

TREE PLANTING TECHNIQUES FOR ADOPTION BY FARMERS IN TANZANIA



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Tree planting techniques are of several types. However, before the techniques are used there are several activities that are done before an individual embarks in the use of any of the technique to be used. These activities are outlined below.

SELECTING TREES FOR SEED PRODUCTION

The appropriate selection of seed producing trees results in a high quality of seed for healthy trees. Thus, seeds shall be appropriately selected based on the following conditions:

1.1. Appropriate selection of mother trees

- Mother trees should be selected in the natural forest or forest plantation, because the seeds from trees that grow alone mostly have disease, slow development and bad shape.



Figure 1: Natural or plantation forest from where it is advised to select seeds



Figure 2: Single mother tree from which IT IS NOT advised to select seeds

- A farmer is advised to select mother trees with a smooth, straight shape, few branches, without any holes, and free from disease.



Figure 3: Mature mother trees from which seeds should be selected

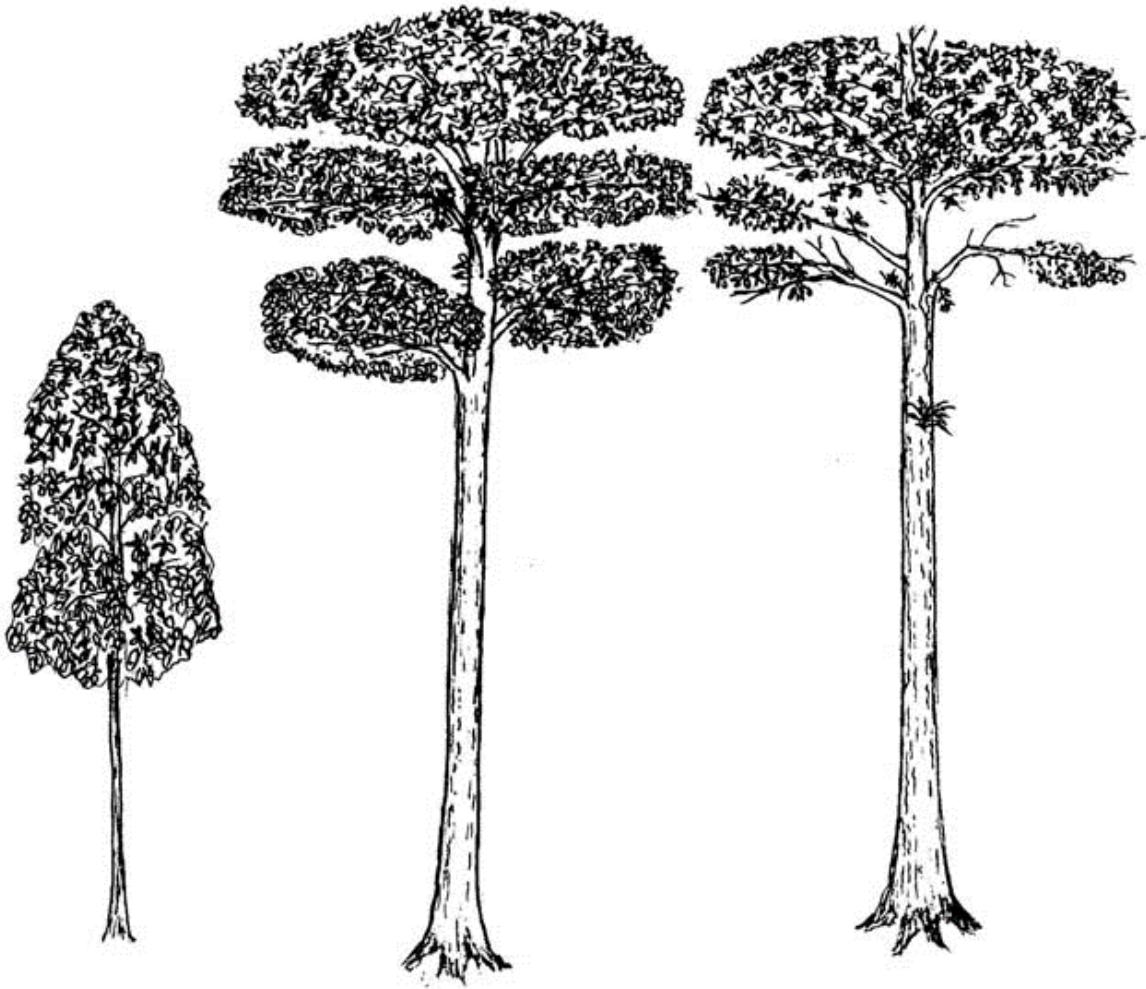


Figure 4: Too tall and too young trees. It is advised not to select trees that are too old or too young.

1.2 Selection of tree by purpose

Select mother trees according to their desired purpose: this could be for construction. For construction, the mother tree should have a straight and smooth stem, with few branches as shown in Figure 5.

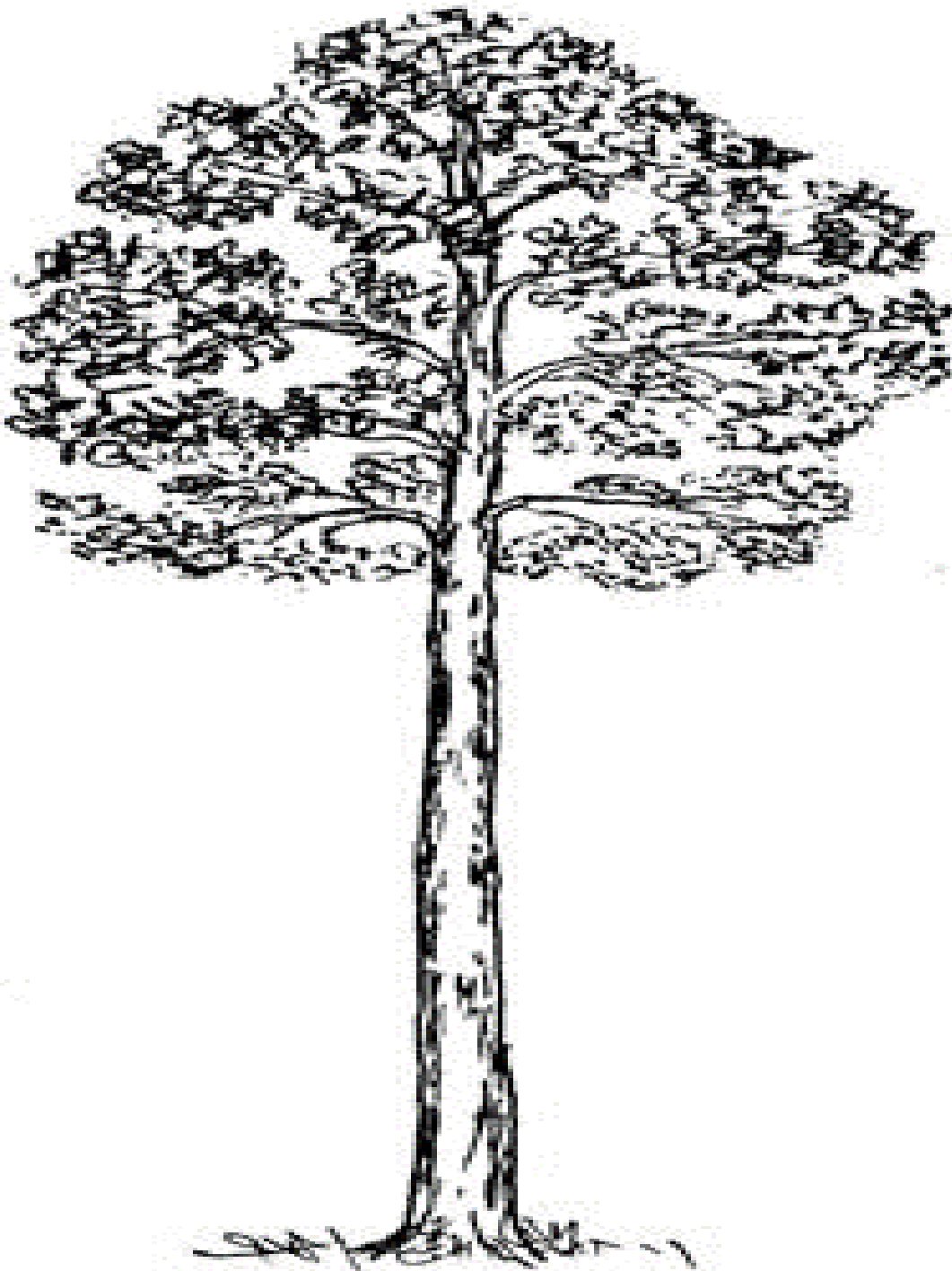


Figure 5: Straight stem mother tree

For firewood purposes, select trees that are fast growing with bushy branches, the best types will have a high coppice potential as indicated in Figure 6.



Figure 6: Mother tree that is bushy with high coppice potential

For animal fodder, select trees that: have leaves and fruit that can be eaten by animals; are fast growing; have many branches and leaves; have high coppice potential.

Note: Evergreen species provide more fodder than coniferous species

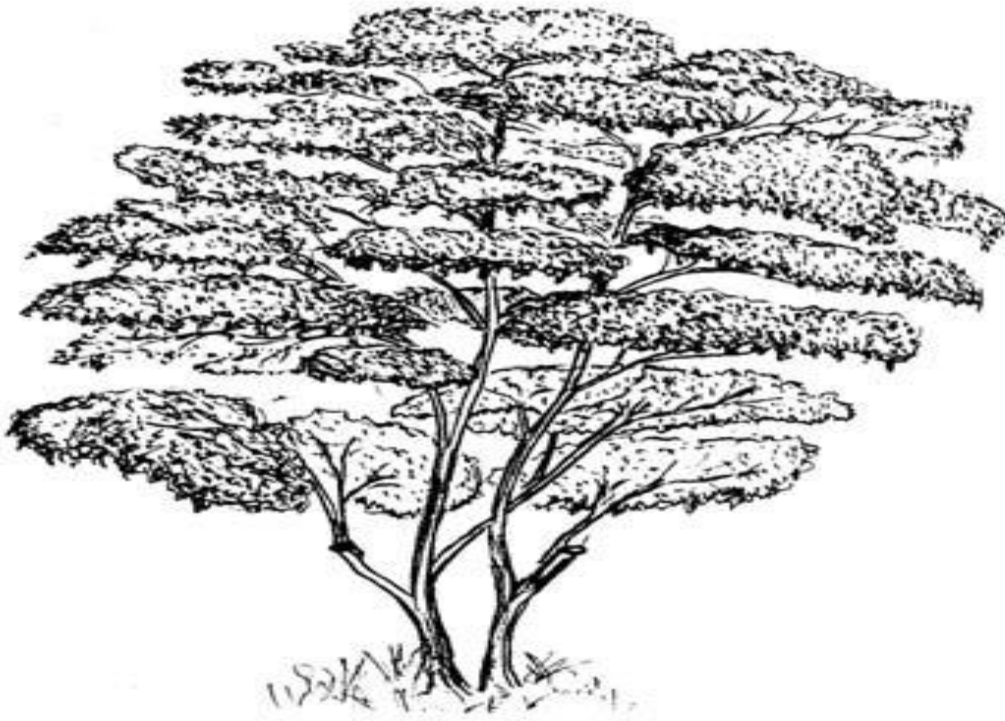


Figure 7: Mother tree suitable for animal fodder

1.3. Location of source for appropriate seeds

Seed should be collected in any area with a similar climate to the planting area, with consideration of latitude, temperature, rain ratio and type of soil.

Seeds collected from upland areas (mountainous or highland area) shall not be planted in lowland areas and vice versa. The best way is to collect seeds from the area to be replanted because they are already adapted to the climate in the area.

