to refurbish the old forest stations and equip them with the necessary furniture and equipment for the smooth running of activities in the two reserves.

**Table 21: Existing and proposed houses/offices**

| STATION | DETACHED | SEMI-DETACHED | UNIPORT | TOTAL |
|---------|----------|---------------|---------|-------|
| Kikunda | 1(0)     | 0(0)          | 2(0)    | 3(0)  |
| Rwoho   | 1(0)     | 0(0)          | 0(0)    | 1(0)  |
| Kagara  | 0(2)     | 0(0)          | 0(0)    | 0(2)  |
| Kirungu | 0(1)     | 0(0)          | 0(0)    | 0(1)  |
| Total   | 2(3)     | 0(0)          | 2(0)    | 4(3)  |

### 8.2.4 Vehicles

One Motor vehicle is available and will be maintained. A new tractor is required because the current one is irreparable and hampers work. Six to ten motorcycles will be required for effective patrolling of the forest reserve.

### 8.2.5 Equipment and tools

In the table below the necessary equipment to manage the plantations is outline.

**Table 22: Required equipment**

| TYPE               | UNIT | UNIT COST   | TOTAL COST         |
|--------------------|------|-------------|--------------------|
| Pangas             | 450  | 3,000       | 1,350,000          |
| Hoes               | 450  | 3,000       | 1,350,000          |
| Axes               | 50   | 10,000      | 500,000            |
| Chain saw          | 2    | 2,000,000   | 4,000,000          |
| Planting trowels   | 60   | 2,000       | 120,000            |
| Pruning saws       | 200  | 10,000      | 2,000,000          |
| Knap sack sprayers | 40   | 150,000     | 6,000,000          |
| Fire beaters       | 40   | 67,000      | 2,680,000          |
| Water bouzer       | 1    | 157,651,000 | 157,651,000        |
| <b>Total</b>       |      |             | <b>175,651,000</b> |

## 9 FINANCIAL PLAN

### 9.1 Expected cost and revenues

To allow for continuity, estimates detail first year (Table 18) but summarise subsequent 40 year (two rotations) expenditure and revenue projections. During the first year of the plan, 90% of the costs will be plantation establishment (58%), followed by overheads (21%) and preliminary documentation (10%). The remaining costs (11%) include protection expenses, natural forests assessment, road construction, house for the nursery site, vehicles and fuel and maintenance; land rent capture as well as expendables in the office.

**Table 23: Bugamba and Rwoho Forest Management Plan summary costs for year one**

| SUMMARY COSTS FOR YEAR ONE |                      | PERCENT    |
|----------------------------|----------------------|------------|
| PRELIMINARY                | 105,250,000          | 9.97       |
| ESTABLISHMENT              | 609,384,800          | 57.71      |
| PROTECTION                 | 11,160,000           | 1.06       |
| NATURAL FOREST             | 10,000,000           | 0.95       |
| ROADS                      | 27,696,000           | 2.62       |
| HOUSES                     | 24,000,000           | 2.27       |
| EXPENDABLES                | 1,053,000            | 0.10       |
| OVERHEADS                  | 216,696,160          | 20.52      |
| VEHICLE & FUEL             | 36,295,000           | 3.44       |
| LAND RENT                  | 4,000,000            | 0.38       |
| FIRE PROTECTION            | 10,490,000           | 0.99       |
|                            | <b>1,056,024,960</b> | <b>100</b> |

**Table 24: Bugamba and Rwoho Forest Management Plan detailed costs for Year one**

| ACTIVITIES FOR YEAR ONE BUGAMBA AND RWOHO   | Units Msre | Quantity | Freq | Unit Cost | Year 2006          |
|---|------------|----------|------|-----------|--------------------|
| Preparation of Plan and other documentation | Ha         | 10,210   | 1    | 10,000    | <b>102,100,000</b> |
| Boundary plan demarcation                   | Km         | 63       | 1    | 50,000    | <b>3,150,000</b>   |
| Boundary maintenance                        | Km         | 63       | 4    | 30,000    | <b>7,560,000</b>   |
| Initial Clearing                            | Ha         | 400      | 1    | 70,000    | <b>28,000,000</b>  |
| Lining out                                  | Ha         | 400      | 1    | 20,000    | <b>8,000,000</b>   |
| Pitting                                     | Ha         | 400      | 1    | 30,000    | <b>12,000,000</b>  |
| Pre_Plant Spraying                          | Ha         | 400      | 1    | 30,000    | <b>12,000,000</b>  |
| Planting                                    | Ha         | 400      | 1    | 30,000    | <b>12,000,000</b>  |
| Beating up                                  | Ha         | 400      | 1    | 1,333     | <b>533,200</b>     |
| Strip Slashing for Bugamba and Rwoho        | Ha         | 1,398    | 6    | 35,000    | <b>293,580,000</b> |
| Spot hoeing for Bugamba and Rwoho           | Ha         | 258      | 1    | 20,000    | <b>5,160,000</b>   |
| Spot hoeing for Rwoho carbon areas only     | Ha         | 400      | 6    | 40,000    | <b>96,000,000</b>  |



*Bugamba and Rwoho CFRs Forest Management Plan*

| <b>ACTIVITIES FOR YEAR ONE BUGAMBA AND RWOHO</b> | <b>Units_Msre</b> | <b>Quantity</b> | <b>Freq</b> | <b>Unit_Cost</b> | <b>Year 2006</b>     |
|--|-------------------|-----------------|-------------|------------------|----------------------|
| Seedlings  | Seedlings         | 400             | 1,333       | 193              | <b>102,907,600</b>   |
| Handling Seedlings                               | Seedlings         | 400             | 1,333       | 20               | <b>10,664,000</b>    |
| Road opening                                     | Km                | 8               | 1           | 1,250,000        | <b>10,000,000</b>    |
| Firebreaks opening                               | Km                | 15              | 1           | 160,000          | <b>2,400,000</b>     |
| Fire line maintenance                            | Km                | 43              | 1           | 80,000           | <b>3,440,000</b>     |
| Road maintenance                                 | Km                | 122             | 1           | 118,000          | <b>14,396,000</b>    |
| Install culverts                                 | Numbers           | 11              | 1           | 300,000          | <b>3,300,000</b>     |
| Sprout cutting                                   | Ha                | 400             | 1           | 15,000           | <b>6,000,000</b>     |
| Fire Patrol                                      | Man<br>Months     | 30              | 1           | 50,000           | <b>1,500,000</b>     |
| Fire gangs                                       | Numbers           | 63              | 1           | 50,000           | <b>3,150,000</b>     |
| General patrol (against grazers)                 | Man<br>Months     | 72              | 1           | 50,000           | <b>3,600,000</b>     |
| Diagnostic assessment of natural forests Rwoho   | Ha                | 2,000           | 1           | 5,000            | <b>10,000,000</b>    |
| Nursery House                                    | Numbers           | 1               | 1           | 20,000,000       | <b>20,000,000</b>    |
| Hand Tools (assorted: Table 17 in Text)          | Lump sum          | 1               | 1           | 22,540,000       | <b>22,540,000</b>    |
| Installation of solar panels                     | Lump sum          | 2               | 1           | 2,000,000        | <b>4,000,000</b>     |
| Stationery and Photocopying                      | Lump sum          | 1               | 1           | 1,053,000        | <b>1,053,000</b>     |
| Security guard                                   | Man<br>Months     | 12              | 4           | 75,000           | <b>3,600,000</b>     |
| Fuel for pick up and tractor                     | Lump sum          | 49              | 1           | 235,000          | <b>11,515,000</b>    |
| Vehicle maintenance                              | Vehicle           | 2               | 12          | 500,000          | <b>12,000,000</b>    |
| Motorcycle fuel and maintenance                  | M/Cycle           | 6               | 12          | 177,500          | <b>12,780,000</b>    |
| Coordinator's allowance                          | Visits            | 1               | 4           | 2,000,000        | <b>8,000,000</b>     |
| Maintenance of forest stations                   | Station           | 2               | 1           | 4,000,000        | <b>8,000,000</b>     |
| Staff allowances                                 | Numbers           | 296             | 1           | 62,500           | <b>18,500,000</b>    |
| Office attendant                                 | Numbers           | 1               | 12          | 150,000          | <b>1,800,000</b>     |
| Airtime  | Numbers           | 36              | 1           | 22,000           | <b>792,000</b>       |
| Land rent recovery                               | Ha                | 400             | 1           | 10,000           | <b>4,000,000</b>     |
| <b>Sub Total</b>                                 |                   |                 |             |                  | <b>880,020,800</b>   |
| Supervision                                      |                   |                 |             |                  | <b>176,004,160</b>   |
| <b>Total for year one</b>                        |                   |                 |             |                  | <b>1,056,024,960</b> |

