KENYA FORESTRY RESEARCH INSTTUTE

A GUIDE TO TREE

PLANTING

BY

C.K. KIRIINYA

(2008)

1.0 Introduction

The most utilized natural resource in this country is soil and therefore it must be conserved at all costs, from being washed away by rain water or being blown away by wind.

Rain and run-off water remove the top soil from arable land, clearfelled forest areas and over grazed pastures. If not stopped the top soil will get thinner every year and crop yields will decrease.

There are many ways of protecting our soils from being washed away (**Wenner 1980).** Planting of trees is one way of reducing soil erosion, at the same time trees.

- Produce timber for building and furniture
- Produce building poles fuel wood
- Provide shelter belts and wind breaks
- Provide fodder and fruits for both human and animals
- Provide cash.

It was realized along time ago that indigenous forests could not meet the country's rapid growing demand for wood and wood products on a sustained yield basis. The annual increment per hectare in respect of indigenous tree species is not well known but it is obvious that it is too small compared with exotic species whose annual increment range from 15- 20m^3 per year: Even with the high turn-over of the exotic species, the existing forest reserve is unlikely to meet the future demand of fuel to the rapid growth of our population currently at 2.6%. Current consumption of wood fuel is estimated at over twenty cubic metres per year per person (Ndegwa 1982). It is with this realization that the Kenya government launched Rural Afforestation Extension Scheme in 1971 and chief's nurseries and school nurseries schemes in 1980's to meet future wood and fuel wood demand. The scheme aims at increasing number of trees in rural areas especially to meet individual wood demand. It is therefore Kenya Government policy to encourage various non-governmental organizations and individuals to start their own woodlots or forests.

The establishment of private forests and woodlots will contribute greatly to reduction of the mounting pressure on our national forest resources and economy and therefore every Mwananchi should be encouraged to plant few trees if not many in or around one's garden or home.

Trees may also be grown on farms when you do not intend to cultivate the land for the next five or more years.

2.0 Choice of tree species

The choice of trees for planting is yours. You may choose any kind of trees you many wish to grow depending upon the purpose for which you wish to grow them (on advice from forest officer)

Whatever kind of trees you choose must be those recommended for that area so as to realize the full growth vigour and when raising seedlings you should follow the instructions on the manuals e.g (A manual for tree nursery management 2000 by J.M. Kimondo and J.M. Kioko). Avoid water logged and extremely dry sites. Below is a few tree species which are currently being preferred for planting by a broad spectrum of farmers.

Species	**Uses**	**Time of maturity**	**Site**
Eucalyptus. Tereticornis	Poles posts Timber	5-8 years Above 35 years	**Lowlands 0-1000m asl 800-1000mm**
Eucalyptus camaldulensis	Poles fire wood charcoal	5-8 years	
Casuarina equisetifolia	Poles post Timber	5-7 years 20 years	
E. urophylla	Poles post Timber	4-7 years 25 years	
Moringa oleifera	Medicinal	2 years	
E. grandis	Poles post, Timber	5-7 years 30 years	**Mid altitude 1500- 2000m asl > 1000mm**
E. saligna	Poles, posts Timber	5-7 years 30 years	
Prunus africana	Medicinal Firewood Timber	3 years >3 years 35 years	

Melia volkensii (Mukau)	Timber Posts and poles	20 years 8-12 years	**Semi-arid lands Rainfall 500-800mm**
Azadirachta indica (Neem)	Timber Medicinal	>15 years 3 years	
Jatropa curcus	Nuts (Biodiesel)	8 months	

3.0 Preparation of Planting Site

3.1 Clearing

The site for planting once the areas had been determined, any weeds and bushes must first be cleared. The manner of clearing depends on the type of vegetation. If there are trees in the area, which are to be left standing, they must be singled out and the vegetation around them should be cleared. Weeds and grasses can be burnt out just before planting. If the area is covered with scrub, it is easiest to uproot the scrub after burning (Note that if the roots of scrub are not taken out they will generally shoot up again and the roots will drain the soil of its moisture).

On steep slopes it is best to leave strips of native vegetation so as to prevent soil erosion. If you want to plant near streams remember that all fast growing trees take much water (e.g. *Eucalyptus*) and will reduce stream flow. If many people are dependent on the water such sites are best not planted with fast growing tree. Once the ground is clear for planting, pits in which the plant are to be set may be dug.