2. SEED HARVESTING METHODS

2.1. Time limits for seed collection

A good time for collecting seeds is when the fruits of the trees are all fully ripe. Make sure that the fruits to be harvested are mature, you should not harvest too early or keep them too ripe. In general, we can identify ripe fruit through the following characteristics:

- Colour of the fruit: the skin changes from blue/green to dark brown/yellow, or the skin becomes dry.
- Colour of the wing: for any fruit with wings, fibers appear slightly on the wings, become hard and dry and turn from pink to purple red, and sometimes turn from light green to dark green with light red.
- Smell: the fragrance of some fruit is noticeable when they are ripe.
- Being eaten by animals: animals frequently eat ripe fruit, providing a good indicator for collection.

- Splitting fallen fruit: fruit of some trees are ripe and loose in their pod. If we split the pod, we will see its internal part is white and hard, such as *Azelia xylocarpa*, *Sindora siamensis*, *Delonix regia*, but for some species we can see the sprouts clearly that are white or green, such as *Dipterocarpus alatus*, *Hopea odorata*, *Dipterocarpus tuberculatus*, and *Dipterocarpus obtusifolius*.

2.2. Seed Collection Methods

2.2.1. Collecting fruits from branches

Seeds on lower branches are easy to harvest but they are not good quality. Seeds from the upper branches are good but they are difficult to harvest. Therefore, we should collect seeds from both the lower, middle or upper branches.

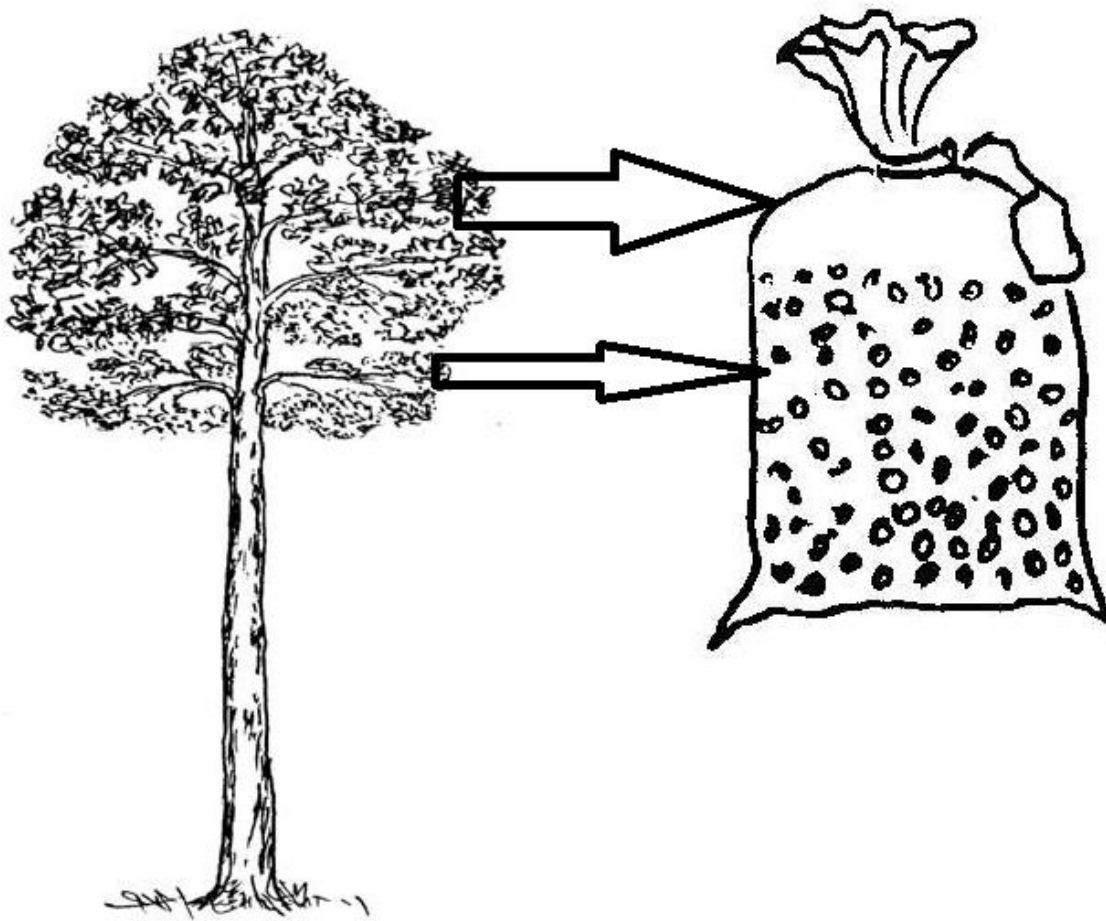


Figure 8: Best part of tree to collect seeds

2.2.2. Other means of seed collection

2.2.2.1 Collection of naturally fallen fruits

The collection of fallen fruits is the easiest method, especially for tree species with fruit or a large seed such as *Tectona grandis* (teak tree) and some other species, which have fruit with wings.

Collection tools include: rakes, knives, and baskets, palm-leaved mats or plastic sheets

Steps:

- o Clear the ground beneath the seed tree (remove fallen leaves, grass and weeds) before the ripe fruits fall, to ease collection;
- o Lay a plastic sheet under the tree to collect the falling fruits; and
- o Collect the fruits daily and clean them by sorting out the rubbish.

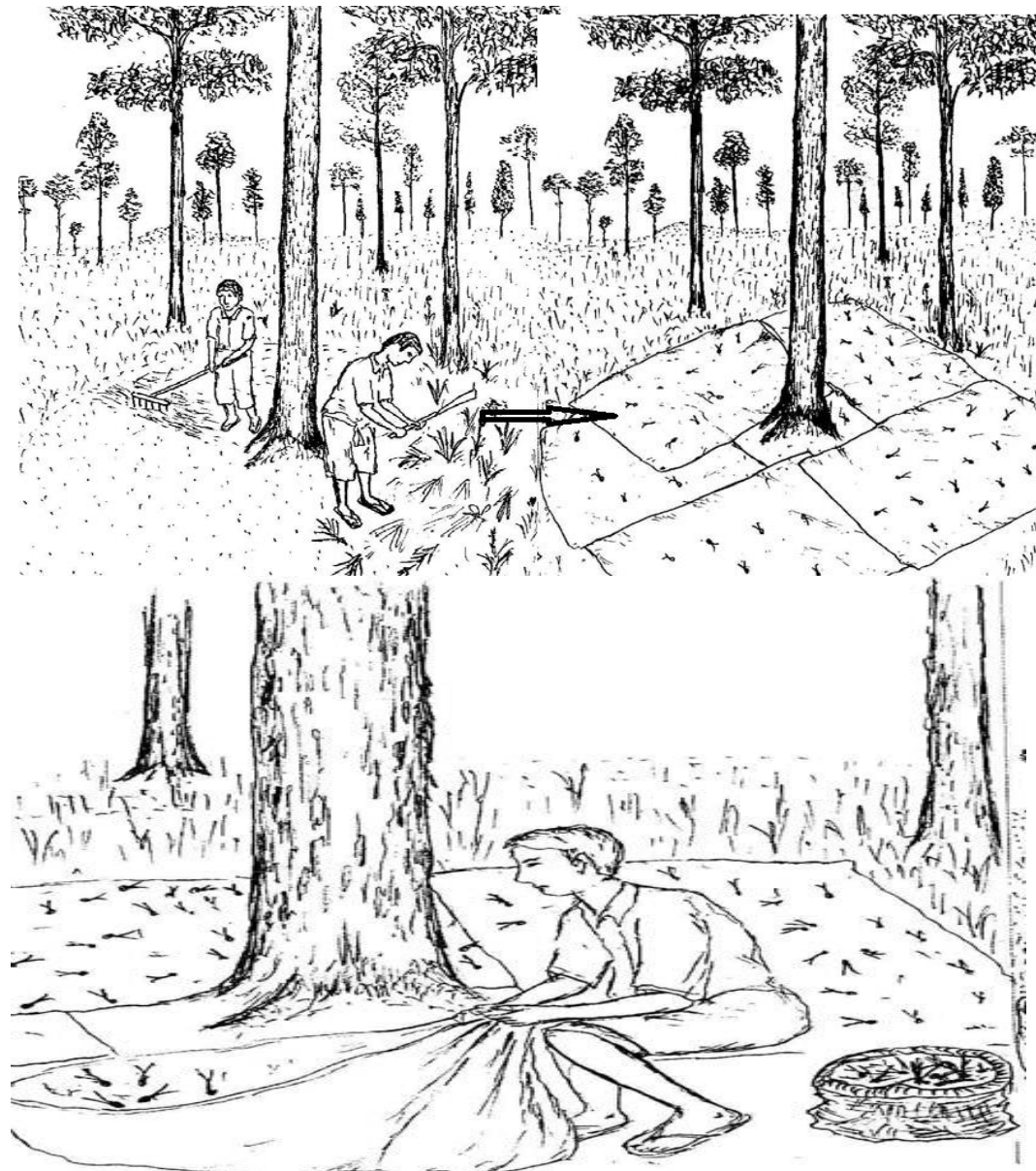


Figure 9: Clearing the ground beneath the trees

2.2.2.2 Shaking the tree or its branches

Fruits or seeds of some trees do not naturally fall simultaneously, so you should shake the trunk or branches so that the ripe fruits or seeds fall together. It is an easy collection method.

Here are steps followed:

- o Clear the ground under the tree, then lay down the mat or plastic sheet;
- o Shake the trunk or branches by using a long picking stick; and
- o Collect by sorting out fresh from dried fruits.

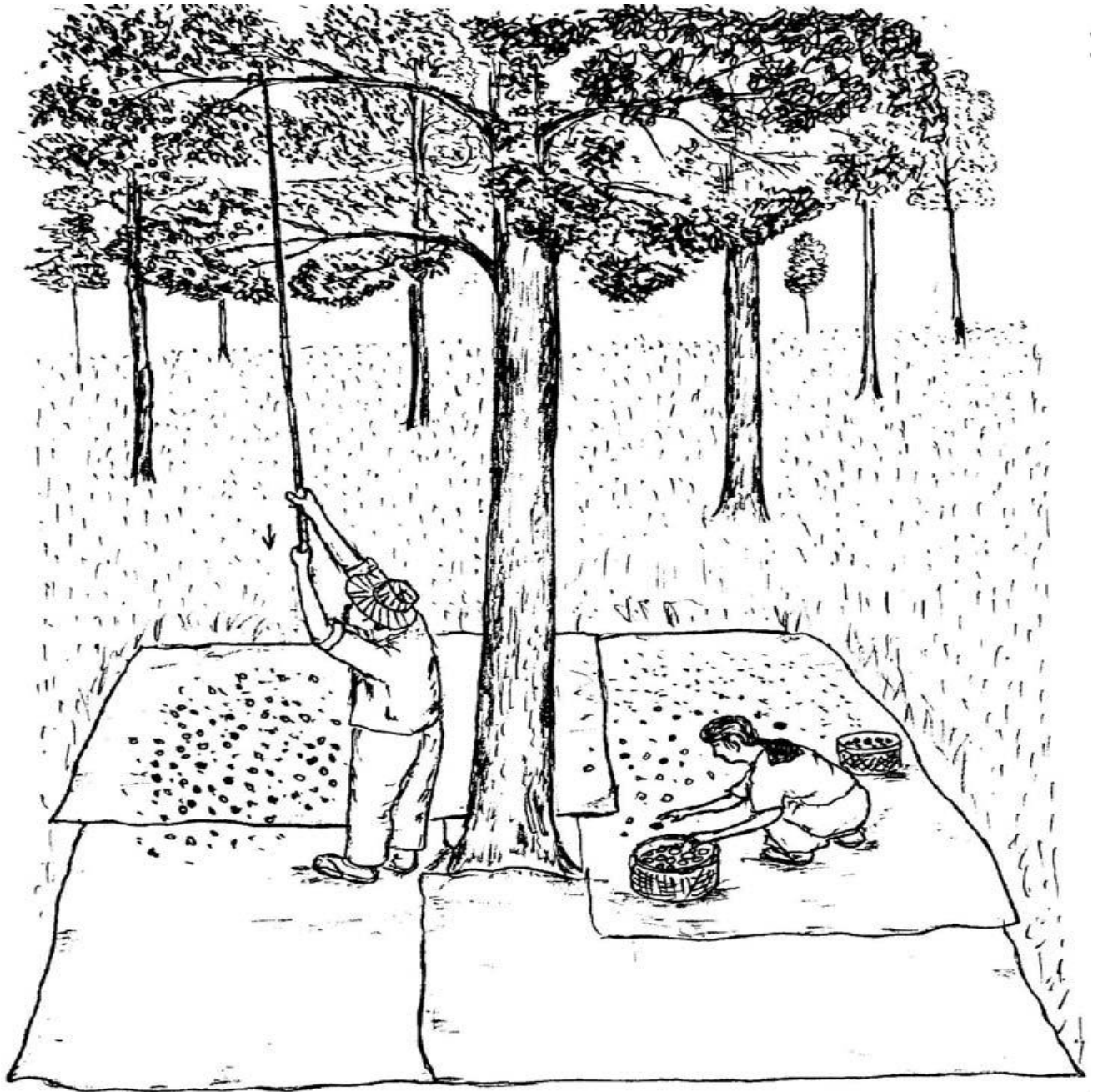


Figure 10: Shaking tree branches

2.2.2.3 Cutting fruit-bearing branches

When fruits or seeds are high on the tree, beyond your reach, and its stem is tough on the branch, and will not fall when shaken, then you have to cut the fruit-bearing branches to collect the fruits on the ground.