## **9.2 Cash-flow and financing needs**

Year one requirements (Table 19) are greater than those indicated in the annex because of the differences in targeted activities in the annex and actual operational plans prepared for the financial year. The forward cash flow estimates cover 40 years (2006-2048) to allow for continuity and offer confidence to partners with which we may enter into financing agreements such as the Bio Carbon Fund of the World Bank. Belated 39 year (1967-2006) cash flow estimates were prepared to account for the standing crop which will generate revenue that will contribute to the self sustenance of the management plan financing mechanism. Annual costs of executing the management plan will be adjusted annually but the cash flow is indicative.

Financing the management plan will be by NFA's own revenue some of which will be from the two reserves. Other sources of financing will be from the sale of verified emission reductions under the emission reduction purchase agreement (ERPA: attached). The forward cash flow estimates covering 40 years (2006-2048) is mainly positive because the plan inherits a mature crop planted in 1967, 1968 and 1969.

**Table 25: Summary of the forward cash flow and financial requirements for Bugamba and Rwoho**

| YEAR | TOTAL COSTS           | TOTAL REVENUES         | NET BENEFIT (WITH CARBON) | NET BENEFIT ( WITHOUT CARBON) |
|------|-----------------------|------------------------|---------------------------|-------------------------------|
| 2006 | 735,162,885           | 145,170,480            | -589,992,405              | -589,992,405                  |
| 2007 | 578,254,200           | 683,578,153            | 105,323,953               | 61,838,593                    |
| 2008 | 891,683,340           | 712,238,629            | -179,444,711              | -253,379,036                  |
| 2009 | 976,848,360           | 560,181,933            | -416,666,427              | -545,863,397                  |
| 2010 | 1,006,169,610         | 1,835,239,326          | 829,069,716               | 565,155,654                   |
| 2011 | 999,280,137           | 1,834,643,736          | 835,363,599               | 532,939,197                   |
| 2012 | 584,122,767           | 1,227,528,865          | 643,406,098               | 361,035,325                   |
| 2013 | 518,612,331           | 1,644,787,090          | 1,126,174,759             | 805,900,169                   |
| 2014 | 529,564,235           | 1,564,683,053          | 1,035,118,818             | 692,310,765                   |
| 2015 | 376,111,882           | 1,526,310,855          | 1,150,198,973             | 772,450,618                   |
| 2016 | 346,110,524           | 1,753,066,860          | 1,406,956,336             | 1,186,120,726                 |
| 2017 | 307,611,981           | 1,814,883,360          | 1,507,271,379             | 1,164,747,394                 |
| 2018 | 339,251,049           | 2,098,034,025          | 1,758,782,976             | 1,471,567,701                 |
| 2019 | 289,617,489           | 2,386,138,133          | 2,096,520,643             | 1,747,248,136                 |
| 2020 | 278,362,359           | 2,105,708,190          | 1,827,345,831             | 1,699,853,266                 |
| 2021 | 278,841,196           | 2,323,791,070          | 2,044,949,874             | 1,751,915,054                 |
| 2022 | 258,843,221           | 2,245,996,488          | 1,987,153,267             | 1,757,250,530                 |
| 2023 | 266,201,465           | 1,862,115,055          | 1,595,913,590             | 1,344,229,785                 |
| 2024 | 266,745,328           | 1,972,616,248          | 1,705,870,920             | 1,464,651,547                 |
| 2025 | 276,784,452           | 2,207,672,225          | 1,930,887,773             | 1,543,442,736                 |
| 2026 | 287,252,684           | 1,279,303,125          | 992,050,441               | 992,050,441                   |
| 2027 | 289,560,574           | 5,894,080,625          | 5,604,520,051             | 5,604,520,051                 |
| 2028 | 224,613,170           | 5,894,080,625          | 5,669,467,455             | 5,669,467,455                 |
| 2029 | 449,999,369           | 5,962,129,020          | 5,512,129,651             | 5,479,515,631                 |
| 2030 | 495,938,253           | 5,962,971,994          | 5,467,033,741             | 5,411,582,997                 |
| 2031 | 517,881,935           | 6,004,418,978          | 5,486,537,043             | 5,389,639,315                 |
| 2032 | 521,411,942           | 6,105,456,797          | 5,584,044,854             | 5,386,109,308                 |
| 2033 | 521,258,815           | 6,129,452,052          | 5,608,193,237             | 5,381,374,935                 |
| 2034 | 539,991,661           | 6,119,299,329          | 5,579,307,668             | 5,367,529,589                 |
| 2035 | 538,835,769           | 6,147,727,193          | 5,608,891,424             | 5,368,685,481                 |
| 2036 | 563,168,885           | 6,171,958,539          | 5,608,789,654             | 5,351,683,615                 |
| 2037 | 560,726,165           | 4,589,198,766          | 4,028,472,601             | 3,745,161,335                 |
| 2038 | 532,494,125           | 4,537,495,458          | 4,005,001,332             | 3,839,374,625                 |
| 2039 | 445,994,914           | 4,611,899,864          | 4,165,904,950             | 3,909,011,961                 |
| 2040 | 431,596,740           | 4,976,813,956          | 4,545,217,216             | 4,329,805,760                 |
| 2041 | 429,058,261           | 6,020,406,881          | 5,591,348,619             | 5,329,394,239                 |
| 2042 | 433,304,016           | 5,328,352,500          | 4,895,048,484             | 4,895,048,484                 |
| 2043 | 489,135,567           | 5,797,552,500          | 5,308,416,933             | 5,308,416,933                 |
| 2044 | 470,826,861           | 4,018,502,500          | 3,547,675,639             | 3,547,675,639                 |
| 2045 | 495,152,498           | 6,165,092,500          | 5,669,940,002             | 5,669,940,002                 |
| 2046 | 398,671,920           | 6,165,092,500          | 5,766,420,580             | 5,766,420,580                 |
| 2047 | 496,492,202           | 6,165,092,500          | 5,668,600,299             | 5,668,600,299                 |
| 2048 | 223,280,455           | 6,165,092,500          | 5,941,812,045             | 5,941,812,045                 |
|      | <b>20,460,825,594</b> | <b>158,715,854,473</b> | <b>138,255,028,880</b>    | <b>130,886,243,074</b>        |

From the cash flow analysis (Table 20), the management plan area should be “theoretically” self financing by 2010.

