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Emiti Nibwo Bulora woodlot technical specification

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SUMMARY

This ʺtechnical specificationò has been developed for use by Plan Vivo projects involving communities participating in the Kagera Region of Tanzania. Through the Plan Vivo system communities may be able to access carbon finance by land use change activities that involve afforestation and reforestation. The activities described in this technical specification are only eligible for establishment on smallholders or community land which is either currently cultivated or neglected. This land management system may not be applied on land that already supports natural forest cover.

The system involves planting a variety of indigenous timber species on fragmented land plots which farmers have difficulty managing because of labor shortage, distance, theft or other constraints. The aim of this land use system is to diversify farm production and provide multiple benefits such as timber, firewood, medicine and fodder while minimizing land management requirements in Kagera, Tanzania.

This technical specification sets out the methods that should be used to estimate the carbon benefits over a 25 year crediting period from planting and managing small mixed woodlots in Kagera, Tanzania. This technical specification also details the management requirements for this system over a long period of time, and the indicators to be used for monitoring the delivery of the carbon benefit.

The technical specification aims to summarise the best available evidence about the environmental benefits associated with the sustainable management of this land use system. Further information and research is welcome and will be incorporated periodically.

This land use system has been developed in consultation with communities and individual farmers in Kagera Region in Tanzania. Other valuable contributions to the development of this system have been received from SCC-Vi Agroforestry staff, national and district government officials and forestry and agricultural extension workers. The inputs have been received through a structured process of meetings and interviews with these key stakeholders between May 2008 and December 2008.

The main objective of the woodlot system is to diversify farm production and provide multiple benefits such as timber, firewood, medicine and fodder. Additional environmental and social benefits will include soil conservation, improved water quality, enhanced biodiversity, and income diversification through firewood, medicine, bees and other non timber forest products (NTFPõs). The carbon finance will make a critical difference in allowing for the implementation of this system by helping to finance the purchase of tree seedlings, increasing capacity in managing this land use system and putting in place frequent monitoring to ensure compliance with the technical specification that will create the carbon sink. This system should allow for widespread participation of small holding farmers in carbon markets, as it provides an opportunity to farmers to use available land which is not optimally utilized in a profitable manner or place it under a less intensive management system.

The net carbon benefit and tradable carbon offset for the woodlot land use system is shown in this table:

Technical Specification	Sink (tC/ha)	Baseline (tC/ha)	Net benefit (tC/ha)	Buffer (%)	Tradeable (tC/ha)	Tradeable (tCO_2/ha)
Woodlot	50	2	48	20	38	140

ACKNOWLEDGEMENTS

This work has been undertaken by ESD/Camco as part of the Plan Vivo pilot project implementation in the Kagera Region of Tanzania. It has only been possible because of the financial support received from SCC-Vi Agroforestry. ESD/Camco wish to acknowledge the contribution made by all the staff of SCC-Vi Agroforestry Kagera, and all the other stakeholders engaged during the participatory planning process used to design and collect data for this technical specification.

1 Description of Land use system

The system involves planting a variety of indigenous and naturalised tree species on fragmented land plots which farmers have difficulty managing because of labour shortage, distance, or other constraints. The aim of this system is to diversify farm production and provide multiple benefits such as timber, firewood, medicine and fodder while minimizing land management requirements. This system may be used on degraded or under-utilised land where in the long term this system may help to re-habilitate degraded lands. Growing of crops during the initial years after tree planting will be possible and may assist with tree establishment and subsequent maintenance.

1.1 Main tree species

Table 1: Tree species recommended for the woodlot planting system.

Botanical name	Common name (English)	Range
Maesopsis eminii	Umbrella tree	Naturalised
Acrocarpus fraxinifolius	Australian ash, Indian ash, pink cedar, shingle tree	Naturalised
Casuarina equisetifolia	Australian pine, beach she-oak, beefwood tree	Naturalised
Podocarpus spp	East African yellow wood	Indigenous
Markhamia lutea	Makhamia	Indigenous
Acacia nilotica	Babul acacia, Egyptian thorn, prickly acacia, scented thorn, scented-pod acacia	Indigenous
Albizia lebbeck	East Indian walnut, English woman's tongue, fry wood	Naturalised
Acacia polyacantha	African catechu tree, white thorn tree	Indigenous

1.2 Ecology

Table 2: Ecological requirements of recommended species

Species	Ecology
Maesopsis eminii	Very common in the ecozone between high forest and savannah.
Acrocarpus fraxinifolius	Grows best in sub-montane areas in the humid and sub-humid tropics with a short, dry spell.
Casuarina equisetifolia	Its natural range is semi-arid to sub humid. Commonly confined to a narrow strip adjacent to sandy coasts, rarely extending inland to lower hills
Podocarpus spp	A humid and warm climate is preferable; in dry and hot areas plantations fail.
Markhamia lutea	The tree is drought resistant but cannot withstand water-logging.
Acacia nilotica	It is drought resistant and occurs in plain, flat or gently undulating ground and ravines
Albizia lebbeck	The species occurs on soils overlying basalt and among sandstone boulders and basalt outcrops on breakaway slopes. It is also found on the

	banks of riverine sites, on stabilized dunes or low lateritic ledges above the beach
Acacia polyacantha	The species occurs in wooded grasslands, deciduous woodland and bushland, riverine and groundwater forests in altitudes between sea level and 1800 m.