Steps:

- o Select branches with good fruits;
- o Use a stick attached to a sickle or adze to cut the selected branches; and
- o Collect the fruits or seeds from the cut branches.



Figure 11: cutting branch bearing seeds

2.2.2.4 Tree climbing to collect the fruits or seeds

This is a method to collect fruits or seeds with tough stems that are hard to make fall, or for seeds that stick to their open pod. This method requires skills in tree climbing.

The fastest and safest way is to use steps. Aluminum steps, which are portable, and easy to use, are recommended. However, farmers could also use a self-made bamboo ladder (7-9 m).



Figure 12: Using ladder to climb the tree

Alternatively, farmers can climb the tree and use a saw, adze, machete, or other similar means to cut down small branches, which bear fruit, for collection on the ground.

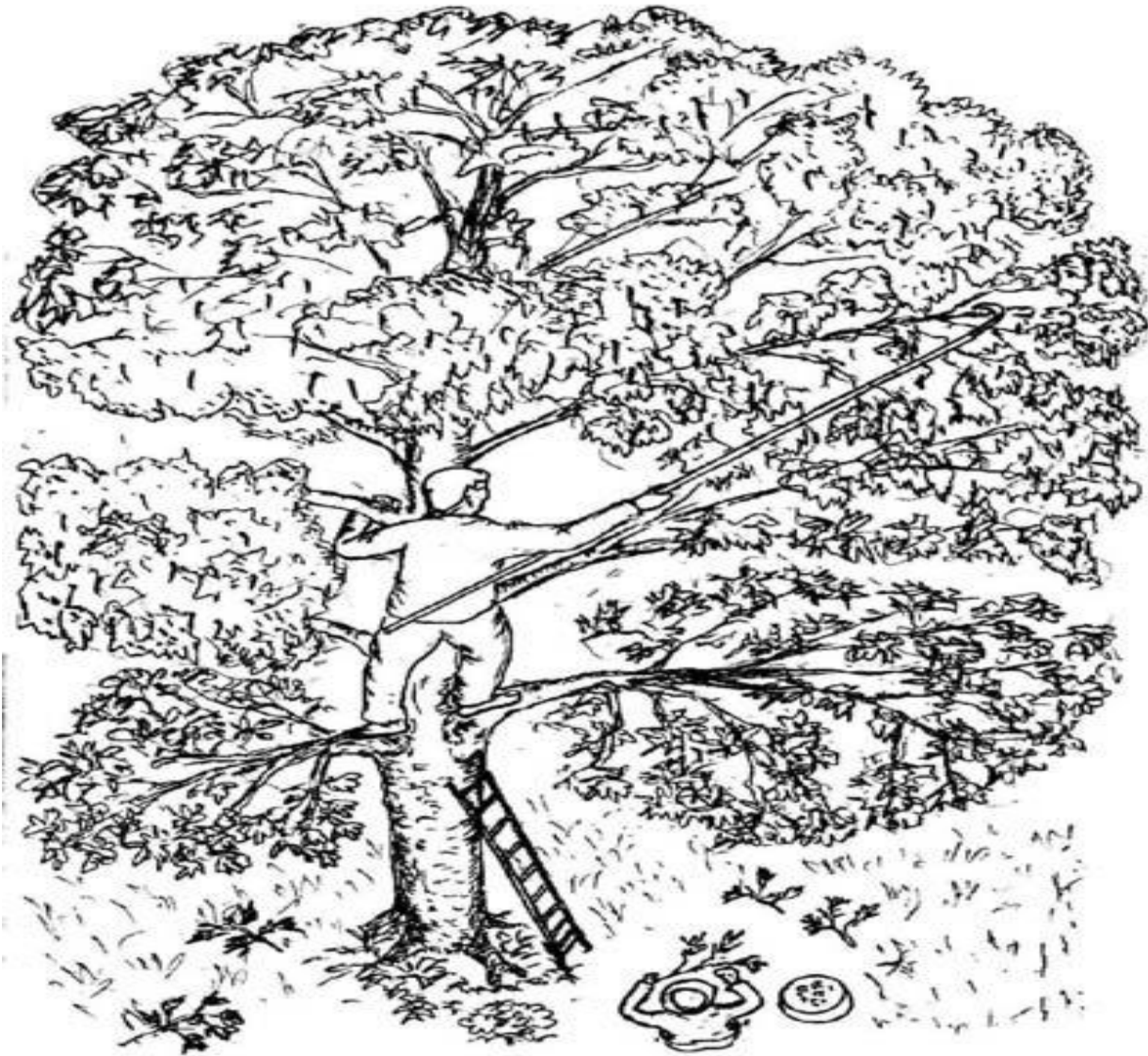


Figure 13: Using machetes or a saw to cut tree branches during seed collection

3- SEED TREATMENT

3.1 Seed picking

The fruit or seed of trees (the differences between fruit and seed are indicated in Annex 2) harvested as ripe fruit, a pod, fruit with a dried ripe pod, or a single seed, shall be picked carefully in order to avoid decay due to fungus or rot. Once the seeds are picked, they are easy to store. The most appropriate picking and caring methods are required.

Most seed picking requires the prior drying of pods, but some species need to be soaked in water to ease picking. Below are easy methods for seed picking and caring:

3.1.1 Pod Drying

Dry the pod under the sun on a cement floor, plastic sheet or cloth until the pods crack. This method is used for *Acacia*, *Casuarina equisetifolia*, *Pinus merkusii* and *Cassia siamea*. The pods

can be dried in a large basket or colander with a mat underneath. When they crack and open, the seeds drop onto the mat.

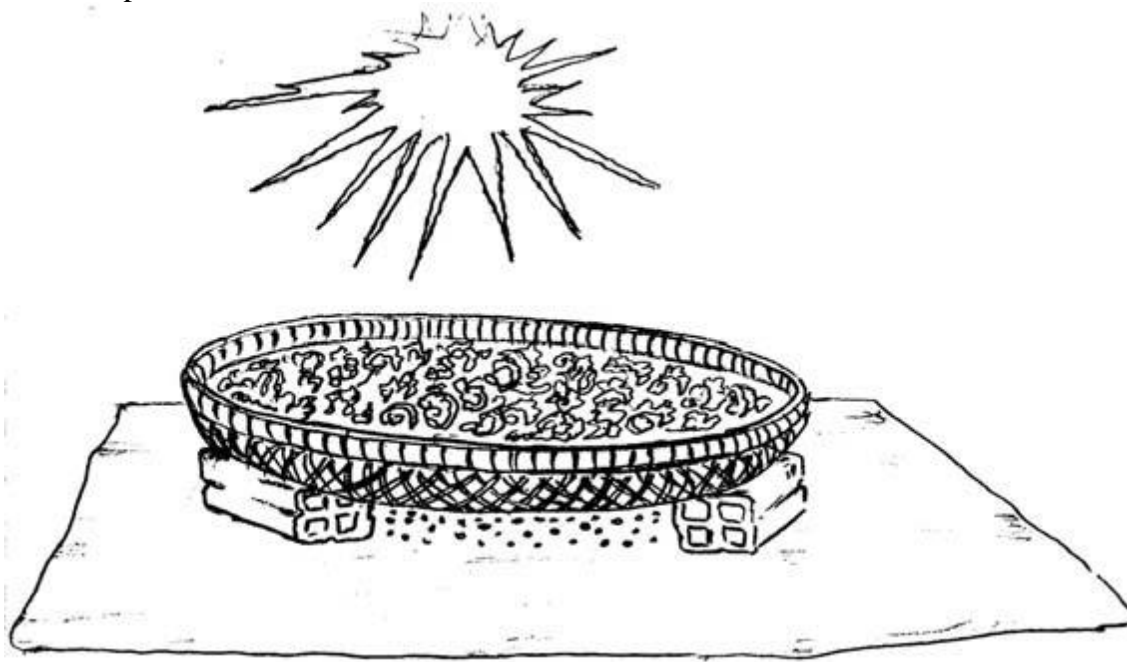


Figure 14: Seed drying under the sun

Some pods do not crack even if we dry them in the sun. In this case, we should crush them by stepping on them with our feet, or by putting them into a sack and beating them with a pestle. These species include *Peltophorum dasyrrhachis*, *Albizia lebbeck*, and *Dalbergia bariensis*.

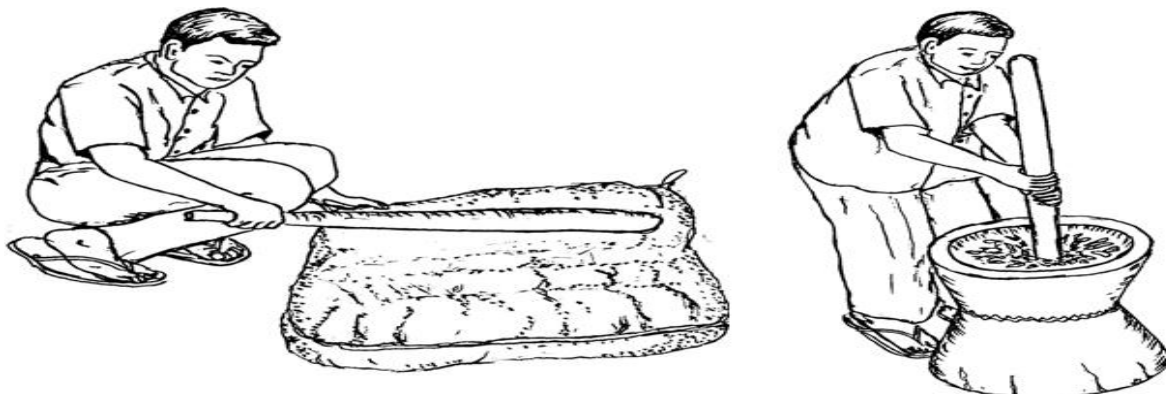


Figure 15: Crushing seed pods

- Others do not crack and cannot be beaten because by doing so the seeds inside the pods will be damaged. In this case, we should pick them manually, such as *Moringa oleifera*.
- Clean the seeds by winnowing or sprinkling to remove the pollen.



Figure 16: Winnowing seeds

Wash the seeds in a water basket, select the sunk seeds, then immediately throw away the water.