### **9.3 Risk analysis**

The greatest risk to the management plan is failure to secure adequate financing for the critical five years where most of the planting will be done. To minimise this risk, we proposed that all revenue from Bugamba-Rwoho management plan area be re-invested there and only surplus be spent on other areas. The other risks are associated with failure to yield a reasonable return on the investment on account of lower yield or slump on prices of stumpage. To alleviate those risks, we have used a conservative yield estimate (averaging 300 m<sup>3</sup> per Ha when there is evidence of up to 600m<sup>3</sup>: See tables 12 and 13) and prepared all the costs at their present values. In addition, we have spread the harvesting quarter at lower than the planting rates to partly cater for the conversion to “normal” forest but also to allow for volume increment (for the non-harvested crop). Other risks are minimal and will be handled administratively as they become apparent. A budgetary estimate on supervision takes charge of that.

## 10 MONITORING AND EVALUATION

**Table 26: Broad indicators for the Bugamba-Rwoho Management Plan**

| RESOURCE              | OBJECTIVE  | INDICATORS OF OBJECTIVE BEING ACHIEVED   |
|-----------------------|--|--|
| Timber                | To increase the area planted for timber production   | <ul style="list-style-type: none"> <li>• All the area classified for planting should be fully planted by the 10<sup>th</sup> year of this management plan.</li> <li>• Timber volumes produced from Rwoho and Bugamba CFRs should be within the range expected of the area planted</li> <li>• All area licensed to private businesses for timber production is planted</li> </ul>   |
| Carbon                | To generate Kyoto and where necessary non-Kyoto compliant carbon offsets in Rwoho CFR      | <ul style="list-style-type: none"> <li>• All the activities necessary for the generation and delivery of 500,000 t-Co<sub>2</sub>e contracted to the IBRD are undertaken in Rwoho CFR</li> <li>• A PDD prepared and registered with the UNFCCC</li> <li>• All verifications for “Uganda Nile Basin reforestation project” undertaken and relevant certifications obtained</li> <li>• Additional legible and designated area brought under carbon offsets generation</li> <li>• Additional All the activities necessary for the generation and delivery of 500,000 t-Co<sub>2</sub>e to the IBRD or other buyers are undertaken in Rwoho CFR</li> </ul> |
| Financial             | To turn the cash flow from negative to positive and to maintain it as a positive cash flow | <ul style="list-style-type: none"> <li>• Revenues exceed expenditure up to overhead level by the 6<sup>th</sup> year</li> <li>• Revenues exceed expenditure including overheads by the 10<sup>th</sup> year</li> <li>• Timber in the AAC is felled when it is likely to fetch the highest (but within a five year range)</li> </ul>  |
| Biological Diversity  | To maintain and where possible enhance the biological and nature conservation values       | <ul style="list-style-type: none"> <li>• Nature reserve demarcated</li> <li>• Anthropogenic activities controlled to below 10% of baseline</li> <li>• Species plans for one tree species and three species of butterflies which do not occur anywhere else in Uganda’s Protected Area System drawn and implemented</li> <li>• Regular monitoring done</li> <li>• One forest wide assessment of major taxa undertaken</li> <li>• Indicator species measurement, flora and fauna descriptions</li> </ul>   |
| Watershed             | To retain and enhance soil and water quality   | <ul style="list-style-type: none"> <li>• Area of natural forest stand maintained and where possible enhanced by restoration planting</li> <li>• Guidelines for establishing access, landings, bridges reflecting site characteristics are adhered to</li> <li>• Heavy machine use restricted to what is prescribed</li> </ul>  |
| Protection            | To maintain forest health and protect the forest   | <ul style="list-style-type: none"> <li>• Observed presence or spread and increase in populations of weeds and pests and invasive</li> <li>• Visible signs of insect and fungal attack</li> <li>• Presence of fire safety rules and equipment and their use</li> </ul>  |
| Community livelihoods | Integrate community forest needs into forest management activities                         | <ul style="list-style-type: none"> <li>• Area allocated to communities for plantation activities</li> <li>• Level of involvement of community members in the management activities of the forest</li> </ul>  |
| Research              | Establish and maintain research plots  | <ul style="list-style-type: none"> <li>• Research plot establishment and assessment reports</li> </ul>   |

**Table 27: Monitoring forest management activities**

| <b>Activity</b>  | <b>Indicator</b>  | <b>Means of verification</b>  | <b>Timing</b>                           | <b>Responsible staff member</b>  |
|--|---|---|---|--|
| Plantation establishment seedling production initial clearing planting   | No of hectares targeted and achieved. No. of good quality seedlings produced. | Field observation and reporting advice given and acted upon Nursery statements          | Weekly<br>Monthly<br>Quarterly          | Forest Supervisor<br>Sector Manager<br>Plantation Manager<br>Range Manager<br>Coordinator commercial plantations according to their routine visits |
| Plantation maintenance weeding pruning and thinning                      | No. of ha programme and achieved  | Field checks and reporting  | Weekly<br>Monthly<br>Quarterly          | Forest Supervisor<br>Sector Manager<br>Co-commercial plantation and Range Manager  |
| Fire protection and management   | No. of un burnt forest area frequency of fire management training conducted   | Fire reporting after every visit.   | Weekly<br>Monthly<br>Quarterly          | Forest Supervisor<br>Sector Manager<br>Coordinator Commercial plantations and Range Manager  |
| Road construction and maintenance boundary patrols and fire line cleared | No. of Kms constructed and maintained   | Field visit measurements done on map and field reports                                  | Quarterly<br>Every 6 months<br>Annually | Forest Supervisor<br>S. Manager<br>Plantation Manager and Coordinator Commercial Plantations   |
| Forest protection  | Is the whole forest intact, encroachers evicted and area planted              | Reports   | Monthly<br>Quarterly                    | Forest Supervisor<br>Sector Manager<br>Plantation Manager<br>Law Enforcement Coordinator   |
| Revenue collection   | Amount of funds collected and banked  | Receipts and revenue out turn   | Monthly                                 | Forest Supervisor<br>Sector Manager<br>Plantations Manager<br>Coordinator<br>Commercial Plantations Coordinator Utilisation                        |
| Harvesting   | No. of coupes and plots measured volume (m3) of timber declared               | Coupe maps<br>Reports<br>Declaration<br>Books<br>Returns<br>Field checks by inspections | Annually<br>Monthly<br>Weekly           | Mapping and Inventory Specialist<br>Forest Supervisor<br>Sector Manager<br>Plantation Manager  |