1.3 Altitudinal range

Table 3: Suitable altitudinal ranges for recommended species

species	Altitudinal range and climatic factors
Maesopsis eminii	700-1500 m, Mean annual temperature: 22-27 deg. C, Mean annual rainfall: 1200-3000 mm
Acrocarpus fraxinifolius	0-1500 m, Mean annual temperature: 19-28 deg. C, Mean annual rainfall: 1000-2000 mm
Casuarina equisetifolia	0-1 400 m, Mean annual temperature: 10-35 deg. C, Mean annual rainfall: 200-3 500 mm
Podocarpus spp	1 550-3 000 m, Mean annual temperature: 13-20 deg. C, Mean annual rainfall: 1 200-1 800 mm
Markhamia lutea	900-2000 m, Mean annual temperature: 12-27 deg. C, Mean annual rainfall: 800-2000 mm
Acacia nilotica	0-1 340 m, Mean annual temperature: 4-47 deg. C Mean annual rainfall: 200- 1 270 mm.
Albizia lebbeck	0-1 800 m, Mean annual temperature: 19-35 deg. C, Mean annual rainfall: 500-2 500 mm
Acacia polyacantha	Altitude 200-1 800 m, Mean annual rainfall: 300-1 000 mm

1.4 Habitat requirements

Table 4: Habitat requirements for recommended species

Species	Habitat requirements.
Maesopsis eminii	Tolerates a wide range of site conditions but grows best on deep, moist and fertile sandy loam soils with a neutral to acid pH.
Acrocarpus fraxinifolius	-Is a pioneer and demands light, but it can tolerate slight shade when young. - Grows best in deep, well-drained, clayey loam soils with a pH of 4-7. It l also thrives in shallow and compacted soils.
Casuarina equisetifolia	The species tolerates both calcareous and slightly alkaline soils but is intolerant of prolonged water logging and may fail on poor sands where the subsoil moisture conditions are unsatisfactory.
Podocarpus spp	Can tolerate moderate frost but not drought.
Markhamia lutea	Trees prefer red loam soil but can tolerate well-drained, heavy, acidic clay soils
Acacia nilotica	Grows best on alluvial soils in ravine areas subject to periodic inundation
Albizia lebbeck	Roots are near the surface so requires a high water table

	- prefers black-cotton soils but will grow in a wide range of soils including acid, , alkaline and saline
Acacia polyacantha	It prefers sites with a high groundwater table, indicating eutrophic and fresh soils. It occasionally prospers on stony slopes and compact soils.