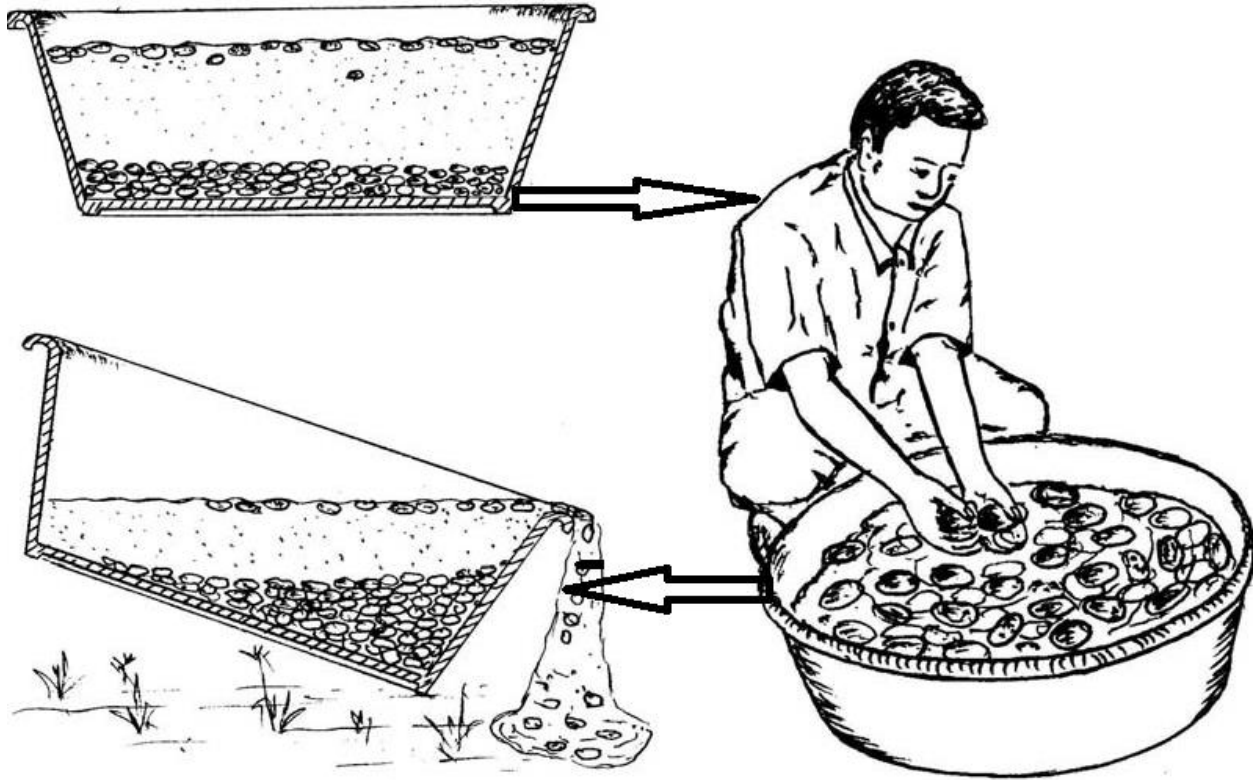


Figure 17: Washing seeds

Dry the seeds again. If we want to plant the seeds quickly, we do not have to dry them.

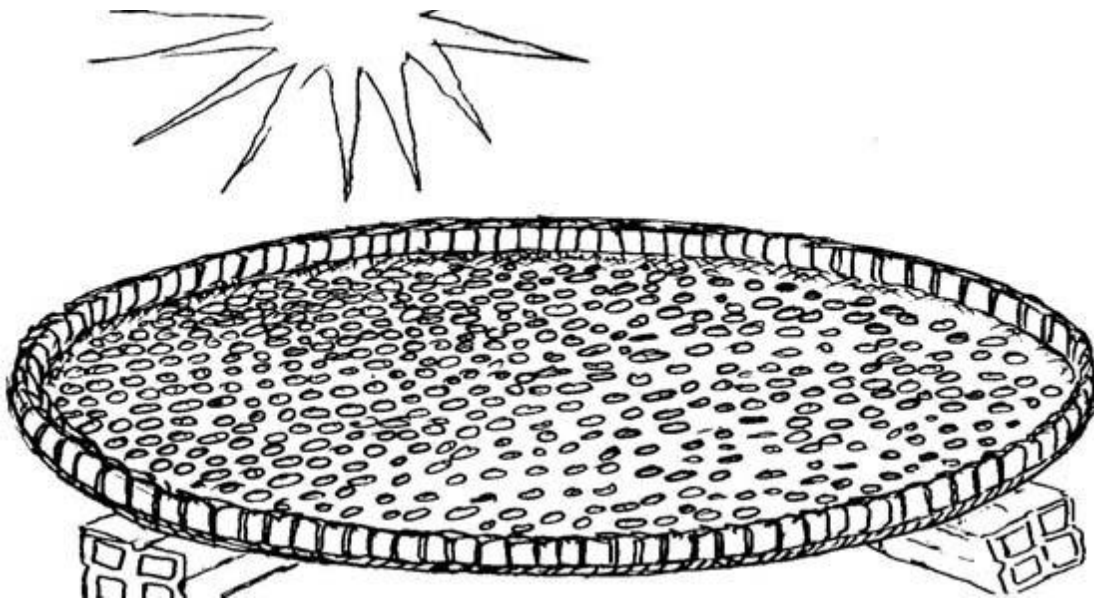


Figure 18: Re-drying seeds after washing

3.1.2 Pod with flesh inside

It would be more comfortable if we could pick the seed from its pod at home. However, one should not spend more time than necessary for seed picking, and you should not store or pile seeds as this interrupt their development. Heating or sour smelling while seed are piled on each other could decay or reduce the germination quality of seeds.



Figure 19: Correct seed handling

Below is the method to pick and clean seed:

- Soak the pod in water (1-2 days) until the flesh becomes soft enough for cleaning;
- Clean the pod by hand thoroughly and carefully, separate the seed from the flesh;
- Sort out the floating pods and flesh then drain the water from the bucket;
- Dry the seed in the wind; and
- Winnow the seed to sort out the waste.

3.2. Seed drying for long storage

Seeds shall be dried under the heat of the sun so that they can be stored for a long time. Below are appropriate seed drying methods:

- Spread and level the seeds on a palm mat, plastic sheet, bright-colored plastic sheet (a dark-colored plastic sheet will accumulate too much heat for the seed), or winnowing basket, then choose a location where there is sun for the whole day.
- Stir the drying seed 4 to 5 times per day to ensure that the seed is thoroughly dry. If possible, one should keep the seed in the shade when the weather is too hot (from noon till afternoon).
- Before rain or dawn the seed should be kept in the house.
- Dry the seed for 1-3 days depending on the moisture level of the seed.
- When drying, you should prevent damage by rodents or birds.

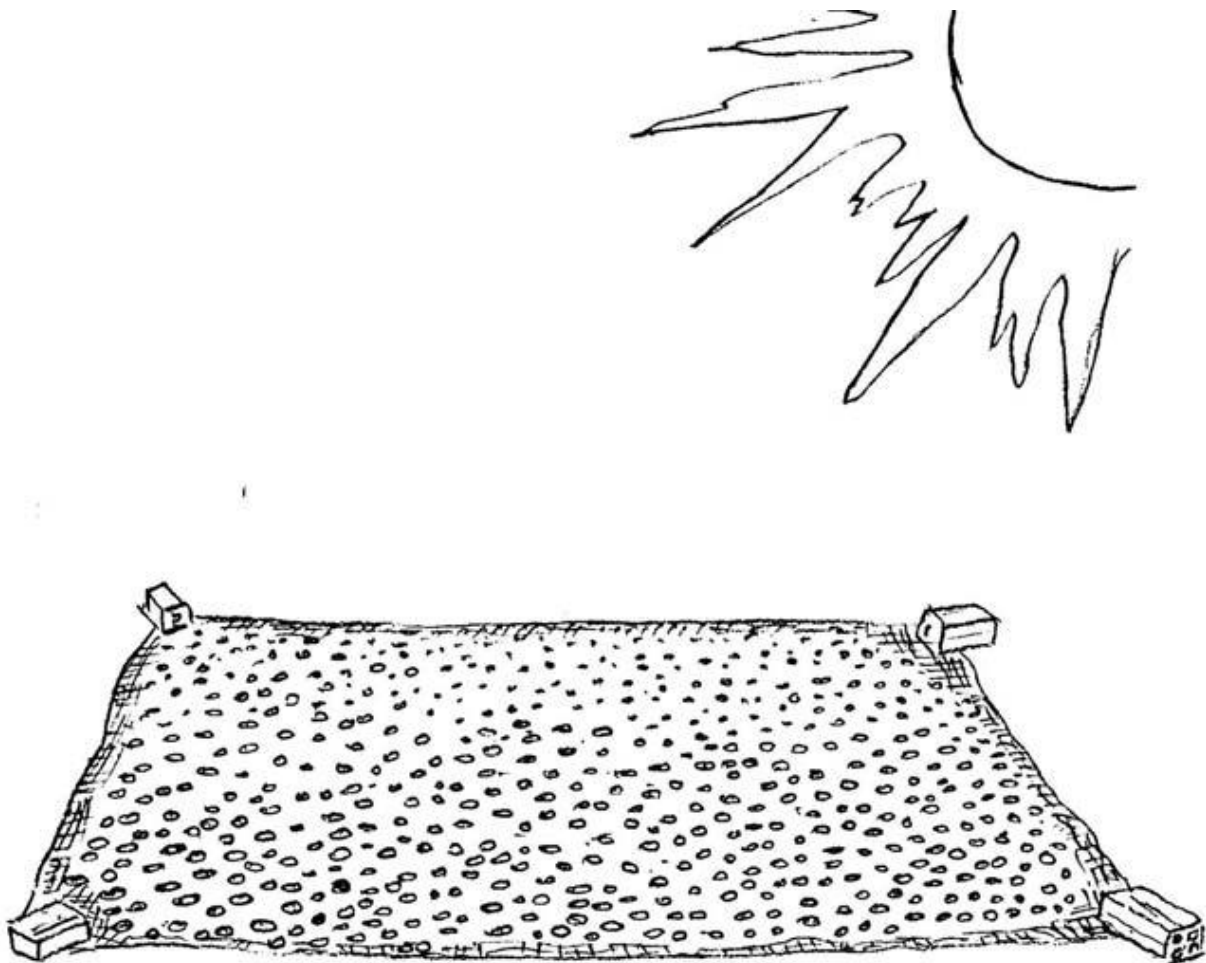


Figure 20: Seed drying under the sun

Note: Seeds that easily rot, such as the winged-species (Recalcitrant) should be sown or germinated soon after harvest because these species cannot be dried.

4. SEED STORAGE AND MAINTENANCE

If the seed needs to be germinated 2 or 3 days after harvest it can be kept in a cloth sack in the house without the use of any special moisture controllers. If the seed is to be kept for a long duration, then you have to be aware of some appropriate storage methods.

4.1. Seed that can be stored for long or short term

Initially, you should understand the types of seed that have natural characteristics to enable long-term storage. Seeds that rot quickly (Recalcitrant) cannot be kept for long and you have to grow them immediately after harvest.