**Annex I: Historic event of Rwoho and Bugamba CFR (J. Lang-Brown 1964, R.A Owen and Others 1985)**

| DATE      | EVENT  | SIGNIFICANCE TO FOREST MANAGEMENT  |
|-----------|--|--|
| 1940      | Gazettement as South Ankole CFR  | Gazettement as a Central Forest Reserve comprising of East Rwampara Central Forest Reserve 26407ha and Rweibogo Central Forest Reserve (0168.3ha with objectives to:<br>Protect streams that rise in Rwampara hills<br>Supply timber props from <i>Markhamia platycalyx</i> from the Musambya valley forests to Mwerasandu tin mines.<br>Plant softwoods for use in western Uganda |
| 1938-1955 | Sporadic cutting of pit props in Rwoho and Rweibogo valleys by Kagera Mines for use in tin mining  | Demand for <i>Markhamia platycalyx</i> and need for sustainable utilisation  |
| 1948      | Extensive experimental planting of softwoods in Rwoho valley species planted: <i>C. lusitanica</i> , <i>P.patula</i> , <i>P.elliotii</i> ( <i>caribaea</i> ), <i>P.taeda</i> and <i>P.radiata</i> .<br>Enrichment planting in valley bottoms with <i>Newtonia buchananii</i> and <i>Entandrophragma excelrum</i> | Vast knowledge on species trials that work for the area.   |
| 1955      | Issue of directive by Chief Conservator of Forests No. 698 of 25/5/1955 to carry out limited planting in Northern block and controlled settlement in valley bottoms  | Planting of 32 acres of <i>P. patula</i> in Rweibogo Valley and 14 acres of black wattle   |
| 1957-1961 | Working Plan written by RB Watson to provide for research and small scale planting within Bugamba  | Plan prescribed that planting would continue at 40 ha per year and species to be planted were: <i>P. patula</i> , <i>P. radiate</i> and <i>Eucalyptus grandis</i> in fire breaks with a rotation of 40 years envisaged.  |
| 1962-1963 | Expansion of planting programme – 1963 mandated to Forest Department as of legal notice No. 11 of 5 <sup>th</sup> January 1963.  | 81 ha per year were being afforested and <i>Cuppressus lusitanica</i> was also planted in addition to <i>P. patula</i> and <i>P. radiate</i> at a spacing of 9'x9' though some of the earlier planting was 8'x8' or 7'x7', <i>Eucalyptus</i> 6'x6' in the fire break of 60'.   |
| 1964-67   | Working Plan drawn by J. Lang Brown with objective to grow softwoods for production of utility timber  | Continuation of expansion of afforestation at a rate of 202ha per annum.<br>Advocated for planting of <i>Pinus caribaea</i> that had first been planted in 1963. Stopped planting of <i>P. radiate</i> that had shown poor form and prescriptions for thinning and pruning developed.  |
| 1970      | Completion of planting in Bugamba on schedule  | Fulfillment of the management prescription for the area  |
| 1998      | Formulation of Statutory Instruments that contain the constitution of the reserves   | Constitution of the reserves as No.63 of the Statutory Instruments; supplement No. 23 (Forest Reserves – Declaration Order)  |
| 2000      | Formulation of the National Forestry and Tree Planting Act, 2003   | Mandated Management of Central Forest Reserves under a responsible body; currently the National Forestry Authority that is to manage them on a business-like manner.<br>Defined roles and responsibilities of all stakeholders and defined out the need for participatory approaches in Forest Management  |
| 2001      | Establishment of the National Forestry Policy, 2001  | Made a commitment to create a responsible body (National Forestry Authority), to replace the Forestry Department to improve the management of Central Forest Reserves.   |

**Annex II: Stakeholder interests in Rwoho and Bugamba CFR (Source: Field Staff of Southern Plantations)**

| Stakeholders  | Interest  | Potential Contribution  |
|---|---|---|
| Local Community   | <p>Forest Product Sources:<br/>Firewood, timber, building poles, grazing land, water sources, land for growing crops, medicinal plants, land for tree planting</p> <p>Services:<br/>Employment, improved environment and environmental protection (reduced wind impact, soil erosion and protection of water sources)</p> | <p>Employment (labour supply)<br/>Protection against fires and illegal activities<br/>Tree planting and generally collaborative forest management</p> |
| Local Government  | <p>Employment for local people<br/>Energy supply (fuel wood)<br/>Infrastructural development through road maintenance<br/>Extension services from forest staff<br/>Revenues from taxes (income to local governments)</p>  | <p>Awareness campaigns about forestry, forestry management<br/>Partners in fighting illegal activities<br/>Popular support</p>                        |
| Saw millers and Pit sawyers   | Saw logs  | Market for saw logs, income for NFA   |
| Private tree planters   | <p>Land for tree planting<br/>Extension services from NFA staff</p>   | <p>Increase in forest area in the sector<br/>Improved Forest Management</p>   |
| National Environmental Management Authority (NEMA)                    | Environmental protection and sustainable land use   | Guidelines on land use with environmental protection concerns   |
| Construction Companies  | <p>Supply of construction poles<br/>Firewood for brick making</p>   | Market for forest products (firewood, poles) hence income to NFA  |
| Institutions (schools, army (UPDF 4 <sup>th</sup> Division), prisons) | Supply for firewood   | Market for firewood and hence income to NFA   |
| Tax bodies (URA)  | Collection of taxes on forest products  | Regulation of illegal activities through checks on permits for forest produce   |
| Government of Uganda  | <p>Proper forest management, sustainable supply of high quality forestry related goods and services to the people of Uganda<br/>Poverty eradication</p>   | <p>Making policies and laws concerning the forestry sector<br/>Supervision of National Forestry Authority<br/>Funding for the Forestry Sector</p>     |

**Annex III: Sample License for Tree Planting within Central Forest Reserves**

**THE REPUBLIC OF UGANDA**  
**LICENSE AGREEMENT**

**THIS LICENCE** made this ..... day of ..... 200...

**BETWEEN**

**THE NATIONAL FORESTRY AUTHORITY** (hereinafter referred to as “**LICENSOR**” and shall where the context so admits include its successors) of Plot 10/20 Spring Road, P.O Box 70863 Kampala on the one part;

**AND**

**Rwoho Environmental and Protection Associations – RECPA** – (hereinafter referred to as “**LICENSEE**”) of P.O. Box 17, Ntungamo Uganda, on the other part;

**WHEREAS:**

- a) The Licensor has been mandated by the National Forestry and Tree Planting Act 8/2003 to manage Central Forest Reserves (herein after referred to as CFRs) in Uganda;
- b) The Licensor is desirous of promoting the development of forest plantations through issuance of tree farming licenses to private investors in designated CFRs;
- c) The Licensee has represented to the Licensor that the former possesses the requisite technical competences and financial resources to be able to establish a commercial forest plantation to the satisfaction of the latter;
- d) The Licensee is ready and willing to temporarily acquire usury rights to enter upon a designated CFR and establish a commercial forest plantation for the entire duration of the period envisaged herein;
- e) The Licensor has on the basis of the Licensee’s representations entered into this agreement for purposes of regulating the Licensee’s use of the land which is the subject of this license for the purpose stated herein and to standards that may from time to time be issued by the Licensor;
- f) The schedules attached to this agreement, any addenda, acknowledgement of receipt of payment from the Licensor and any communication incidental hereto shall be considered to be part and parcel of this license agreement;

**WITNESSETH as follows:**

**1. GRANT OF LICENSE**

In consideration of the payments herein agreed to be made by the Licensee to the Licensor and the covenants and conditions hereinafter contained and to be observed and performed by the Licensee, the Licensor hereby grants to the Licensee for the benefit of themselves and all their servants working thereat a license to enjoy the rights enumerated in clauses 2 & 3 herein at ..... CFR;

**2. USE OF LAND**

The Licensee has by virtue of this License the rights to:

- (a) Use an area measuring approximately ..... hectares of the CFR to establish and manage a forest plantation and to maintain the land provided the Licensee shall have obtained all the requisite consents, approvals and permissions as by law prescribed and by virtue of the conditions, performance standards and targets as set out in **Schedule A** (hereinafter referred to as the “conditions of licence”); and
- (b) Obtain access to the said land.
- (c) EXCLUSIVE USE OF LAND & OWNERSHIP OF CROP**

These rights shall be exercised by the Licensee in common with all other persons now hereafter authorised by the Licensee to use any of the part or all of the area affected by the license except that no license shall be granted for the permitted use save as herein otherwise provided.

**3. LIABILITY FOR DAMAGE OR USE**

The Licensor shall not be liable to the Licensee or any of its authorised persons exercising these rights for any injury, damage, loss or inconvenience howsoever or by whosoever caused to them or to any goods or chattels brought by any such person onto the land, it being the intention of and agreed between the parties hereto that the Licensee and any other person exercising the rights on the land at the invitation of the Licensee shall do so at the risk of the Licensee; and the Licensee accordingly agrees to indemnify the Licensor against all claims (as herein defined) by any lawful visitor to the land who shall have entered thereon for the purpose (in whole and in part) of lawfully visiting the Licensee or any of their authorised persons or who shall have entered thereon with the permission of the Licensee. A claim shall mean a claim in respect of the condition of the land or breach of statutory common duty of care.