1.5 Growth habit

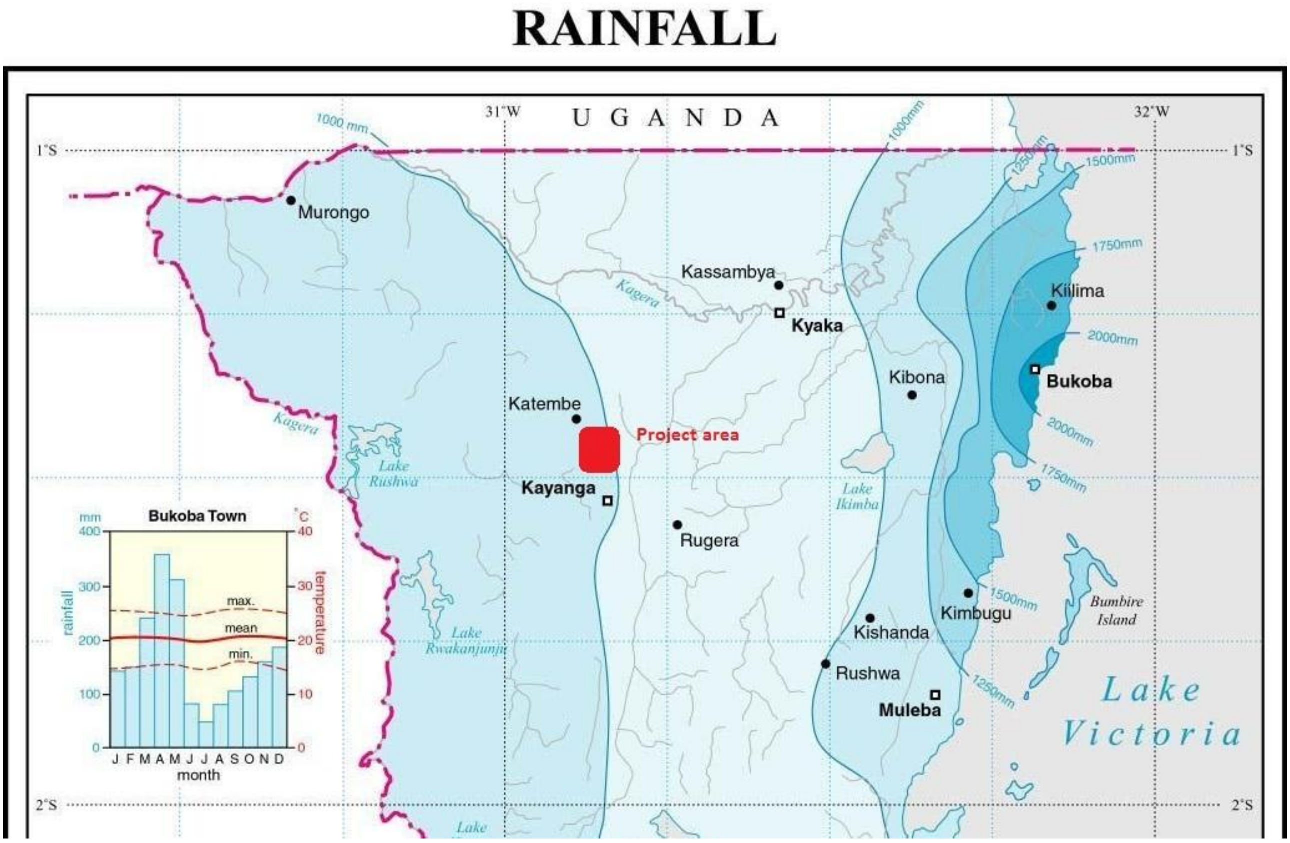
Table 5: Growth habits of recommended species

Species	Growth habit
Maesopsis eminii	It is an early successional species, adept at colonizing grasslands and disturbed areas in the high forest.
Acrocarpus fraxinifolius	Fast growth and very sensitive to frost.
Casuarina equisetifolia	Crown shape initially conical but tends to flatten with age.
Podocarpus spp	It is an evergreen tree up to 46 m in nature but much smaller if planted, with a long clean and cylindrical trunk
Markhamia lutea	It is an upright evergreen tree 10-15 m high, with a narrow, irregular crown and long taproot
Acacia nilotica	-Fast growing in favourable conditions - Bears full leaf in the dry season but is often very thorny
Albizia lebbeck	Fast growing on good sites. A deciduous tree which may reach 25m, usually 8 14m, trunk often short, crown low and spreading
Acacia polyacantha	Fast growing to 18m with open canopy

1.6 Scope and applicability of this system

The project area (E31.07; S01.48) falls within the perennial banana/coffee agro-ecological zone with elevation of 1300-1600 meter. The annual precipitation is between 1000 and 1250 mm and mean annual temperature 20^{o}C. The agro-ecological zone of the project area as described above supports practicing the system, for example beside carbon revenues the system provides:

1. High demand for wood fuel as main source of energy for household use, woodlots can sustainably provide such benefits.
2. Farmers adapting to climate change as a result of increased food, income, improved technologies and environmental services
3. Other needs for tree products such as poles for construction can be supplied through this system.
4. Important source of income to the households.
5. An insurance during crop failure or sickness in the families.



2 Managing this land use system

2.1 Management objectives

This mixed native woodlot system provides an opportunity for farmers to use available land which is not optimally utilized in a profitable manner or place it under a less intensive management system. Land may be too far from farmersô compounds because of fragmentation, or crops grown may be affected by theft or vermin originating from the neighbouring protected area. Farmers may not have the necessary labour to cultivate. Each species has its own primary management objectives as follows

Table 6: Management objectives of recommended species.