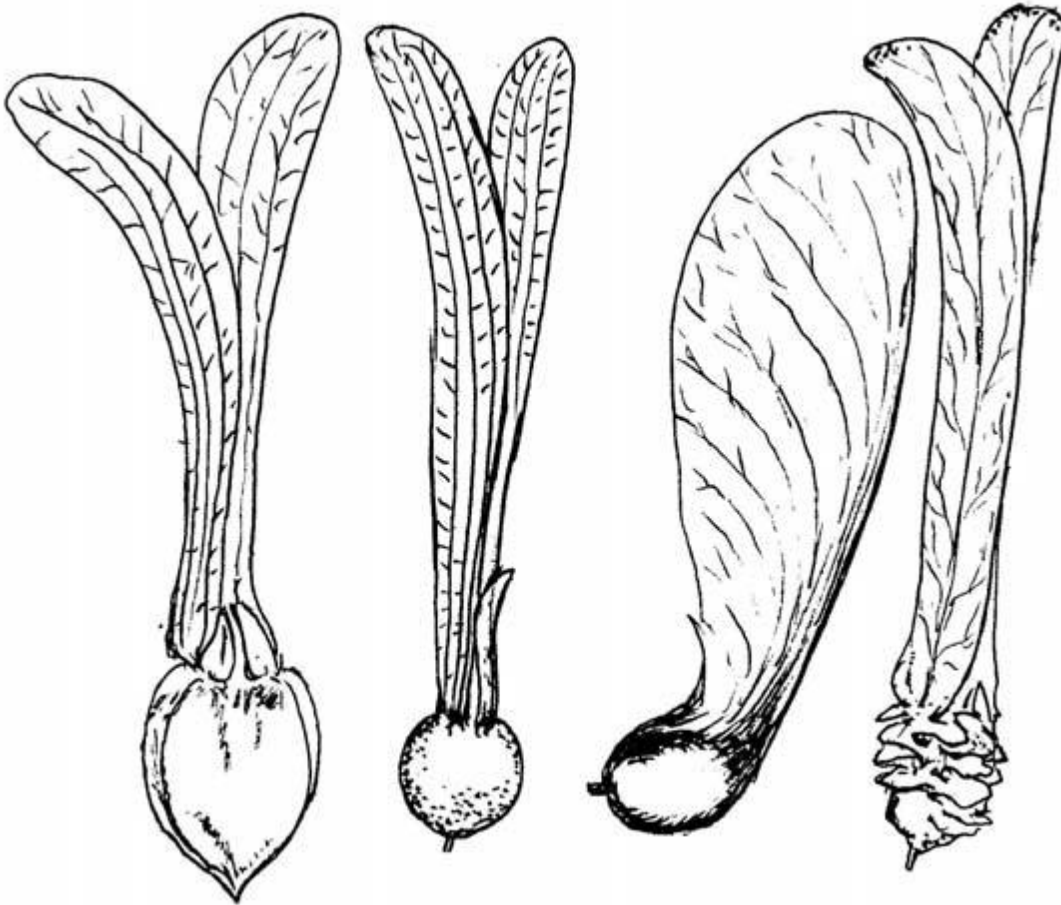


Figure 21: Quickly decaying species (Recalcitrant)

The species with seed that can be dried (Orthodox), as shown in the picture, can be kept for longer.

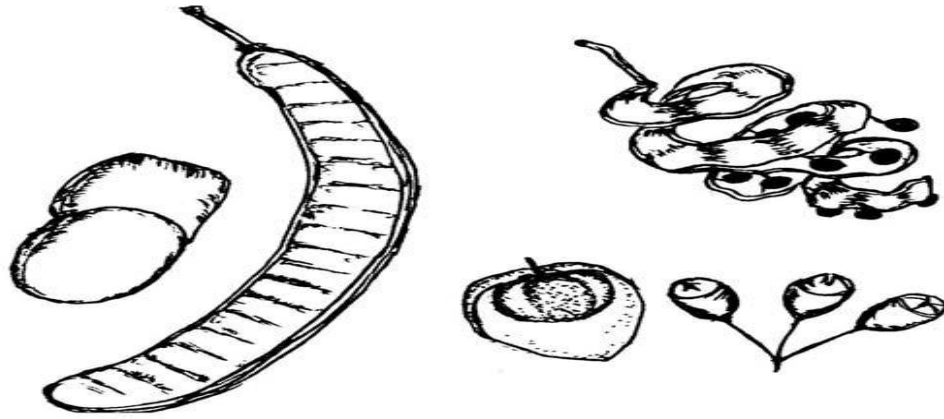


Figure 22: Dry seed species (Orthodox)

4.2. Storage (for seeds that can be stored - Orthodox)

It is important that we maintain the moisture and temperature of the seed at a low level, and that we regularly check both.

Below is important guidance for storing seed:

- Store only new, ripe and well dried seed;
- Store the seeds in a dry, cold location that is waterproof and shaded, but accessible by air, in order to keep them alive for a long time.

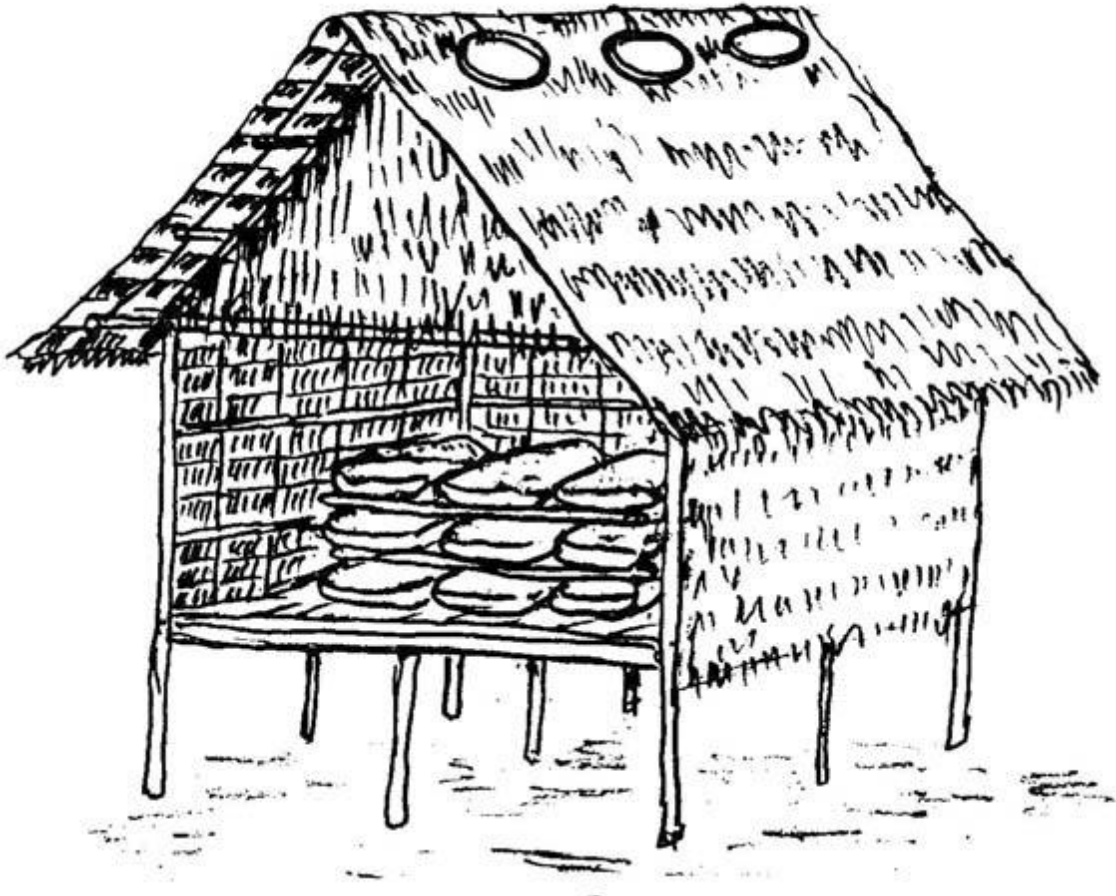


Figure 23: Correct seed drying

Seed affected by moisture shall be stored in containers not accessible by air, such as a barrel, tin or glass bottle with a tight cap. Otherwise, you can add a moisture-absorbing element such as kitchen ash, dried coal, dried cooked rice, or small pieces of paper. The moisture-absorbing elements shall form one fourth of the content of the container.

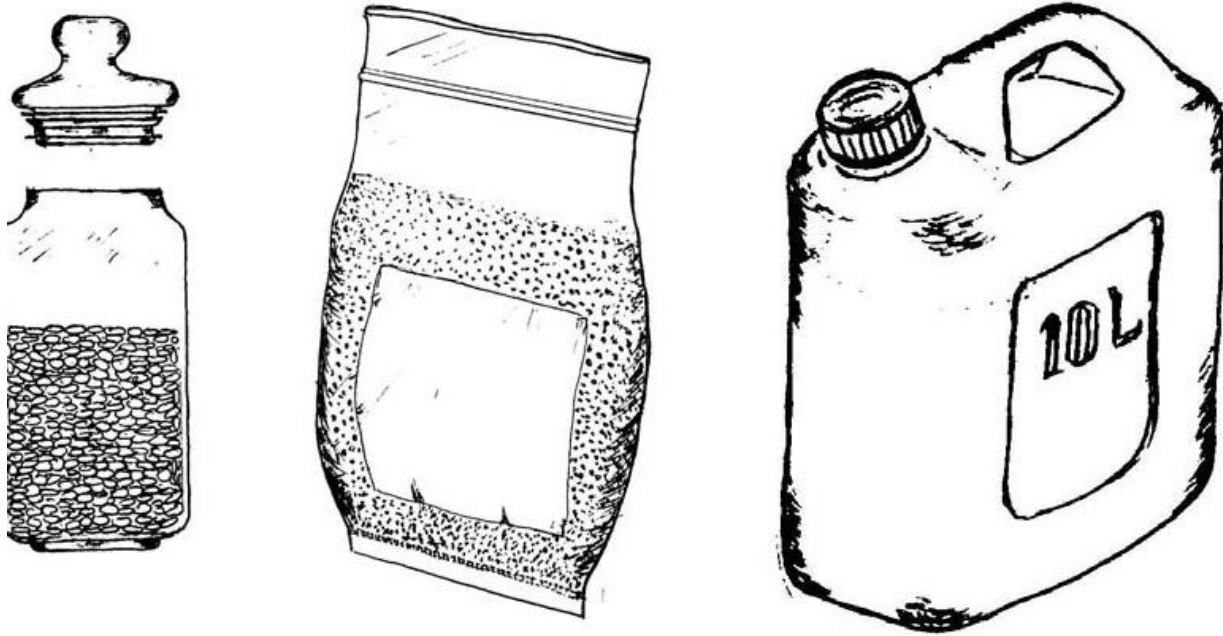


Figure 24: Seed containers

You should label the containers in which you store seed with the name and type of seed, location and date of harvest.

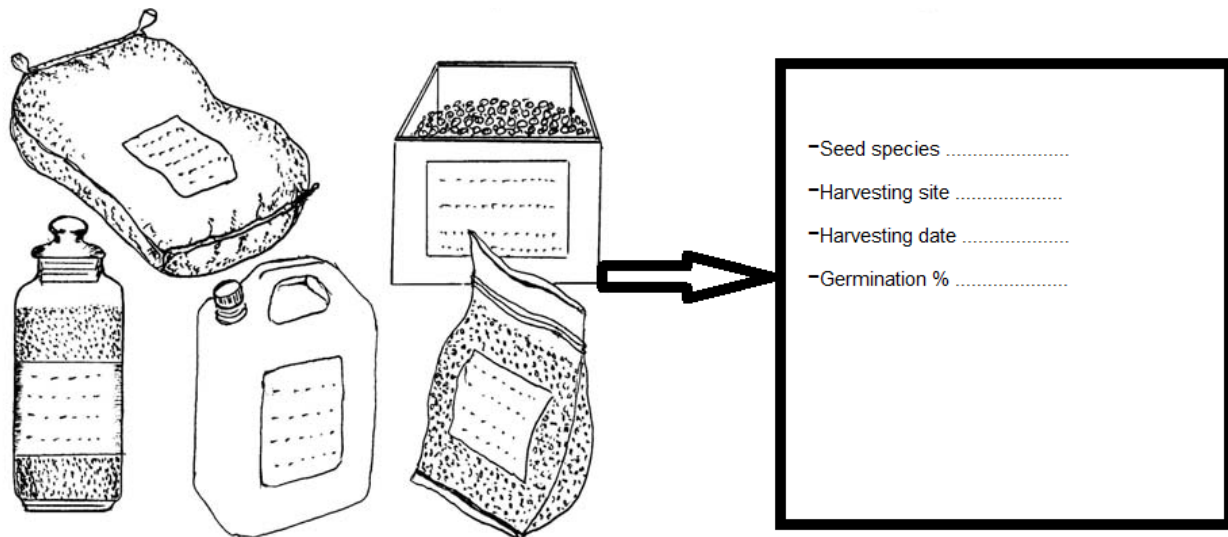


Figure 25: Labelling seed containers

If it is possible, you should also record the germination rate of the seed on the label. To be able to calculate the germination rate of a particular seed, you should germinate some seeds and see how many grow. If you see that 8 among 10 seeds grow, then the germination rate is 80 percent. With this information, you will be able to determine how many seeds are able to grow when you store them in between the harvest and planting period.