**4. RETAINED RIGHTS**



## Bugamba and Rwoho CFRs Forest Management Plan

Without prejudice to the rights of the Licensee herein contained, the Licensor shall reserve the right to do the following:

- a) Right to inspect the land from time to time for purposes of monitoring the Licensee's performance in accordance with clause 11;
- b) Right to any proprietary/legal title to the area in as far as the Licensor's role as manager shall mandate;
- c) Right to amend and/or adjust standards that may from time to time be established by the Licensor in accordance with clauses 11, 12 & 13;
- d) Right of ownership of any existing forest produce on land as at the commencement of the License; and
- e) Right to conduct environmental audits on the Licensee's systems, processes and procedures.

### 5. PERIOD OF THE LICENSE

- (a) This License shall be for a period of 50 years with an initial probationary period of 24 months commencing on the date of this License;
- (b) Two months prior to the expiry of the probationary period, the Licensor shall evaluate the performance of the Licensee as per set performance standards and targets envisaged in **Schedule A**.

### 6. CONSIDERATION FOR THE LICENSE

The Licensee shall pay an annual Licence fee of .....

### COVENANTS BY THE LICENSEE

The Licensees hereby covenants with the Licensor as follows:

- a) Not to use the land for any purposes other than that stated in clause 2 above and in accordance **Schedule A**;
- b) To exercise the rights hereby granted and to ensure that the same shall be exercised by all its servants in accordance with the relevant provisions of the law and make adequate restoration and/or compensation for any damage nevertheless caused;
- c) To conduct its activities and to ensure that the rights hereby granted and the activities hereby authorised are exercised in a manner which does not in any way interfere with or adversely affect the enjoyment of the beneficiaries of the CFR for which the Licensor is accountable;
- d) To manage and maintain the land in an environmentally sound manner;
- e) Not to sub-license or part with the rights hereby granted over the land or any part thereof;
- f) Not to assign/transfer the benefits of/rights enjoyed under the License to a third party;
- g) To keep the Licensor indemnified against all damage, loss and injury of every description;
- h) Within one (1) calendar month of the termination of this License by effluxion of time or for any reason whatsoever upon receiving appropriate written request from the Licensor made either prior to such termination or within one calendar month thereafter to remove all the works and fixtures incidentally constructed on the land before or after the date hereof by the Licensee and to leave the land clean and tidy to the reasonable satisfaction of the Licensor.
- i)

### 7. TERMINATION OF THE LICENSE

The License may be terminated forthwith by notice being given by the Licensor:

- a) If the Licensees fails for a period of one hundred and eighty (180) days to remedy any breach (capable of remedy) of any of the stipulations and conditions herein contained after being required to remedy the same by notice in writing from the Licensor specifying the breach and requiring the same to be remedied;
- b) In the event that the period envisaged in clause 8 (a) is deemed to be insufficient, the Licensor shall extend the time subject to justification by the Licensee
- c) Upon such breach of the stipulations and conditions of this license, which in the opinion of the Licensor are incapable of being remedied and is stated so to be in the notice given by the Licensor;
- d) If a bankruptcy order is made against the Licensee or in case a resolution is made to wind up the License, or a winding up order is made or the License is wound up; or
- e) The Licensee may terminate this License upon expiry of one hundred and eighty (180) day prior written notice to the Licensor.

### 8. FORCE MAJEURE

- a) *Force majeure* shall not include the following:
  - i) Any event which is caused by the negligence or intentional action of a party, or the party's personnel or employee;
  - ii) Any event in which a diligent party could reasonably have been expected to take both into consideration at the same time of the conclusion of this contract and avoid or overcome in the performance of its obligations herein; and
- b) Failure of either party to fulfil any of its obligations herein, shall not be considered to be breach of or default of contract in so far as such inability arises from an event of *force majeure*, provided that the party so affected has taken all reasonable precautions, due care and reasonable alternative measures, all with an intention to executing its obligations herein.
- c) A party affected by an event of *force majeure* shall take all reasonable measures to remove such party's inability to fulfil its obligations herein with minimal delay.
- d) A party affected by an occurrence of an event of *force majeure* shall notify the other party of such event as soon as is possible, but not later than fourteen (14) days following the first evidence of the nature and cause of such event, and shall similarly give notice to the restoration of normal conditions.
- e) The parties shall take all measures to minimize the consequences of any occurrence in *force majeure*.
- f) A party who has served notice of *force majeure* and has taken all reasonable steps to avoid such prevention or delay shall have no liability in respect of performance of its obligations under this license as are prevented by the *force majeure* event(s) during the continuation of such event(s), and for such time after they cease as is necessary for the party, using all reasonable endeavours, to recommence its affected activities in accordance with this license.

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**9. AGREEMENT NOT TO CREATE TENANCY**

It is hereby agreed by both parties that this Agreement constitutes a License and confers no tenancy or other interest whatsoever to the Licensee and that possession of the land is retained by the Licensor subject however to the rights of the Licensee herein created

**10. NOTICES**

All notices required to be given under this License shall be in writing and sent by post or facsimile to the address of the other party or such other address as the recipient may designate from time to time by notice in accordance with this clause. Any such notice shall be deemed to have been delivered to an authorised representative of the party to whom the communication is addressed or when sent by registered post, facsimile to such other party at the following addresses:

- a) **For the Licensor** - The Director – Field Operations Division  
Plot 10/20 Spring Road, P.O Box 70863, Kampala  
Fax 041-230269
- b) **For the Licensee** -

Notices will be deemed to have been effectively delivered in the following circumstances – in the case of personal delivery – registered mail; or if it is by facsimile by transmission.

**11. DISPUTES**

- a) If at any time hereafter any dispute, doubt or question shall arise between the Licensor and the Licensees in relation to the land, or meaning or effect of this License or any clause or thing herein contained or their respective rights and liabilities under this License or otherwise in relation to the land then every such dispute shall be resolved by the parties herein in an amicable manner within thirty (30) days from the date of the dispute;
- b) In the event of failure to have the dispute resolved in a manner envisaged in clause 11 (a), the parties shall refer the matter to a mutually appointed mediator. In case the mediator fails to resolve the dispute the parties shall then refer the matter to court.

**12. MODIFICATION OF TERMS OF THE LICENSE**

- a) The parties may modify the terms or any other provision of this License from time to time depending on the performance of the Licensee;
- b) Either party shall give due consideration to the other’s proposals for modification and shall not unreasonably withhold the requisite consent; and
- c) All consents shall be mutual and shall be expressed in writing as addenda to this License.

**13. GOVERNING LAW**

This License shall be construed in accordance with the laws of Uganda and each of the party agrees to submit to the non-exclusive jurisdiction of the courts of Uganda.

**14. WARRANTIES**

Subject to the Limitations set forth in this license agreement, the Licensor warrants that it has the right to license activities envisaged under this agreement and that if the Licensee exercises the rights entailed herein, they shall not infringe on any other third party’s rights. The Licensor shall indemnify and hold the Licensee and authorized persons or visitors harmless for any losses suffered as a result of breach of warranty.

**IN WITNESS WHEREOF** the parties hereto have set their respective hands and seals this day and year first above written;

**SIGNED and SEALED for and on**

Behalf of **THE NATIONAL FORESTRY**

**AUTHORITY by** .....

J. RUHOMBE

**DIRECTOR of FIELD OPERATIONS**

.....

J. NDIMUKULAGA

**CO-ORDINATOR, FOREST UTILISATION**

.....

**MANAGING DIRECTOR**

**In the presence of:**

**SIGNED by the LICENSEE**

**In the presence of:**

.....