Species	Management objective
Podocarpus spp	**Timber, Fuel (firewood), furniture**, windbreaks around homesteads, soil reclamation/conservation, shade/shelter, food and panelling.
Maesopsis eminii	**Reforestation purposes**, **firewood**, medicines (leaves, barks and roots), bee-forage, fodder (leaves), ornamental, shade (coffee), **timber**
Acrocarpus *fraxinifolius*	**Timber**, Apiculture, shade/shelter, firewood and charcoal, soil erosion control, soil reclamation (on degraded areas), soil improver (mulching), furniture
Casuarina	**Timber**, Reclamation on barren polluted sites, **firewood** (even when green),

equisetifolia	ornamental, windbreak, intercropping for soil fertility
Markhamia lutea	**Timber,** Soil improver (provides mulch which enhances soil moisture retention and increases organic matter), **poles** used as props to support banana trees soil erosion control, shade
Acacia nilotica	Bee forage, **fuel** (charcoal and firewood), degraded soil/land **reclamation**, **timber**, Nitrogen fixing, wind break
Albizia lebbeck	**Timber**, Fodder (leaves), **construction**, **erosion control** (good soil binder due to its extensive, fairly shallow rooting system), **shade/shelter**, soil improver as it is nitrogen fixing, mulch, ornamental,
Acacia polyacantha	Firewood, charcoal, timber, medicine, nitrogen fixing, soil conservation, fodder

2.2 Costs of implementation

These costs are based on planting 698 seedlings per hectare (assuming a mixture of 3m x 3m and 4m x 4m tree spacing is used in proportions listed (Table 10) for carbon sequestration models). The costs presented are merely indicative.

2.2.1 Nursery costs

The activities and costs during the setting up of the nursery are

- Seeds
- Digging and mixing of the soil
- Pot filling, transfer, and topping
- Seed sowing and bed management
- Pricking out and selection/transfer
- Watering and sanitation
- Cost of one wheelbarrow, 3 hoes, 2 spades, 1 machete, shade netting, poles, water, and fuel costs

The total cost of these activities per hectare is estimated to be $ 190

2.2.2 Establishment cost

The activities in the establishment phase would include

- Demarcation and soil test
- Bush clearing
- Chaining/marking
- Planting

The total cost for this phase per hectare is estimated to be $ 210.

2.2.3 Maintenance cost

Operations for year one are grass slashing, spot weeding, firebreaks, uprooting shrubs. The cost per hectare is estimated to be $165

Year two operations include grass slashing, spot weeding, firebreaks maintenance, and uprooting shrubs,. The total cost in this year is estimated to be $ 170

Operations for year 3, 4, and 5 are maintaining of firebreaks is estimated to cost $ 180 per hectare

Other costs would go to buying equipments such as one slasher, one hoe, one machete, a pair of boots, and one overall coat. This is estimated to cost $ 40. In total, the maintenance cost is estimated to be $ 515

Table 7: Maintenance costs for woodlot planting system

Activity	Cost (per hectare of woodlot)
Nursery costs	$ 190
Establishment	$ 210
Maintenance year 1	$ 165
Maintenance year 2	$ 170
Maintenance year 3	$ 60
Maintenance year 4	$ 60
Maintenance year 5	$ 60
Operations	$ 40
Total	$ 955

2.3 Potential income

The calculations are based on planting 698 trees. The potential income is merely indicative.

2.3.1 *Timber*

Assumptions

- 1 hectare = ~300m^3
- The recovery rate is 25%
- 1m^3 is $260

Therefore 1 hectare woodlot would yield,

$$\frac{300 * 25 * 260}{100} = \$19{,}500$$

2.3.2 *Fuel wood*

Assumptions

- Firewood from timber off cuts (75%)

$$\frac{300 * 75 * 18}{100} = \$4{,}050$$

- Firewood from intermediate first and second thinning (60 m^3)

$$60m^3 * 18 = \$1{,}080$$

2.4 Management operations

The objective of this system is to produce high-quality timber at the end of established rotations, as well as fuelwood obtained through woodlot management operations (thinning and pruning). Integration of indigenous trees into rural landscapes also provides soil erosion control as well as biodiversity conservation benefits.

The system can be combined with intercropping during the two first growing seasons before competition would affect tree growth. Intercropping can provide significant tree maintenance benefits.

2.4.1 Preparation of site

Demarcate the planting area clear any unwanted undergrowth (competition) and mark where individual trees will be planted as follows:

1. All shrubs and unwanted trees should be removed from the planting area in order to remove undue competition with the young plants.
2. The litter should then be collected for burning
3. Uprooting of any stumps in the area.
4. Opening of holes (60cm x 60cm). This should be done before the onset of rains.
5. Planting should be done immediately 50 mm of rain is achieved during the onset of rains.

When planting nursery grown stock:

- Water seedlings before planting to hold nursery soil together and to assist establishment in case it fails to rain on the day of planting
- Care should be taken handling plants not to cause damage to shoots, buds or bark
- Only remove plastic from around root-ball at the time of planting. Care should be taken to remove all the plastic
- Prune back roots (especially any circular roots) at the time of planting to stimulate new root growth once in the ground
- Plant to depth of root collar (i.e., for bagged plants, to level of existing soil). Never plant deeper than in nursery leaving no roots exposed
- Ensure that soil is replaced firmly around trees (i.e., well heeled in). Put top soil back in planting hole first

2.4.2 Establishment

Table 8: Spacing and stocking density for recommended species.