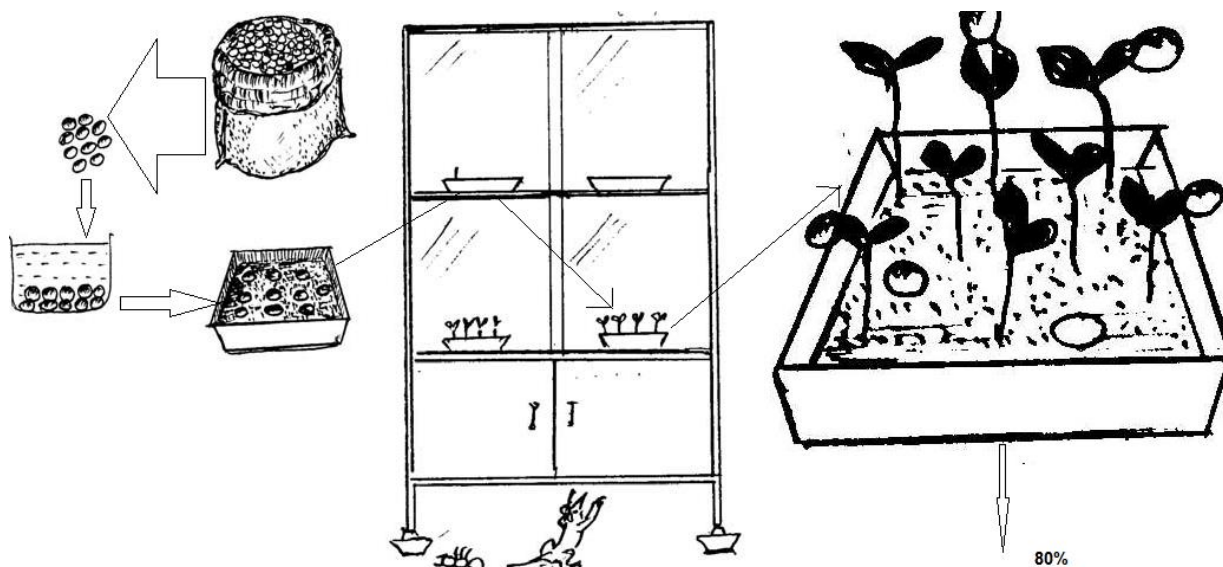


Figure 26: Determining the seed germination percent

To prevent the stored seed from being damaged by termites, ants or fungi, you should mix the seeds with neem leaves before loading them into the storage container, or you can mix a spoonful of neem oil, bean oil, or kapok oil into a kilogram of seeds, or use one or two cockroach repellants mixed with ten kilograms of seeds.

Prevent the stored seed from being destroyed by rodents or birds.

Storing seed in firmly closed containers:

- Do not keep damp seeds in closed containers;
- Use airtight containers such as a plastic barrel, a bottle/jar or a bucket with a firm cover; and
- Open the seed storage containers when necessary.

Some seeds are not accustomed to drying or cold temperatures, such as *Durio zibethinus*, *Mangifera indica*, *Artocarpus heterphyllus*, *Garcinia mangostana*, *Nephelium lappaceum* and kinin. These seeds can only be kept for up to one to two days in a simple room. It is better if we can plant these seeds quickly after the harvest.

To store these seeds:

- We must not dry them excessively. We should only dry the outside husk and keep the inside moist;
- Plastic bags should be half filled with seeds and half filled with slightly damp coal, saw dust or sand.
- Keep the bagged seeds in a cold place.
- Open plastic bags for one hour and a half per day to allow the circulation of air.

5. TRANSPORT OF SEED

5.1. Transportation of quickly rotting seeds

After harvest, we should quickly transport the seeds as follows:

5.1.1 Pack in a bag

- Store 3-5 kilograms of seeds in a plastic or cloth bag, close the bag but make sure that air has access;
- Place the bags in a vertical position in the store room;
- Cover with a plastic sheet when transporting.

5.1.2 Burying in sand

- Place sand at the location where you want to store the seeds;
- Lay the seeds on the sand (2-3 seed height);
- Continue layering for 2-3 layers finishing with a sand layer.

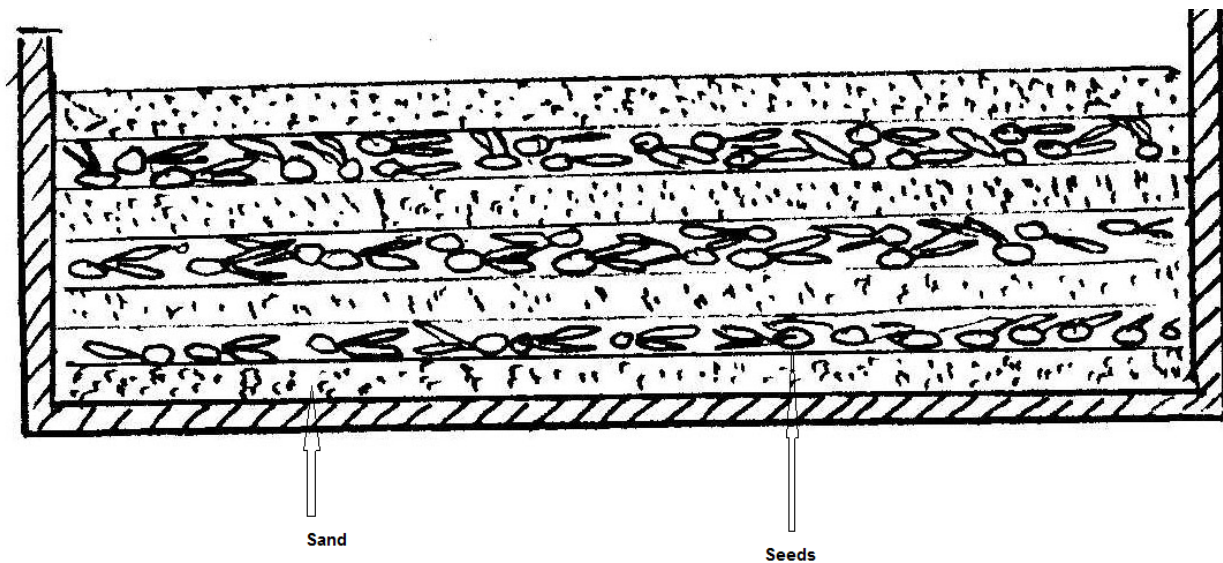


Figure 27: Seed storage in sand

5.2. Transport of Long Lasting Seeds

This kind of transport shall consider the following points:

- Take good care of the seeds during transport to the nursery bed, and during storage before sowing;
- When transporting, we shall double pack; the first layer should be plastic to keep out rain and the outer layer should be board or cloth sacking to avoid damage from hard objects and as protection from sun light.

Some advice for people responsible for transporting seeds:

- o Keep the seed bag away from water and do not expose to the sunlight. When transporting, we shall use a thermometer to check the temperature and moisture in the storeroom. We shall not allow the temperature of the seed bag to exceed the setting, otherwise, the seeds will be ineffective or dead; and
- o Take care with sticking the label onto the seed bag;

Advice for people responsible for the nursery bed:

- o Store the seeds properly upon delivery;
- o Take care with the remaining seeds, do not leave seeds on the nursery bed or in the sun, as this can reduce the quality of the seeds or spoil them; and

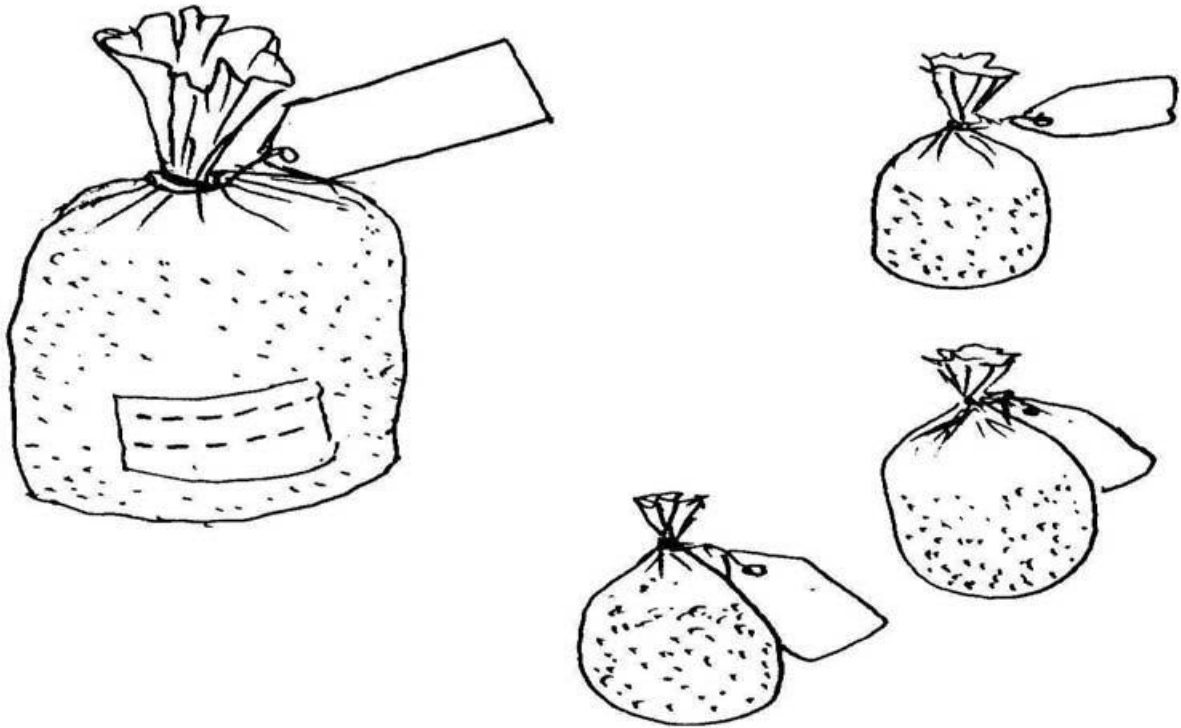


Figure 28: Seed container labelling

Use small bags to separate the seeds in the larger bag to avoid opening the bag many times, which can increase the seed moisture.

TREE PLANTING ACTIVITIES

1. PREPARATION OF THE TREE PLANTING SITE

Site preparation for tree planting is necessary to provide appropriate conditions for the seedlings to grow well. The preparation shall be completed by June at the latest. Techniques vary according to the site and planting purpose.

1.1. Site preparation for tree plantation

1.1.1 Identification of site and size of land for planting

One should select the site for planting trees in the form of a square shaped annual lot that is adjacent to others used in rotation, so that the seedlings are together and easy to care for. The size of lot shall be calculated according to the number of seedlings available for planting. For

example, if we have 5,000 seedlings and can plant 2,500 per hectare on average; we will prepare two hectares of land.