3.2 Cultivation

This is a very important operation and its absolutely essential if you select to grow eucalyptus. Ploughing is the best form of cultivation and is strongly recommended because it is difficult to hole a plantation adequately and is costly. Ploughing helps the percolation and retention of moisture, which promotes tree growth. To reduce the cost of ploughing annual agricultural crops can be inter-planted with the trees for the first two years and when sold can pay for the ploughing.

3.3 Espacements

This means spacing of trees between rows and between individual trees. Before choosing the spacing many factors should be considered. Espacement determines the number of trees you wish to grow y given piece of land and for what purpose you wish to grow, the cost of weeding is reduced on close espacement because trees close canopy quickly and kill all the weeds, whereas on wide espacement trees take longer time to close canopy and therefore to continue weeding annually until such time that canopy closes .On the other had you would normally expect small trees from crowded tree stand whereas a wider spacing results in bigger trees. Also where total volume is required closely planted trees produce bigger total volume than widely spaced trees.

Plate 1 5-year *Pinus patula* spacing trials

Below is a rough guide of spacing required for different species and purpose:-

Species	Spacing	Non-of trees per hectare	Purpose
Eucalyptus spp	2.5 x 2.5 m	16000	Poles, posts
Eucalyptus spp	1.5 x 2.0 m	3300	Firewood
Cypress	2.5 x 2.5 m	1600	Timber
Pines	2.5 x 2.5 m	1600	Timber
Prunus	3.0 x 3.0 m	1110	Timber
Bamboos	5.0 x 5.0 m	400	Various

Any closer espacement than above will result in very thin and poor growth of the trees. For Eucalyptus close spacing should be used when some small poles are needed and these are to be cut some years before the main crop. Also for timber species i.e. cypress and pines several thinning will be necessary before the final crop (see plate 5)

3.4 Pitting

The commonly used pits are 30 x 30 cm but the depth may vary from place to place. If the soil is soft and there is enough rainfall, smaller pits will be sufficient. But in dry places larger pits are recommended. Pitting on ploughed land may not be essential. In areas with annual rainfall below 800 mm the pits should be dug and left uncovered until the rain soaks in the pits. The pits must be ready early before the rainy season. All pits should be filled in after first rains and be marked with wooden sticks for ease of location during planting time.

On level ground the pits should be dug in rows at their required intervals. The rows make it easier for cultivation. Otherwise they could be scattered or in clusters according to the object of management.

On sloppy sites the pits should be staggered on the slope so that they will trap all the rushing rain water between them before a gully can be formed or they can conform to contoured lines with connecting ditch for even distribution of water in the pits.

4.0 Raising seedlings

This topic is covered in a manual titled "A manual for tree nursery Management published by KEFRI and GTZ". Therefore if you are interested in learning about nursery establishment and management refer to this manual.

5.0 Planting

5.1. Seedlings planting

The planting should be done at the beginning of rainy season after the first rain has soaked well into the soil (the rainfall should be about 7.5 – 10mm). Normally at the end of March or beginning of long rains.

When it is time to plant seedlings should be watered before transporting to the planting site. Carefully pick up the pots one by one taking care not to loosen the pot soil or damage the seedlings. Place all the seedlings under shade while awaiting planting. As little time as possible should elapse between lifting of the seedling and the actual planting.

Using a panga or hoe make a hole at the centre of the already prepared pit. The depth and width of the hole depend upon the size and shape of the roots or ball to be planted. Remove the pot and place the plant in the whole while holding the collar, the plant should be planted up to the root collar and not above or below, the top soil in the pot should be level with the ground soil. So as not to remove any soil from the roots replace soil around the plant firmly with your feet. Pots could be collected for re-using the following year.

5.2 Direct sowing

In order to cut down expenses in afforestation, direct sowing of some species is recommended. In this way all nursery expenses are reduced and the cost of transporting seeds to the field is negligible.

Usually species with large seeds are recommended for direct sowing. Seeds are usually sown at a depth equal to twice their diameter. A steady supply of moisture

and high temperature is a prerequisite of seed germination. The preparation of the site is almost the same as for planting in the pits (e.g Jatropa, Neem, Prunus, Mukau etc).