Species	Establishment	No. to plant per hectare
Maesopsis eminii	Established by use of seeds and transplanted at a spacing of 4m x 4m.	625
Acrocarpuis fraxinifolius	Established by use of seeds and transplanted at a spacing of 4m x 4m.	625
Casuarina equisetifolia	- Propagation is mainly by seed; however, there is an increasing use of cuttings. 3m x 3m - They can be established using containerized seedlings, bare root seedlings or rooted cuttings. -Seedlings should be planted in well-drained light soils, not clay soils, to decrease the incidence of diseases and pests.	1,111
Podocarpus spp	- The trees are established by use of seeds or cuttings but cuttings taken from lateral branches and shoots produce plants with a lateral growth habit rather than an upright one. - When transplanting the seedling into the open ground, care must be taken not to damage the taproot, as it will result in a long period, sometimes up to a year, during which the tree will show no growth. Initial spacing will be 3m x 3m.	1,111
Markhamia lutea	Plant at 3m x 3m. Trees may also be propagated by seedling or wildings They should be planted in a deep hole	1,111

	as the roots are long. Trees can be pruned and pollarded to reduce shading and are coppiced when they are about 1.7 m in height.	
Acacia nilotica	- Direct seeding is commonly used to propagate the tree, though potted seedlings may also be used at a spacing of 4m x 4m. Bare-root seedlings are seldom used because the high incidence of root injury causes poor survival rates.	625
Albizia lebbeck	Typical spacing is 4m x 4 m for fuelwood, and 5m x 5 m for timber It is best established using potted seedlings although bare-rooted seedlings, direct seeding and stump cuttings have all been used successfully	625
Acacia polyacantha	Plant at 4m x 4m. It prefers sites with a high groundwater table, indicating eutrophic and fresh soils.	625

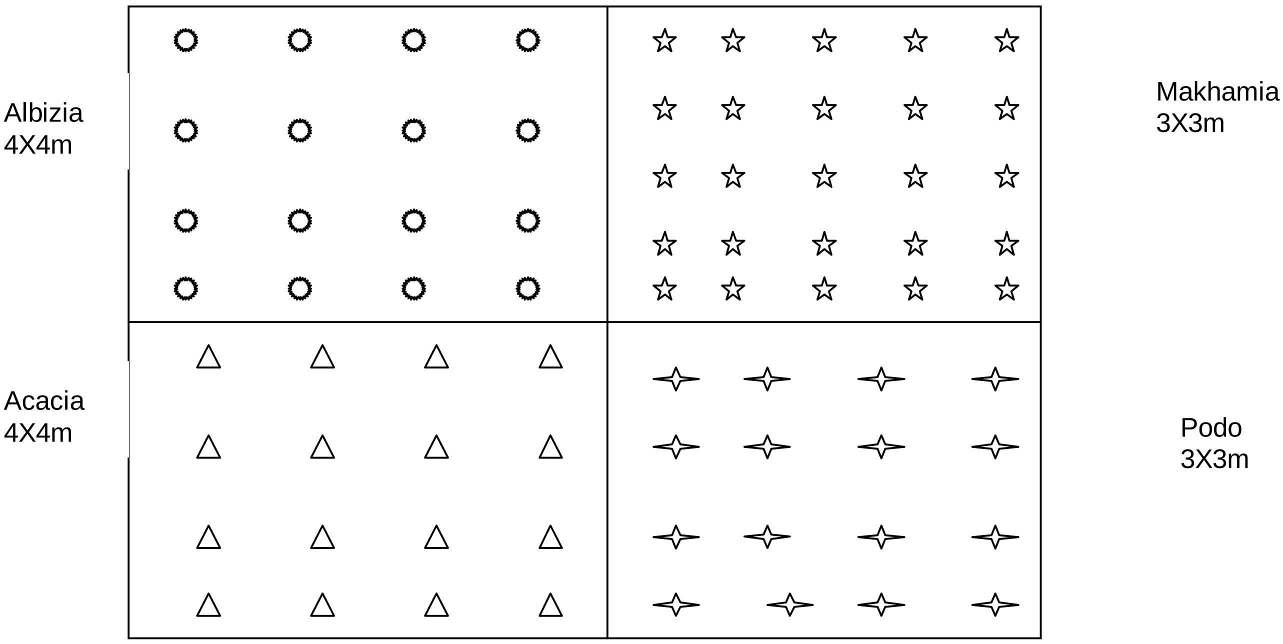


Figure 1: A typical layout of a woodlot with 4 tree species

2.4.3 Weeding

Weeding should be done twice in the first year and once in the subsequent years until dominance has been achieved by the planted trees. Weeding facilitates the achievement of maximum growth rate. Some grass slashing may also be required for the first three years and occasional uprooting of shrubs. Weeding reduces competition for nutrients and fire risk.