One should prepare a firebreak of at least 5 metres around the annual lot, by clearing and cutting the bush and removing easily inflammable materials. The firebreak can also be used as a road. If the community tree-planting project is expanded to 100 hectares, it is recommended to build a firebreak across the middle of the annual lot.

1.1.2 Building drainage canals

If the tree planting site accumulates water for long periods, it is necessary to build a canal to drain the water away.

1.1.3 Clearing the planting site and ploughing the area

1.1.4 Using lines to dig holes for planting the seedlings

For the plantation, lines are used to measure and adjust holes to be dug for the seedlings, which is helpful to enable them to grow in straight rows and to ease weeding, pest control and treatment.

1.1.5 Fencing

A fence is built to protect seedlings from animals, which should be adaptive to the availability and capacity of local people (detailed in Section 2.1, within Seedling Maintenance).

1.2 Planting seedlings

1.2.1 Open plantation

(For infertile soil, with only grass and small, unwanted plants)

- Limit the size of land to be planted and calculate the rate of seedlings to be planted per hectare;
- Construct a canal to drain water accumulating on the land;
- Clear and plough the area if possible;
- Use string to measure the positions of the planting holes in straight lines to be technically appropriate;
- Plant seedlings in this kind of soil between 1.5 – 2 meters apart; and
- Protect the seedlings, or build a fence to stop them from being destroyed by animals.

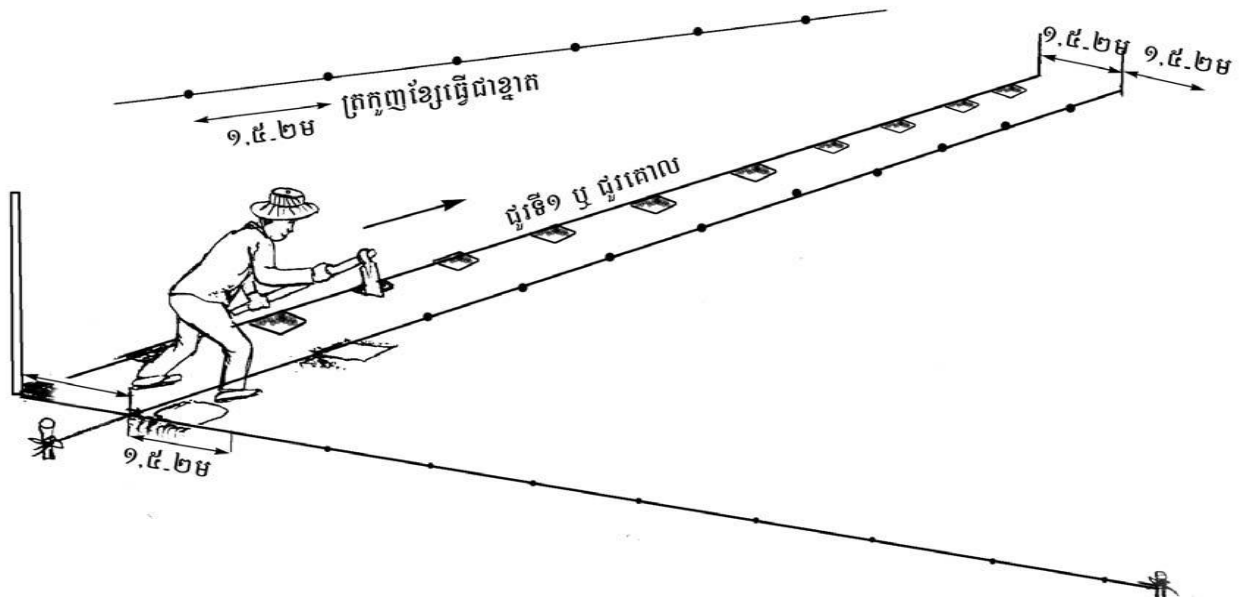


Figure 29: Seedling spacing

1.2.2 Tree planting in fields abundant with tall grass

- Measure the size of the land, and calculate the average number of seedlings per hectare (between 2,500 to 5,000) in order that the seedlings are capable of growing and destroying the grass;
- Construct a broad firebreak around the plantation of 6 to 10 meters in width. Fast growing species, evergreen species, or species with a thick bark, should be planted that can withstand the heat of forest fires.

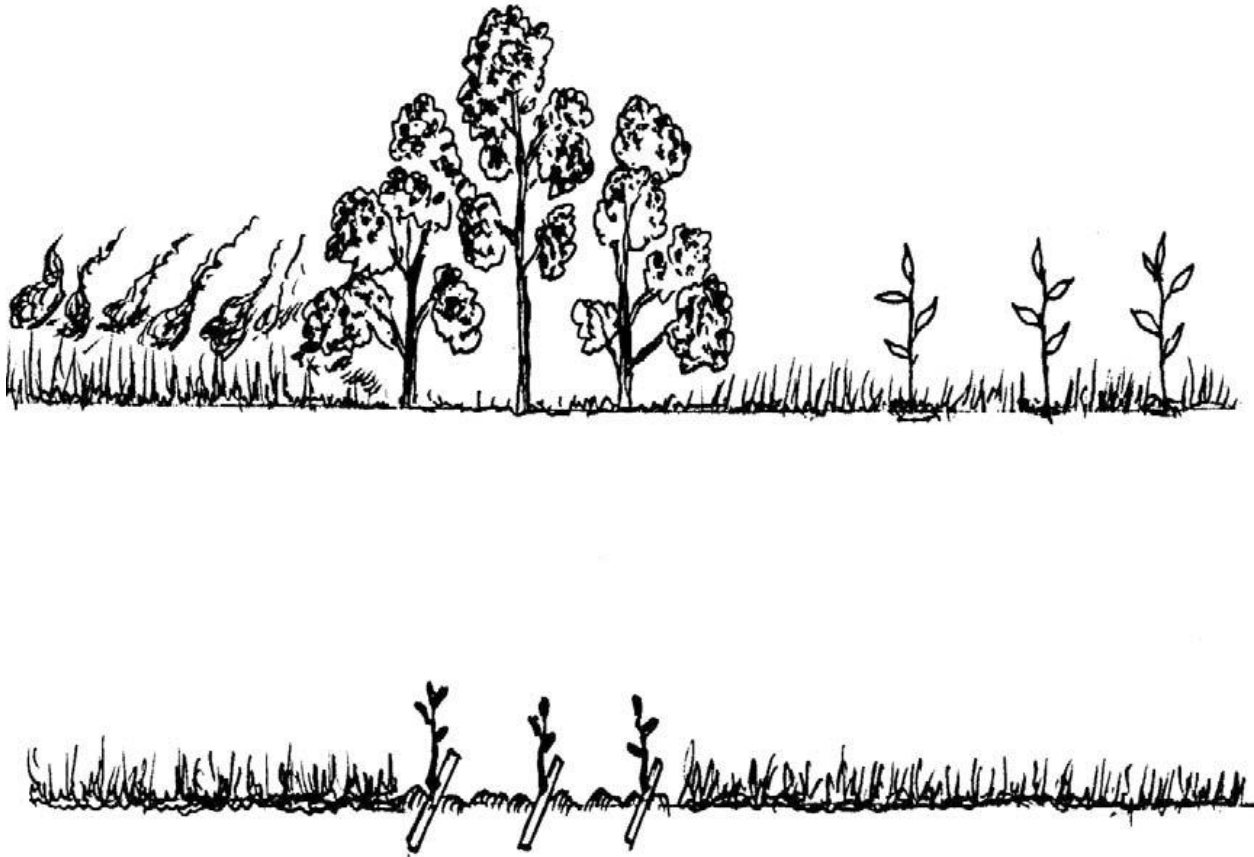


Figure 30: Tree planting in fields with tall grass

Cut and clear the grass. For large-scale state plantations, the whole area should be ploughed by tractor. However, the communities can clear off the grass, or plough the area block by block. Each block should be 2-2.5 square meters with gaps of 1.5-2 metres between each block. Each block can be planted with 2-3 rows of seedlings. The grass needs to be clear-cut for the seedlings to grow well at full capacity. It is also possible to spray pesticide to control newly grown grass, but it must be cut to allow the bud to grow, and can then be sprayed with pesticide to kill and flatten it. It is better during planting if bigger holes can be dug and all grass cleared off.

1.2.3 Planting between existing trees

This kind of planting increases the number of beneficial trees in degraded forests. When clearing the area to plant trees, keep those trees that are beneficial and dig holes between them, keeping space between as appropriate according to the planting technique. We do not have to plant the trees in straight rows.

In the case that the remaining trees have many branches but we need to grow the seedlings nearby, you should prune the branches to allow sunlight and dew to access the newly planted seedlings.

1.2.4 Tree planting as fields in shrub land

Shrubland includes *Rhodomyrtus tomentosa*, *Maclura cochinchinensis* and *Heritiera littoralis*, which generally do not disturb the growth of big trees. Therefore, you only need to clear the forest to open spaces large enough to dig the planting holes in a straight line.

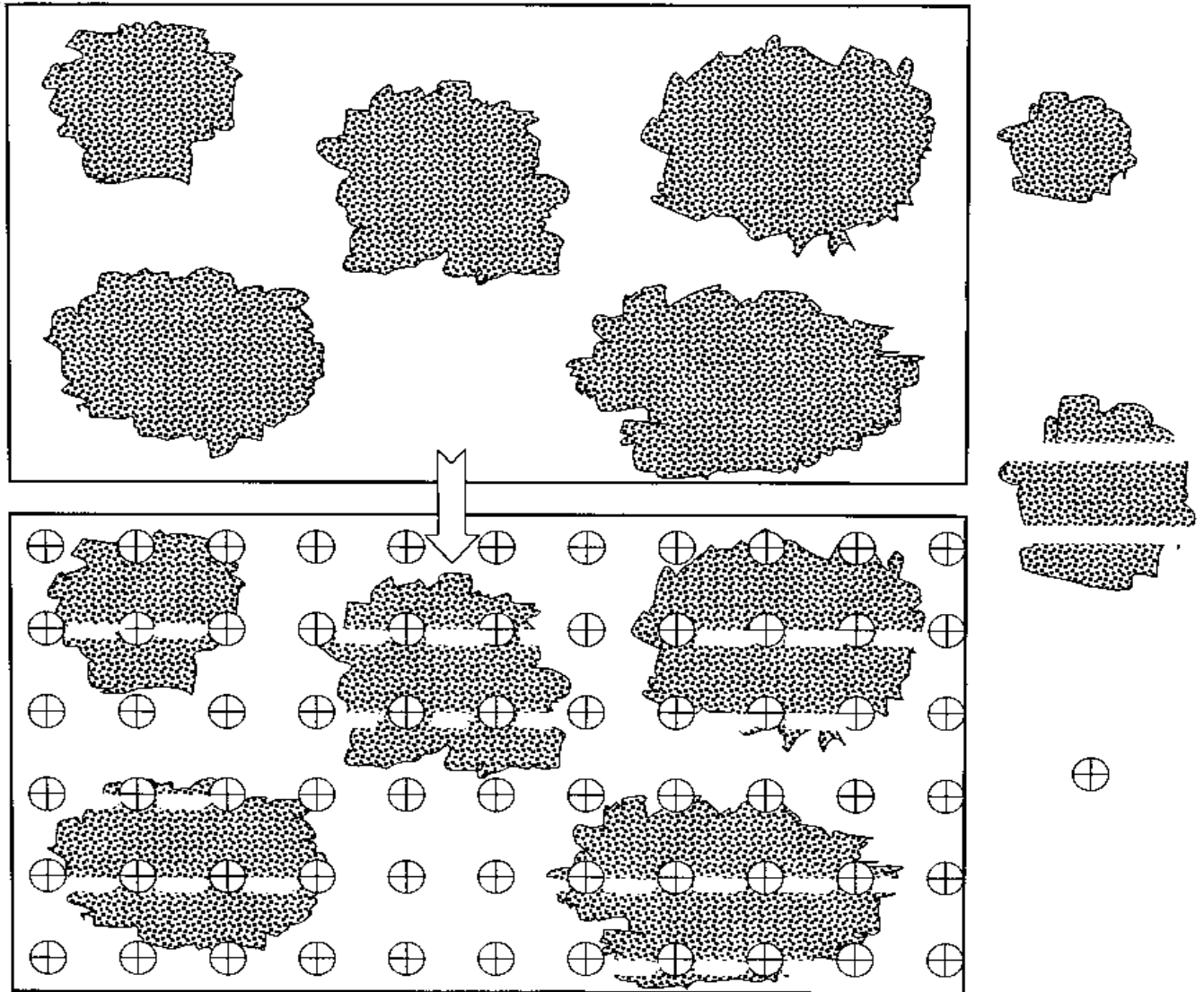


Figure 31: Tree planting as fields in shrub land

Reforestation of this kind of land shall be done throughout the area by keeping the planting spacing not smaller than 2 x 2 meters, with the number of seedlings not more than 2,500 per hectare. We shall use three measurement poles, higher than the shrubs, to make sure that the rows are straight when digging holes, and then we can use split bamboo or step to measure the space between each hole.