**SCHEDULE A: CONDITIONS OF THIS LICENSE TO BE OBSERVED BY THE LICENSEE**

1. The Licence does not vest ownership of the land in the Licensee. Land remains vested in Uganda Land Commission under management of the National Forestry Authority.
2. The licensee and their servants and employees shall at all times assist in the detection, prevention and extinction of fires in or threatening the area the subject of this License, and in the prevention and detection of trespassers and forest offences.
3. In the event of failure to remedy breach as envisaged in Clause 8 (a) and (b) of this License, the Licensor shall terminate this License.
4. The Licensee shall plant at least 10% of the area allocated each year.
5. Within the probation period of this license and where applicable, the Licensee shall;
  - (a) Prepare an appropriate management plan for the area under this License in consultation with the Licensor;
6. The Licensee shall operate within the minimum quality standards. The Licensee shall approach the Licensor for guidance on minimum quality standards required.
7. For purposes of the Clean Development Mechanisms in general and Carbon Sequestration in particular, the licensee shall conform to the provisions of the national strategy of Uganda.
8. The Licensor will, at any time during the currency of this license, bring to the attention of the licensee, any improvements required for good performance. If the licensee does not comply within the specified period in the manner envisaged in clauses 8 (a) or 8(b), the Licensor may take any remedial action, including the cancellation of this license if necessary.
9. The use of “taungya” (growing of agricultural crops among trees) is prohibited, save for initial clearing, in which case a maximum of only one crop season will be allowed.
10. Tree species to be planted are only those approved by the Licensor. The Licensor shall avail the licensee with a list of recommended species for the area which is subject to this license
11. In the interest of social responsibility, the Licensee shall endeavour to develop community outreach programmes and generally work with local communities.

## Annex IV: Summary of Nursery establishment guidelines

### Procurement of seed

All seed will be procured through the National Tree seed centre (NTSC) to ensure quality seeds hence uniformity of seedlings in the nursery. No Seeds will be procured locally. NTSC will ensure appropriateness of seed species/provenance, quality (physical, physiological and genetically superior) required and their availability. However, quality of imported seed is always unpredictable and viability may be affected by administrative delays (e.g. securing a Phytosanitary certificate) and poor handling. NTSC will therefore ensure that all seed procured is treated, tested, well-stored. Adequate information will be needed for all seed procured regarding species, provenance, and source, date of collection, site and stand information. This will help the field manager to know more about the seedlot received and to trace the origin when required.

All seed requests shall be based on the annual planting programme, spacing, under estimate (as an insurance against losses) of expected germination percentage, survival and quality of seedlings at planting time based on experience. Seed orders from the NTSC will be done one to two years in advance of nursery phase. Batch numbers shall be quoted in all seed records. Only Seed with a seed quality test certificate issued by NTSC after germination tests have been carried out will be used for sowing in nursery. A Seed and Nursery Register will be maintained by the nursery supervisor.

The Nursery Register shall record only those plants actually taken out of the nursery and used for field planting; transplants within the nursery and culls shall not be entered.

The Seed Batch registers in the nursery will help in determining the cause of poor germination so that it can be pinpointed i.e. either from poor seed which will be apparent from Silviculturalist's tests, or from poor nursery technique. On pricking out or germination in case of direct sowing the number of plants per kg of seed will be recorded.

Seed procured from seed centre will be stored at the lowest possible temperature and moisture content, in the dark, airtight containers or permeable, and in a refrigerated store to maintain viability depending on species. Seed will, therefore, not be procured until it is required for sowing and this date shall be shown on the order. Before sowing, seed shall be stored in a cool dry place, and any extra seed that is not immediately required shall be returned to the NTSC.

### 1. Forest Nursery

**Location, Design and Layout:** A permanent nursery will be established. One of the main considerations for a nursery site is water supply, accessibility. This shall be available throughout the year and the water delivered to the nursery by means of piping and hoses wherever possible; pumps shall be installed as necessary. The site shall not be heavily shaded for most of the day, slightly sloping (1-3°), have a fairly light soil, be drained and be adequately sheltered from cold or drying winds. The most economic layout in terms of boundary length is a square; in the centre are situated stores, potting shed and shade bandas. The surrounding area will be used for plant pots. In providing shelter for the nursery, fast growing exotics should be avoided as far as possible in view of their adverse edge effects. These can be lessened, however, by digging a deep trench along the nursery side of the hedge or shelterbelt. Hilltops and valley bottoms will be avoided.

**Seedbeds construction and soil mixture:** The function of the seedbed is to provide for the seed to germinate in before transplanting. It will be constructed when raising small seeds that can be directly sown in pots. It shall be freely drained to prevent damping off. Generally the seedling will be transplanted while it is still utilising food reserves in the cotyledons, so the nutrient status of the seed bed mixture is not important. A 10 cm. deep bed, of a mixture of equal parts of sieved forest soil and sand, or even pure sand, over a layer of coarse stone is adequate. No fertiliser is necessary. The size of the sand grains will depend upon the size of the seed. The seedbed mixture shall be firmed and levelled.

**Pre-sowing treatment:** Some seeds may be in dormant state but viable even if given the right conditions normally favourable for germination. The basis of the dormancy must be understood before prescription of treatment methods. These are; mechanical scarification, hot/ boiling water treatment, alternate soaking/ drying, cold moist stratification, and concentrated sulphuric acid etc for different species.

**Sowing in seedbed:** Sowing will be carried out at such a time, that the seedlings will have attained optimum size at the time of planting. Seed will on no account be sown thickly. To avoid this fault, all fine seed (which includes cyresses) will be mixed with sand, 2 parts sand to 1 of seed, at the time of sowing. The mixture is then broadcast carefully and evenly onto the surface of the seedbed. Appropriate sowing density for *E. grandis* is 0.5kg to 25 m<sup>2</sup> of bed and *C. lusitanica* to 4.5 m<sup>2</sup> of bed

**Sowing depth:** The correct sowing depth is equal to the diameter of a round the seed and twice the smallest diameter of an irregular (oblong) seed, which means a very light covering in most cases.

**Direct sowing in pots:** This will be done for large enough seeds. This will not require seedbed establishment, and the expected germination must be good enough to ensure that there will be not much empty pots in the nursery. The seeds are sown directly into growing containers.

The growing medium is first watered to supply moisture for the seed. One, two or three seeds are sown in each container depending on the seed size, quality, availability and the germination rate. Sand or finely sieved soil shall

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be used for the purpose, being evenly applied and then firmed with a flat board. Vermiculite is also a good covering in low moisture areas, though it keeps the soil too moist and may cause damping off. It is useful where water is scarce. Conditions of light and moisture shall be carefully controlled from the time of sowing until the seedlings are pricked off.

**Shade and Watering:** Seedbeds will be given full shade and protection from rain. However, shade and mulch will be provided after germination. Enough water will be applied to keep the soil moist, but not too much to cause damping off. Water will be applied through a fine rose or mist spray. Shading of newly pricked out seedlings will not go beyond 10 days, otherwise the seedlings are likely to suffer damping off.

**Hygiene:** Seedbed soils will not be used for too long unless sterilised as damping-off organisms build up with time.

**Raising containerised seedlings:** Black (to prevent algal development) polythene tubes about 0.04 mm thickness (250 gauge) will be used. The container may be reused several times if the gauge is thick. The seedlings will not be left too long in the container, as the roots coil round inside and this habit continues after planting out, impairing normal lateral growth leading to instability. Modern stiff plastic will be used in future as this encourages downward root growth. The height of the plant at planting time should be one or two times the height of the container.

**Transplanting:** The seedlings will be pricked out into polythene pots or bags. It is essential that seedlings are transplanted as soon as they are large enough to handle. This means, in most cases, one week after germination has taken place. To leave seedlings in the seedbed longer than this results in increasing check on the transplant, a setback from which they may never fully recover from.