2.4.4 Protection from Hazards

The following measures are recommended to ensure the planted trees are not harmed:

1. Fencing off the planted area is recommended to stop grazing and reduce soil re-compaction by both animal and human activity. However, controlled foot paths should be designated to create access points across the planted area for humans.
2. Fire breaks need to be in place before the onset of the dry spell. Firebreaks are important in halting the spread of fire in case of such an eventuality
3. The boundary forest floor should be kept clean of any potential fire hazards.
4. The farmer should always be on the lookout for any fires.

2.4.5 Management

Table 9: Maintenance of various species recommended under the woodlot planting system

Species	Maintenance
Maesopsis eminii	-In case of attack by *Fusarium solani*, selective thinning should be carried out to remove the affected stems.
Acrocarpus fraxinifolius	Pruning and thinning
Casuarina equisetifolia	- Weeding is necessary as young trees are susceptible to competition from weeds, especially grasses. - This tree is a poor self-pruner. Pruning is necessary up to 2 m to make plantations accessible for maintenance. - The species is not fire resistant and protection is necessary. -
Podocarpus spp	- It is self-pruning. However branching associated with wide spacing necessitates pruning operations to maintain the quality of the timber. - The protection of plantations against fire attack is necessary since the bark does not provide adequate protection for the cambium.
Markhamia lutea	-Pruning and thinning
Acacia nilotica	Young seedlings are said to require full sun and frequent weeding
Albizia lebbeck	Coppices well, responds to pollarding, pruning and lopping, and will produce root suckers if the roots are exposed. The trees are vulnerable to strong winds and are killed by even light fires, thus requiring clearing of the forest floor and making use of firebreaks
Acacia polyacantha	Fast growing, weeding required

2.4.6 Harvesting and thinning

Table 10: Thinning and harvesting schedules of recommended species under the wood lot planting system

Species	Thinning	Harvesting
Maesopsis eminii	50% in year 8, 50% of the remaining by year 14	-Rotations are about 8 years for fuel wood, and 20 to 25 years for timber (depending on local conditions). It is expected that harvesting will be done through local pit sawing.
Acrocarpus fraxinifolius	50% in year 8	Rotation of 20 - 25 years for timber
Casuarina equisetifolia	50% in year 8-10, 50% of the remaining by year 12	- Rotation period varies depending on the farmerǒs need e.g. the rotation period ranges from 4-5 years for fuel wood and 10-15 years for poles and 25 to 30 years for timber years .
Podocarpus spp	50% in year 8, 50% of the remaining by year 15	Harvesting 30 to 35 years depending on site conditions. Carbon modelling has been done based on 30-year rotation.
Markhamia lutea	50% in year 12	- Harvesting should be done at age 35 ï 40.

		Modelling is based on 40-year rotation.
Acacia nilotica	50% in year 6 - 8	Can be harvested firewood at age 8 and for timber at age 20.
Albizia lebbeck	50% in year 6 - 8, 50% of the remaining by year 12	-.Fuelwood plantations can be clear felled on a 10-year rotation and for timber at age 25
Acacia polyacantha	50% in year 6 - 8	Can be harvested firewood at age 8 and for timber at age 20.

3 Description of the environmental and social benefits that may be derived from this land use system

- Woodlots will provide a local and sustainable source of firewood, poles and timber.
- Reduced pressure other forest resources (potentially resulting in positive leakage ï see below).
- Income diversification through timber and NTFPȏs.
- Soil conservation - particularly the prevention of soil erosion associated with heavy rainfall events and siltation of water courses (climate change adaptation benefit)
- Hydrological benefit ï harvesting of incidental moisture and improved water flows which will help to reduce catastrophic flooding (climate change adaptation benefit)
- Biodiversity benefit ï through the protection of wildlife habitat (birds, bees).
- NTFP ï beekeeping, medicines, fruits etc.
- Shading for humans and livestock

4 Description of additionality of community and individual on farm tree planting in Kagera Region, Tanzania

A key factor is that the emissions reductions from a project activity or intervention should be additional ï i.e. the intervention would not have occurred in the absence of the carbon derived finance. Additionality can be demonstrated through an analysis of the barriers to the implementation of activities in the absence of intervention. In this case the barriers to the permanent establishment of woodlots that are overcome through the project activity and receipt of carbon finance are:

- Community mobilisation and participation in planning processes
- Capacity (on improved land use management systems, agriculture and silviculture)
- Awareness (benefits that may be derived from tree planting)
- Raising seedlings
- Seedling distribution
- Training to enable long term sustainability of programme through participatory monitoring and evaluation

As there are no formal means by which communities can access funding to cover these costs, the effect of Plan Vivo carbon finance is strongly additional.