5.3 Watering

If the rainfall fails just after planting, seedlings could be bottle fed if they are not very many with a hose pipe or watering can until they establish. This is not practical for plantation or large number of seedlings.

6.0 Tending

6.1. Weeding

Four weeks to six weeks after planting weeds are usually big enough to compete for water with newly planted seedlings. It is therefore best to start weeding about this period for vigorous growth and survival of tree seedlings. Some species like Eucalyptus are more sensitive to weed competition. Therefore complete cultivation should be done immediately after they are out planted. It should be repeated as necessary according to the rain pattern. If the species are not very weed sensitive spot clean cultivation around the tree could supplement clean cultivation. At least one cultivation towards the dry season should be done to conserve moisture. Early attention given to plants promote survival, quick growth and early canopy closure. The early canopy closure eliminates the growth of weeds hence reduces the time of weeding.

6.2 Pruning

This means cutting of the branches close to the trunk, it is done if a clear straight bole is required for timber. It improves the quality of timber and if the trees are ornamentals or hedges they should be pruned as when necessary to give an aesthetic appearance. Some trees like *Eucalyptus* and shade tolerant species do not require pruning as they are self-pruned. Other plantation species e.g pines and cypress need pruning. In general if pruning is required when the trees are young prune ⅓ of its total height and leave ⅔ of crown. When they are about ½ of their rotation age (time of harvesting) prune to half height. When pruning care must be taken to cut the branches as close to the trunk as possible **DO NOT** cut branches far away from the trunk. And when cutting a hand saw is recommended (see Table I for pruning schedule of cypress and pines).

Table I

Pruning Schedule for Cypress recommended by Forest Department

Height of the biggest trees	Type of Pruning	Approximate age (Yrs)
3 m	½ total height	4-5 years
6 m	½ total height	7 years
10 m	½ total height	9-10 years
13 m	3/5 height	12-13 years
16 m	⅔ height	16-18 years

Pruning Schedule for Pines

Height of the biggest trees	Type of Pruning	Approximate age (Yrs)
6 m	½+ one whorl	3-5 years
10 m	½+ one whorl	7-9 years
13 m	½+ one whorl	8-10 years
18 m	½+ one whorl	> 10 years

Plate 2 Un-pruned *Casuarina junghuniana.*

Plate 3 Un-pruned and unthinned *Casuarina junghuniana*

Plate 4 Pruned *Eucalyptus* species.

6.3 Thinning

The aim of thinning is to provide good growing space for the best trees. The trees to take out when thinning are those, which are diseased, forked, very thin, dead, dying, crooked etc. (Undesirables) unless the object of management requires otherwise. Thinning help the remaining trees to have more space and have vigorous growth. Also thinning could be used for fuelwood poles etc. Thinning could be started when the trees are above 7 years old. (If you want to have more

details please contact D.F.O.'s) (see Table II for thinning schedule for cypress and pines).

Table II
Thinning Schedule for Cypress

Age	Thin from – to per (ha)
9-10 years	1600 – 960
15-16 years	960 – 560
19-20 years	560 – 360
23-25 years	360 – 250
35-40 years	Clear fell all remaining trees

Thinning schedule for Pines

Age	Thin from – to per (ha)
7-9 years	1600 – 960
15 years	840 – 600
19 years	600 – 360
24 years	360 – 250
25-39840ars	Clear fell

Plate 5: *Eucalyptus grandis* Unthinned plantation

Plate 6: Unthinned *pinus patula* stand

7.0 Planting Ornamentals

Ornamental trees give beauty, shade and shelter. The commonly available ornamentals are as follows;

Species	Aesthetic characteristics	Time
Araucaria	- evergreen	Always
Bottlebrush	- red and white flowers	Seasonal
Cassia	- yellow flowers	Deciduous in dry season
Cordia	- white flowers	Deciduous in dry season
Cypress	- evergreen	Always
C.torulosa	- evergreen	Always
C.pyramidalis	- evergreen	Always
Ficus	- evergreen	Always

Flamboyant	- orange flowers	Deciduous in dry season
Nandi flame	- orange and red flowers	Often deciduous in dry season
Palms	-white flowers & evergreen	Always
Jacaranda	- blue flowers	Deciduous in dry season

These trees are adaptable and will grow on most sites. In dry areas Jacaranda, Flamboyant and Cassia are most suitable. Ornamental trees should not be planted less than 5 m apart (also do not plant them close to the house they should be planted at least 3 m away). For shade trees, space 3 x 5 m apart and for the shelterbelts, trees can be planted either in a single line 2 x 3 m apart or in several lines leaving about 2.5 m between the lines.