Holes will be dibbled in the pot ensuring that the holes will take in all the roots. In lifting seedlings, always grasp the plant by its seed leaves, or seed coat, never by the stem as this may cause damage to the tissues, which in turn results in checking and the possibility of disease. If the seedling has been left too long in the seedbed, the taproot will be cut back to prevent it being bent up in the hole. The whole operation must be carried out entirely under shade, and the workers themselves will be under shade.

**Potting/ size of Pots:** These are in the form of 5cm lay flat size for Eucalyptus and 7-8cm for conifers. Larger sizes or empty milk pots may be used for hardwoods. The gauge generally used for large pots is 250, but experience may show that a lighter gauge, say 150, is practical. Wide pots take more soil and space.

The pots will be filled to within 1 cm. of the top with the standard soil mixture for the nursery. The mixture can vary from nursery to nursery depending on local conditions, availability of materials etc., but once a satisfactory mixture has been found it will be standardised and laid down as such in the Forest Management Plan, together with the source of supply of each constituent.

**Nursery soil mixture:** This will be prepared using ratios of 5 units of Forest Soil to 2 units of Mycorrhizal soil. If the soil is not sandy loam, then sand will be added to improve drainage. Organic matter from well decomposed plant or animal matter may be used as it improves chemical and physical properties of the soil mixture. The complete mixture (including NPK) will be made up 2 weeks to 1 month in advance of transplanting (pricking out) so as to allow sufficient time for organic material to break down and, nutrients to become fully distributed. During the waiting period, it will be protected from sun and rain and maintained in a nicely moist condition by occasional watering. To allow adequate time for "settling" the mixture will be put into the pots at least a fortnight before pricking out. During this time, weed seeds also germinate and will be removed.

For pines, *Mycorrhiza* will be included in the soil mixture to ensure early growth of seedlings. The mycorrhizal association helps the plant to absorb water, nutrients and protects the roots from diseases. The easiest way to ensure the presence of beneficial *mycorrhiza* is to collect the soils from healthy existing pine plantations/ stands. An amount of 0.1-0.2 by volume or at least 10% will be adequate.

**Fertilisers:** These are added to the soil mixture while it is maturing to provide a source of nutrients for fungi and bacteria that are breaking down the organic matter and to prevent them depleting the nutrients already in the mixture. 1.5 Kg of NPK will be added to every 1.0 m<sup>3</sup> of the soil mixture. The heap of soil will be stored in a bin of known size so that its volume can be calculated. Fertilisers should be obtained in the following forms: N = Sulphate of Ammonia, P = Super-phosphate (usually double), K = Muriate of Potash. N, P and K should be mixed in the ratios 20:10:10. Fertilisers will be carefully protected from damp when in store and will only be mixed immediately before applying otherwise rapid deterioration in the nutrient content takes place.

**Shade and Watering:** Transplants require full shade for the first two to three weeks, then half shade for one week, after which no shade should be necessary. As the shade is decreased the intensity of watering will be increased; for the first few days after pricking off light watering only is necessary, similar to that given to a seed bed. Once the plants are established and fibrous roots are beginning to develop, the rate of watering will start to increase gradually until, by about the middle of the dry season preceding planting, the twice-daily rate has been stepped up. Fine roses will always be used.

Even in a particular nursery it is virtually impossible to lay down definite rules regarding the intensity of watering. The amount of water required by pots can only be judged by the condition of the soil at the time. Nursery workers will be taught how to recognise a "nicely moist" soil by the feel and appearance, and instructed to carry out frequent checks to ensure that this condition is constantly maintained by appropriate watering. This should eliminate the common faults of over-watering young transplants and under-watering old transplants.

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**Cultivation and Mulching:** Once the transplants are well established the soil surface requires cultivation or loosening at regular intervals to prevent it becoming compact hard. Weeding is carried out at the same time. Mulch will be applied to the soil surface when the shade is fully removed, primarily to conserve soil moisture. Thick mulch is essential during the dry season. A variety of materials can be used for this purpose e.g. chopped leaves, chopped grass, charcoal, rotted coffee husks, wood shavings (not sawdust) forest litter etc. After cultivating the soil, the mulch will be applied liberally to form a complete cover 1 - 2 cm. thick. If termites are likely to attack the mulch material it can be treated with a light dusting or before applying, alternatively use charcoal, which is not affected by termites.

**Root Pruning:** About two months after pricking off, root pruning will be commenced using a knife, wire, or scissors or fingernails. Root pruning will be carried out weekly.

**Hardening off:** To prepare transplants for the change to field conditions, a process of "hardening off" will begin five or six weeks before planting out time. This involves gradually reducing the amount of watering and increasing the frequency of root pruning so as to bring the nursery stock to a standstill.

## **2. Protection of plants**

**Termites:** These treatments are for plants that will be used in areas where losses from termite damage are likely. For this reason, pots must be used. If plants are being attacked, then treatment with an appropriate insecticide according to the manufacturer's instruction should be done.

**Pre-treatment of nursery Soil.** Fungicide at 8gm per litre of soil or 8kg per cubic metre of soil is thoroughly mixed in the potting soil before placing into pots. Higher concentrations of the insecticide are not recommended as phytotoxicity may develop. Recommended rates will, therefore, be adhered to.

**Treatment of Plants Already in Tubes:** Once seedlings have been potted, it is unwise to treat them with Fungicide as there is likely to be uneven mixture of the soil. Treatment in potted plants is not, therefore, recommended. However, when planting out, Fungicide granules at 5 gm per tree should be placed in the planting hole. Then thoroughly mix the Fungicide granules with the soil in the planting hole before planting and replace the treated soil around the root zone of the planted seedlings. When pots/tubes have been treated using the method as described, the plants will not be planted too deep. At least 1 cm of the treated soil will be above the ground level. This will prevent untreated field soil from covering the treated soil and thus giving the termites a bridge. When planting, the top 3 cm of the pot will be left intact but the bottom part of the pot will be split or removed to allow for lateral root development.

**Field Applications:** Mix 10g of Suscon granules with soil around the planted tree. Different species of termites forage at different depths in the soil and so it is important that the granules are mixed evenly round the taproot and underground stem of the young tree. In terms of cost, labour, ease of application and effectiveness, nursery treatments are the best. Applications in the field may make planting rates two or three times slower and are generally 5-10 times more expensive. Insecticide applications can do little to help poor plants or careless planting. There is no substitute for vigorous plants. When clearing ground for planting Eucalyptus, termites will be destroyed by poison or digging out the queen-ant. This will be done by digging up the anthill and then pouring in poison or keep digging until the queen ant is found and removed.

Plants will be protected from Crickets, Hoppers, Weevils, Cut -worms, Chafer grubs etc by spreading Beds and paths with treated soil or spraying with appropriate chemicals approved by National Forestry Authority.

**Damping off:** A fungicide such as "Tulisan", Cobox/ Copsap or "Kaptan" containing copper oxide oxychloride will be used as routine measure in all nurseries. The fungicide will be watered onto the seedbed before sowing and at weekly intervals. However, the best protection is thin sowing and avoidance of too much watering. "Perenox" or other copper based fungicides will NOT be used on acid soil or transplant beds because it inhibits root growth. Damping-off is the most common plant disease encountered in the forest tree nurseries. Benign environment created for the maximum growth of the seedlings also favor the growth of the fungi. Fungi, causing the disease include: *Pythium*, *Fusarium*, *Phytophthora*, and *Rhizoctoma*.

The symptom of the damping-off is the dying of the stem tissue of germlings just above the soil surface. The root collar rots felling the germling. The damping off is caused and/or stimulated by the following factors:

- Too moist growing environment and poor drainage (wet season, excessive misting/irrigation often in connection to heavy soils).
- High temperature
- Too little light.
- Poor ventilation and air circulation.
- pH over 6.6
- Too high nitrogen level of the substrate
- Too high sowing density in the seedbeds.