5 Leakage Assessment

Leakage is unintended loss of carbon stocks outside the boundaries of a project resulting directly from the project activity.

In the case of establishing woodlots this is most likely to occur where farmers are establishing trees on cultivated land (many of these tree species are not suitable to be grown in combination with other cultivated food crops). If this were to occur it may result in displacement.

The Plan Vivo system requires that potential displacement of activities within the community should be considered and that activities should be planned to minimise the risk of any negative leakage. These actions should include:

- All farmers should be assessed individually to demonstrate that they retain sufficient land to provide food for themselves and their families.
- Signatories to Plan Vivo activities will be contractually obliged not to displace their activities as a result of the tree planting.
- A plan to monitor leakage on specific other woodland areas to ensure leakage is not occurring.
- Formation of community based ‘policing’ to ensure that leakage resulting from displaced activities does not occur.

Where communities have a satisfactory plan for managing leakage risk resulting from the establishment of fruit orchards there should be no assumption of leakage.

In all probability the most likely outcome of establishing woodlots is positive leakage as a result of reduced pressure to exploit other forest resources..

6 Baseline Carbon Emissions

The ‘**baseline**’ refers to carbon sequestered and stored in any existing vegetation (not including food crops) on a site at the time of planting. When calculating the number of tradable emission reductions (VER’s) that a farmer has generated, the baseline carbon stock is subtracted from the carbon sink achieved by the project activity. The procedure used to quantify the “baseline” carbon emissions that would be associated with land management expected in the absence of the establishment of woodlots is set out in ‘Assessment of Net Carbon Benefit of Emiti Nibwo Bulora Project in Kagera, Tanzania’ (Camco, 2010). Since there is no significant difference between the carbon baseline on cultivated land and that on neglected land a common baseline has been applied for all land use systems. The carbon baseline is estimated to be 2 tonnes of carbon per hectare in the absence of project activities. A slightly different approach from previous carbon sink calculations has been adopted. In this new approach, the baseline value (i.e. 2 tC/ha) was input into the CO_2Fix model, resulting in a marginal increase in the long term carbon sink.

7 Carbon sequestration potential

The approach used for estimating the long-term carbon benefit of afforestation for Plan Vivo VERs is based on average net increase of carbon storage (sink) in biomass and forest products over a 25 year period relative to the baseline. The carbon sink is calculated separately for each of the technical specifications. A three-staged approach is used:

- Calculate tree growth rates based on tree measurement data captured within the project area
- The carbon uptake of each species is calculated using the CO2FIX-V3 model (Mohren et al 2004).
- These model outputs are then used to build the result for the technical specification based on the numbers of species in each system and the length of rotations.

The procedure used to calculate the potential carbon sink created by woodlots is set out in óAssessment of Net Carbon Benefit of Emiti Nibwo Bulora Project in Kagera, Tanzaniaô(Camco, 2010). The potential carbon sink created by this land use system (based on long term average carbon storage over 25 years) is calculated to be 50 tonnes of carbon per hectare.

This result is derived from carbon models based on planting tree species in the proportions shown in table 10. Tree growth data was not made available for all the tree species that may be planted by farmers adopting this land use system. Camco have therefore used the available tree growth data to model carbon sequestration potential using information gathered in the field relating to the most likely proportions of different tree species to be planted i.e. models are based on the most representative trees.

Table 10: Species used in carbon modelling

Technical specification	Species	Proportion (%)
Woodlot	*Maesopsis eminii*	60
	Acrocarpus faxinifolius	25
	Podocarpus spp.	10
	Markhamia lutea	5

8 Risks

The risks involved in relation to this technical specification:

Technical

- Lack of technical skills among farmers and long term extension services from government and NGOs.
- Availability of recommended species of seeds/seedlings is limited and hinders tree planting
- High mortality rates in the plantations due to pest and diseases and/or browsing by animals.
- Improved microclimate resulting from establishment of the system may lead to diversified flora and fauna, that might have negative effect on agricultural production (e.g vermin) leading to negative perception

Social

- Investment cost involved becomes a barrier
- Labour requirement is regarded to high by the farmers for engaging in tree planting activities
- Theft/illegal cutting of trees for fuelwood, fodder, poles etc without consent of owner of property
- Inadequate knowledge and capacity of the small holder farmers to undertake improved agricultural production may lead to negative perceptions on the system in case of crop failure, similarly the same could be true in case of crop failure due to inability to adapt to climate change in agricultural production
- Possibility for Land relocation as per existing land legislation may affect realising the carbon sink benefits form practicing the system

Market

- If pricing for timber increases it can motivate farmers to cut trees before the optimum rotation age.