8.0 Planting of Bamboos

Bamboos will grow in most areas but for good growth require plenty of water, acidic soils should be avoided. Bamboos can be raised from seed but the best method is to use cuttings and rhizomes.

8.1 Stems (culms)

Cut lengths of young culms about 30-50 cm long which must include at least one node (swelling). These can either be buried horizontally just below the ground or buried at an angle so that the bud at the node is just below the ground, and then watered until they sprout.

8.1 Rhizomes

Carefully dig up 30 cm of the rhizome (underground stem) at the bottom of a shoot and cut it off just above a node about 50 cm above the rhizome. These cuttings must be planted immediately by buying the rhizome at approximately the same level that it was at originally.

After sprouting the cuttings or rhizomes be transplanted by burying them at espacement of 5 m x 5 m in pits dug at least 50 cm deep and 50 cm across. The soils must be really moist at the time of planting.

9.0 Planting Hedges

Hedges can be planted for decorations, shelter, privacy or protection and security. The most common hedging plants are as follows:

Cypress	-	requires plenty of water and must be watered in dry areas. But some cypress e.g. (Torulosa cypress) is more drought resistance (evergreen).
Thevetia	-	suited for dry sites becomes open unless carefully tended
Duranta	-	suitable for wetter areas, looses leaves in dry areas.
Kei apple	-	suitable for wet as well as dry areas (evergreen)
Polycantha	-	suitable for wet areas
Euphorbia	-	suitable for dry areas.
Ziziphus	-	suitable for dry areas.

The plants should be 15 cm apart and 30 cm between the rows. Usually two rows are used so as to have a compact fence. If you plant two rows of plants make sure they are staggered or alternate. Note the above-mentioned trees are not the only ones for making a hedge. Many local trees and shrubs can be used for hedging.

10.0 Protection

There are 4 major agents of forest destruction; these are fires, animals, insects and diseases.

10.1 Fires

The greatest danger to the plantations is fire: Fires can burn your forest in less time that it took you to build it up. Therefore adequate provision must be made to protect every plantation from fire. This could be done by clean weeding or hoeing a fire break round the forest stand. This operation should be done on the approach of dry season, and through out the dry season keep watch in case there is any fire out break. In the event of a fire occurring try your best to suppress it before total damage is done, use green branches to beat it out. If you find it is not possible give an alarm so that any possible help can be given by your neighbors.

Some species like *Eucalyptus, Gmelina* and *Bamboos* can survive light fires but *cypress, Pine,* and *Grevillea* do not coppice when cut and hence they are very tender to fires.

10.2. Animals

Arrangements must be made to keep the grazing animals out when the plants are small. Goats are the most ravenous animals that can cause a lot of damage to tree seedlings by nibbling and debarking. Cattle trample down the saplings and wild game has also got some share in destruction. Fencing round the forest stand is recommended for keeping animals out.

10.3 Insects

Caterpillar crickets, weevils, beetles, aphides and termites are also destructive agents to your trees. You should detect when there is a population build up and control them. For other insects use insecticides available and spray over the trees. If any pest or disease is noticed inform Pest Management KEFRI Muguga.
Termites can cause considerable damage in young plantations. They attack plants within six inches of soil eating the bark just below the root collar. This is followed by an extension of damage up and down the root and stem, finally resulting in ring barking and death of the tree. Termite activity in the soil is greatest in areas with prolonged dry season. Eucalyptus are particularly susceptible to termites at altitudes below 1300 m a.s.l. Environment friendly termite control chemicals can be used to protect seedling from termite attack. The chemical can be applied to the soil round the base of the plant at the beginning of the dry season following planting.