The damping-off may begin from several different places at the same time, spreading very quickly and can kill a big number of germlings in a few days. The spread of the fungi often takes place at night through air, water or substrate. The fungus may also be seed born.

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Because of the quick spread of the disease, you have to respond to it promptly. The following control measures are recommended:

- Check all germlings quickly to assess the extension of the damage
- Estimate the stage of the attack; early stage (symptoms) or intermediate /serious stage (lots of germlings have fallen)
- If the attack is at an early stage, fungicide spraying usually helps. Chemicals, such as copper oxide and Benlate (Benomyl 50%) are available and can be used. The dosage must be according to the instructions of manufacturer. Good spraying frequency is 2 – 3 times a week. Spraying must be done in the afternoon and no watering must be done after spraying.
- Most infected stock must be removed, if at least 70% of germlings have been attacked, burn all germlings as it is impossible to cure them. The substrate must not be reused.
- All sowing boxes, growing tables and the germination environment must be disinfected

Since prevention is always better than cure one can prevent damping off by the following means:

- Control of humidity
- Reduce shading
- Avoiding over-watering
- Avoiding too dense sowings
- The amount of light in germination house should be maximized
- Thorough cleaning of sowing tools and equipment, this is done by washing away the fungicide treatment and by drying in the sun
- Store the seed in a dry, cool and clean environment
- Maintain the substrate moist, but not wet

Measures to prevent fungal diseases at the later stage of the growing include:

- Reduction of the growing density of bigger seedlings to improve air circulation between the seedlings as this prevents the growth of fungus
- Improve lignification. This can be done through increased P and K application

Prolonged use of a certain chemical in the nursery creates partial resistance in the seedlings. Therefore, it is advisable to use different products or products with different active ingredients in turns.

**Safety:** Maximum safety will be ensured before using insecticides and fungicides.

**Alignment:** Accurate horizontal espacement is essential at establishment; without it, subsequent selection and thinning are more difficult and liable to serious error. On easy terrain, where the difference between stocking per ha obtained by measuring the length along the ground and horizontally is negligible (slopes less than 20 degrees), a nylon rope marked at lengths desired for spacing will be used for lining out, taking care to maintain a the required square/ rectangular pattern on ground. For sloping at 20 degrees or over, lining out will be done using horizontal measures of lengths by the following method:

- Lay out a “base line” through the planting area choosing as long an uninterrupted roughly horizontal line as possible (in rugged terrain the base-line is best selected nearer to the top of a ridge than the bottom because it is easier to work down hill than uphill from it).
- Lay a rope along the base line. Using a light stick held horizontally and with length exactly equal to the desired espacement, put in pegs at desired length (spacing) along the base line.
- At or near the end of the base line, using a Cross Staff or Optical Square (never a compass), lay off a “cross line” exactly at right angles to the base line.
- Lay a rope along the cross line then, using a light stick with desired espacement held horizontally as before, put in pegs at every desired espacement along the cross line above and below the base line.

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- Depending on the degree of control desired, cross lines will be laid down as described above at intervals along the base line - e.g. every 10th stake or every 20th stake. These stages will be done by trained staff of not lower than a technician level).
- Now it is possible to start lining out the planting area by the echelon method which can be repeated from each cross line as follows:
- Lay a rope (Rope 1) from the base line parallel to a cross line at the required spacing measured horizontally from it, then, as before stake every desired espacement measured horizontally along the rope.
- Move Rope 1 to its second position still parallel to the desired espacement from the cross line, repeat the staking process.
- As soon as Rope 1 has moved to its second position, Rope 2 can be introduced starting again from the base line and laid parallel to and horizontally from the first position of Rope 1 while staking this - and all subsequent lines - not only will the desired espacement be measured horizontally but also the lines of stakes at right angles to the rope will be maintained by eye.

Alignment depending on espacement will be carried out. Pits (30 cm deep with a radius of 30 cm) will be dug well in advance of planting.

### **3. Seedlings transportation**

**Loading and unloading:** Seedlings will not be held by the shoot but rather by the container. Packing of seedling for transportation for long distance transportation of seedlings from the nursery to the plantation site will follow the following guidelines:

- It is important to water sufficiently prior to the transportation to guarantee the moisture of root balls during entire transportation. Proper watering must be done 1 to 2 times of watering daily during the intermediate storage awaiting planting.
- Fumigate against plant diseases, remember to follow pesticide safety instructions.
- Undertake quality control.
- The seedlings shall be packed with care so that no damages during transport, unloading the truck, intermediate storage and unpacking would occur.
- The seedlings shall be placed in upright position.
- The height of the seedlings (total height with root system) shall not exceed the free height of the box or crate in case these are used.
- The seedlings shall be placed in one layer; no stacking allowed
- Too strong tightening to be avoided to protect roots
- Care must be taken to avoid stress caused to the seedling by vibration or other kind of mechanical damage, wind, heat or cold and desiccation.
- A truck with a frame to make possible efficient use of tarpaulins to protect the seedlings from wind will be used.
- Care must be taken so that the canvas (tarpaulin) does not damage the vulnerable shoot tips.

### **4. Nursery Planning and Organisation and Nursery Records**

The proper recording of nursery information is absolutely essential and will involve the keeping of information by use of labels and forms.

**Labels:** All forms of nursery stock whether in seed beds, transplant beds, boxes, or pots etc. will be fully labelled; a scrap of paper in a cleft stick does not count as a label - ivorine or metal labels will be used. Labels will show the following e.g. species, batch No., date sown, quantity sown, date germinated, date transplanted and number transplanted. Example:

*Entandrophragma excelsa*, butch No. 256, sown 26-05-2006 500grams, germinated on 07-6-2006 directly sown in 2000 pots planted in good condition.

|                                     |
|-------------------------------------|
| Species: <i>Pinus patula</i>        |
| Batch No: S.123                     |
| Date Sown: 01/11/05: (100g)         |
| Date Germinated: 07/12/05           |
| Date Transplanted. 10/7/96: (2,400) |



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A nursery plan with these details will be useful, in case of loss of labels

**Nursery Calendar:** This lays down for the nursery, the sequence of operations to be carried out by nursery staff month by month. Once a calendar has been drawn up and approved, in practice, it remains in force until amended. In addition to the actual timetable of operations, standard instructions for soil mixtures, fertilisers etc. will be incorporated as footnotes.

**Nursery Stock Requirements:** This form will be compiled by the nursery operator for each nursery to show as far in advance as possible the number of plants to be raised in accordance with the annual planting programme. After approval, a copy of the completed form will be sent to the Forestry supervisor in charge of the nursery, who will then be responsible for organising the nursery work accordingly. Seed requirements shown on this form will of course be incorporated in operator's annual seed indents, whilst the sowing and planting months quoted will be in accordance with the Nursery Calendar.

The primary objectives for these forms will be to ensure that sufficient plants are raised for annual planting programme; and that the stock produced each year is of optimum size i.e. not more than 25cm high and well proportioned, at the time of planting.

**Sale of Nursery Plants to local communities and private investors:** If it is certain that there is a good market for nursery plants (for timber/poles/fuelwood/ X-mas trees or ornamentals), then overall supervisor will plan and budget to meet such a demand. It will not only be a commercial venture but also good publicity for organisation and to ensure that only quality plants are planted in the area. However, when it is found out that other agencies already or have the capacity to perform this service adequately, there will be no need for the NFA to do so. These agencies may be the Agricultural Advisory services, Local governments, NGOs/ CBOs and individual commercial nursery owners.