9 Buffer

20% of all VERõs generated by the project activities are maintained as a risk buffer. Records of all buffer stock should be maintained in the database. It has yet to be decided at what stage the right to trade these VERõs will return to the farmer.

10 Calculation of credits

For the purposes of quantifying Plan Vivo certificates (carbon offset), the net carbon benefit of each tree planting system in addition to the baseline has been calculated. In accordance with Plan Vivo standards (http://www.planvivo.org/) 20% of all the carbon offset (i.e. net carbon benefit) is set aside to be kept as a risk buffer (i.e. non tradable carbon asset). Records of all buffer stock should be maintained in the database. The net carbon benefit, buffer stock and tradable carbon offsets (Plan Vivo certificates) generated by the woodlot land use system (technical specifications) is presented in the table below:

Table 11: The net carbon benefit and tradable carbon offset for the woodlot land use system

Technical Specification	Sink (tC/ha)	Baseline (tC/ha)	Net benefit (tC/ha)	Buffer (%)	Tradeable (tC/ha)	Tradeable (tCO_2/ha)
Woodlot	50	2	48	20	38	140

The figure below shows the long-term average carbon sink over the simulation period (25 years).

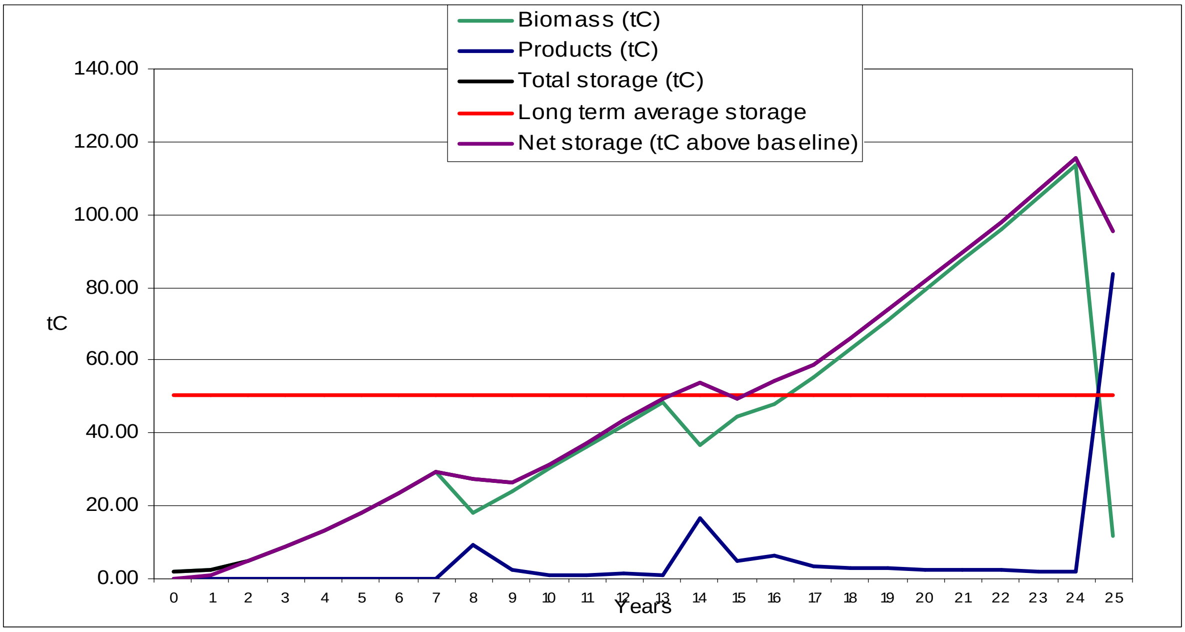


Figure 2: Woodlot technical specification carbon sequestration potential over 25 years

11 Monitoring

Monitoring targets for the first 4 years are based on establishment; the whole plot must be established by the third year with at least 90% survival of seedlings. Thereafter monitoring targets are based on DBH average. The expected DBH at the time of monitoring is based on a predicted mean annual diameter increment on which carbon sequestration estimates are based.

Table 13: Monitoring indicators for the woodlot land use system

Year	Indicator
1	At least 50% plot established
2	Whole plot established, 90% survival (at least 732 stems / ha surviving)
3	Whole plot established , 90% survival
4	Whole plot established
5	Whole plot established and average DBH not less than 8cm
6	Whole plot established and average DBH not less than 11cm
7	Whole plot established and average DBH not less than 13cm
10	Whole plot established and average DBH not less than 19cm

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