10.4 Disease

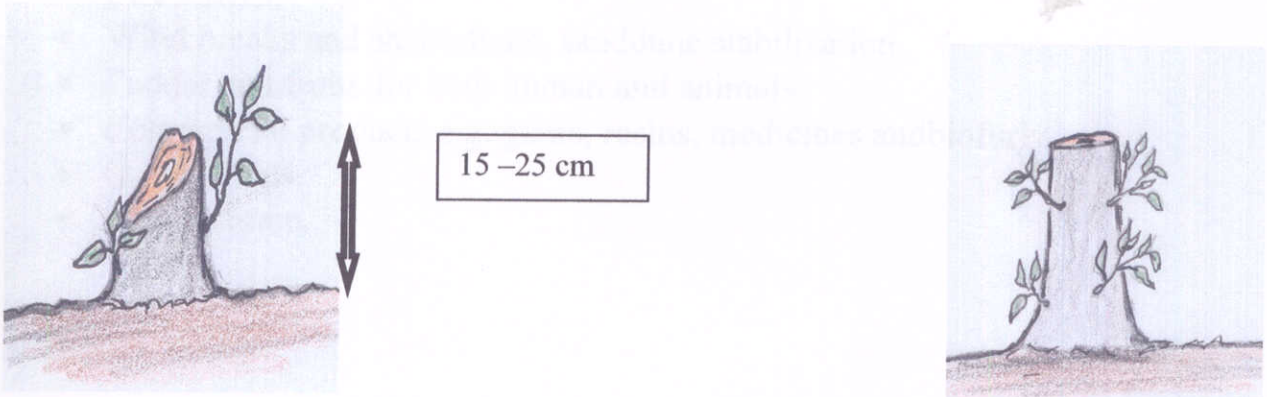
Fungal diseases also can kill the trees. The early attack may not easily be noticeable to you and it is its early stage of attack that is important because that is when damage is done, most of fungal diseases are caused by root rots, bark kill, cankers, drying of leaves die backs etc.

Avoid planting in areas where trees have recently been felled because root rots attack can come from old stumps. Therefore prior to planting removal of old stumps and slashing and any other woody material is recommended.

11.0 Harvesting

Two ways of harvesting could be considered either clear felling or selective felling. This will depend on what is required. Felling could be done by either using saws or axes. All branches and tops should be piled for later use as fuel wood or other purposes or for sale. If you cut by selection you must do it in a way that minimizes damage to the remaining trees. The debris should be cleaned to avoid fires, disease and insect breeding.

For poles always cut by selection when there is need for them either for sale or for your own use. As for firewood cut only large, poorly shaped, disease stressed, which would not qualify for timber or poles. Avoid the temptation of clear felling for firewood unless you have to. Please do not fell unless you have a prospective buyer. If you have the intention of re-afforesting after you have cleared the forest, you must get on immediately with the ground preparation for the following years.



a) Recommended cutting height and angle

b) Wrong cutting height and angle

Figure 1: Cutting height and angle for Eucalyptus

After felling, the stumps should be cleared of branches, twigs and leaves so that young coppices can develop without interference.

Bamboos

Exploitation should be as follows:

1 year old	None, except diseased stems
2 years old	One in 10 to one in five
3 years old	Three or four in five
4 years old	Any remaining stems

The management really depends on what size of bamboo you require.

12.0 Cutting method

Cutting of trees should be done 10 cm to 15 cm above ground. This eases extraction of your produce from the area and do not present a significant danger to your movements. For trees which do not coppice (sprout after cutting), the cut should be sloping to prevent rain water lying on the stump and rotting it. When these coppice shoots are about as thick as your finger, choose the best one or two shoots and remove the others away close to the stump. Eucalyptus can be coppiced 3-5 times quite easily if cut each time when not older than 10 years, after this the tree loses vigour. Bamboos should be cut at 20 – 30 cm above the ground and just above a node.

Utilization and uses.

- Timber, firewood, charcoal, posts and pole.
- Life fences.
- Wind breaks and shelterbelts, sanddune stabilization.
- Fodder and fruits for both human and animals.
- Commercial products e.g. gums, resins, medicines andbiofurls.
- Ornamentals.
- Conservation.

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