1.2.5 Tree planting as a wind break

For this purpose, we can plant a variety of species, such as tall or medium height species, or shrub species. The planting proportion should be 15% of tall species, 20% of medium-height species and 65% of shrub species.

The tall and medium height species should be:

- Strong and durable against the wind (tough branches);
- Fast growing;
- Able to grow shoots; and
- Economically important.

We shall not select species if the upper part of the tree is bushy and too heavy. Appropriate species are those with a lower part dense with leaves or branches, slightly thick in the middle part of the tree, and sparse at the upper part, which helps to divert the wind current away from the trees. The trees shall be planted in 1 to 5 rows.

We plant trees of five rows or more to protect against direct strong wind, known as a main windbreak. Trees planted for this purpose shall be planted in rows 300 m to 400 m from each other. Tree planting of 1-3 rows is to protect against moderate wind and these trees shall be planted in an angled position to the main wind. These species are *Cassia siamea*, *Pinus merkusii*, and *Casuarina equisetifolia*.

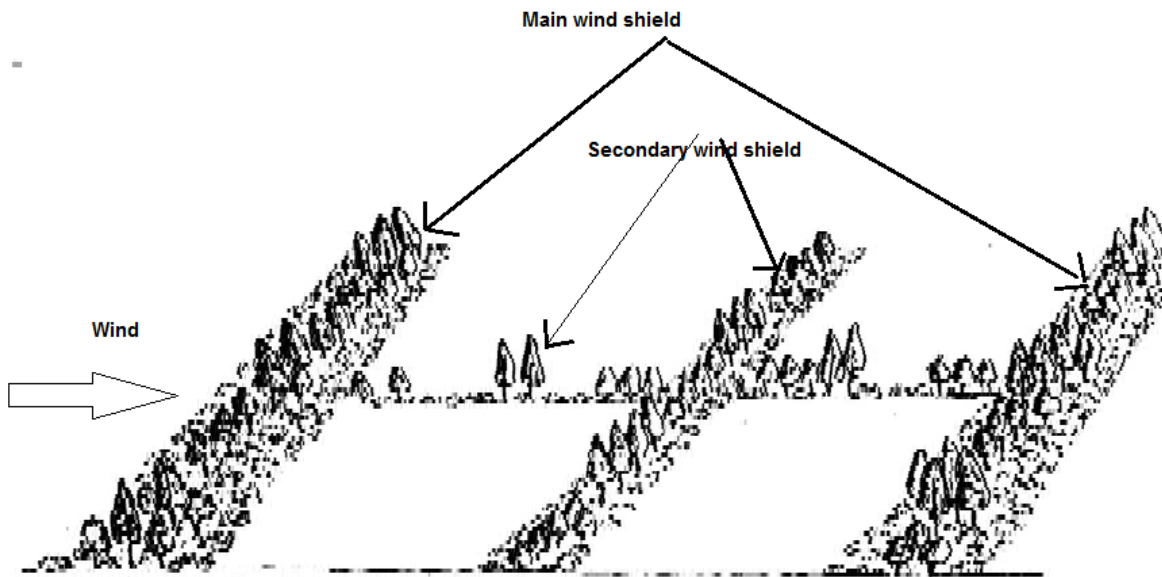


Figure 32: Tree planting as a wind break

Trees shall be planted 1-1.5 metres apart, in groups of 2-7, where each group consists of one species. Note: tall species are planted in the centre, with medium height and short species planted alongside.

1.2.6 Tree planting along the road

At present, the construction of roads and pathways is developing very rapidly to assist the travel of local people. Therefore, tree planting along these pathways provides various advantages such as beautifying the road, providing shade, and preventing soil erosion.

Local people should be aware of these advantages and some important techniques for planting trees along the road, as the following:

- Tree planting should start in the early wet season depending on place;
- Trees with small leaves or branches should be planted from the middle slope of the road to the base, 2-3 meters apart. However, those with large branches should be planted on the base slope of the road. If the area is adjacent to rice fields or accumulates water, the land needs to be raised to a higher level. In this case, seedlings shall be planted 3-6 meters apart.

One should not plant seedlings on the inner part of a bend in the road because it would be difficult for travelers to see each other;

- You shall measure planting holes from the middle of the road to the side (the measurement line shall be angled to the road) to ensure consistency. By doing so, the seedlings will be in straight rows or curved around bends; and
- One shall prepare enough protective frames for each seedling planted.

1.2.7 Tree planting for shade on the plateau

Tree planting for shade is conducted as follows:

- A site is prepared where seedlings can be planted in groups of 9 – 16;
- Each group should be at least 100 m apart;
- Seedlings should be 2 m apart because young trees, affected by strong sunlight, will need more shade. When they grow, we can cut some of them to reduce the density; and
- We shall build fences to protect the seedlings in each group.

1.2.8 Tree planting to prevent soil erosion and for drainage

1.2.8.1 Prevention of soil erosion along waterways

Ground alongside waterways suffers from soil erosion according to the speed of the water flow.

We shall plant the tree species as mentioned above to protect against soil erosion on the affected or threatened banks, because collapse of the banks can spread to other parts of the waterway. For that part which suffers severe erosion, we shall take temporary or urgent measures, at least within one year, to allow enough alluvium soil to accumulate for planting the protective trees. We shall also plant trees on the alluvium soil, which accumulates behind bamboo, or wooden barricades, which were placed as temporary protection.

We shall plant shrub species in the lower part and large tree species in the upper part;

- On average, we should keep a space of 1 x 1 m for shrub species but if we plant in front of a strong current of water, we shall plant them close to each other in the initial stage.
- We shall quickly plant the protective trees between November and December because the plants that grow along waterways in Cambodia mostly blossom in the dry season.

1.2.8.2 Prevention of soil erosion on slopes

- In the case of planting trees on slopes to prevent erosion, we can plant trees mixed with existing ones angled in rows as in plantations in the open field.

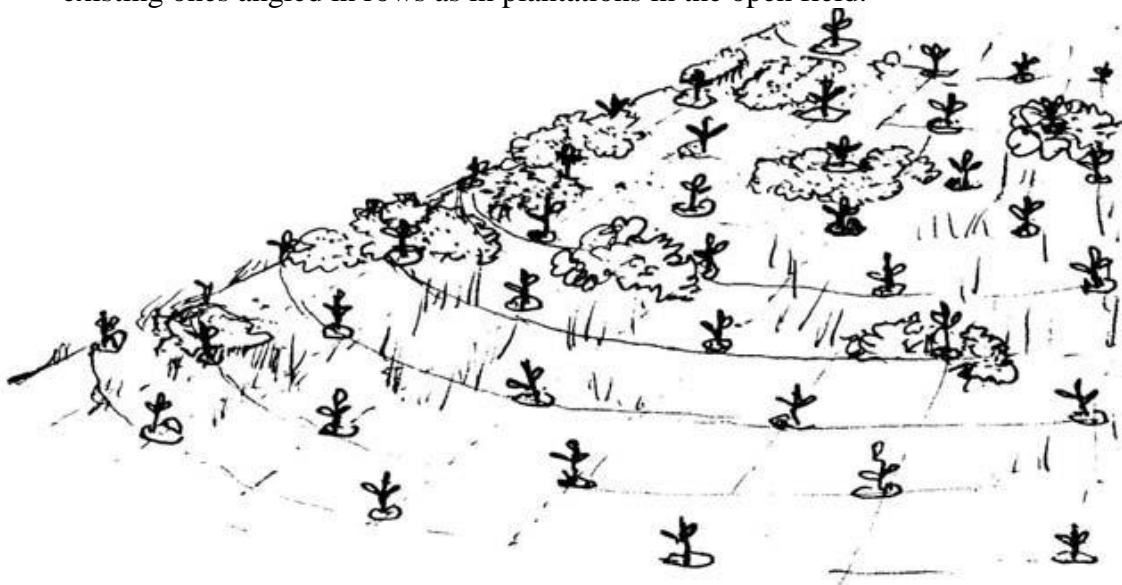


Figure 33: Prevention of soil erosion on slopes

For slopes with no existing trees, we shall do the following:

- Plough the area into terraces, with planting blocks between 4-6 m in length and 2-4 m in width, in an angled form.

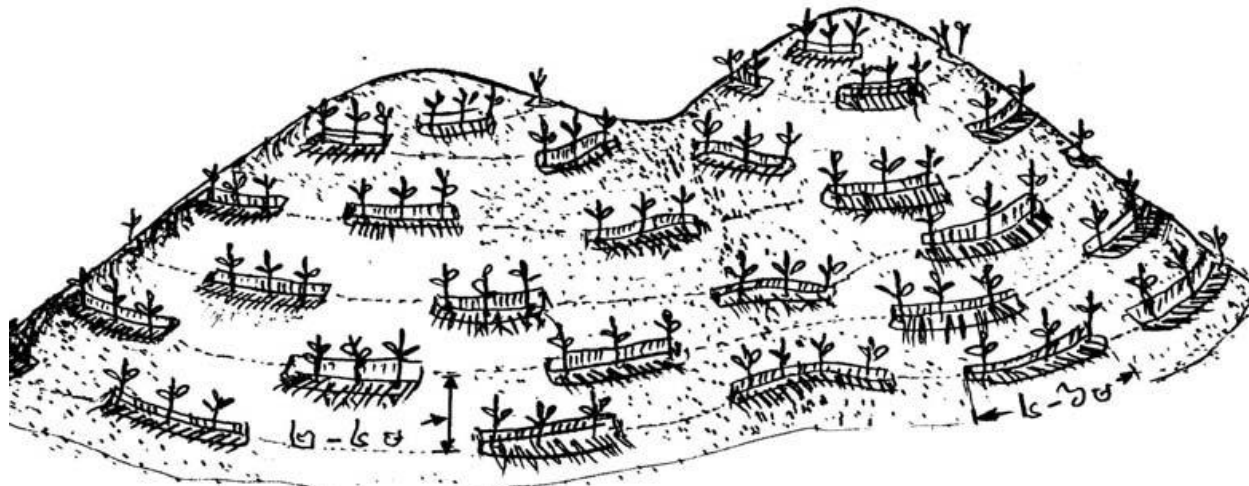


Figure 34: Ploughing the slope with terraces

Cut small branches to put on each block and place small poles around to prevent the earth from collapsing; o Seedlings shall be planted near to those barricades.

1.2.9 Tree planting for fodder

To plant trees for fodder, we shall use seedlings which germinate from branches;

- Fodder trees can be planted in rows between crops (figure A), as a fence around the house or plantation, or in an open field to supply fodder or as grazing land.

- We can plant in beds of 0.5-1 m width, with 2-3 rows per bed, keeping 0.5-1 m of space between each tree (figure B), for intercropping or planting along the fence.

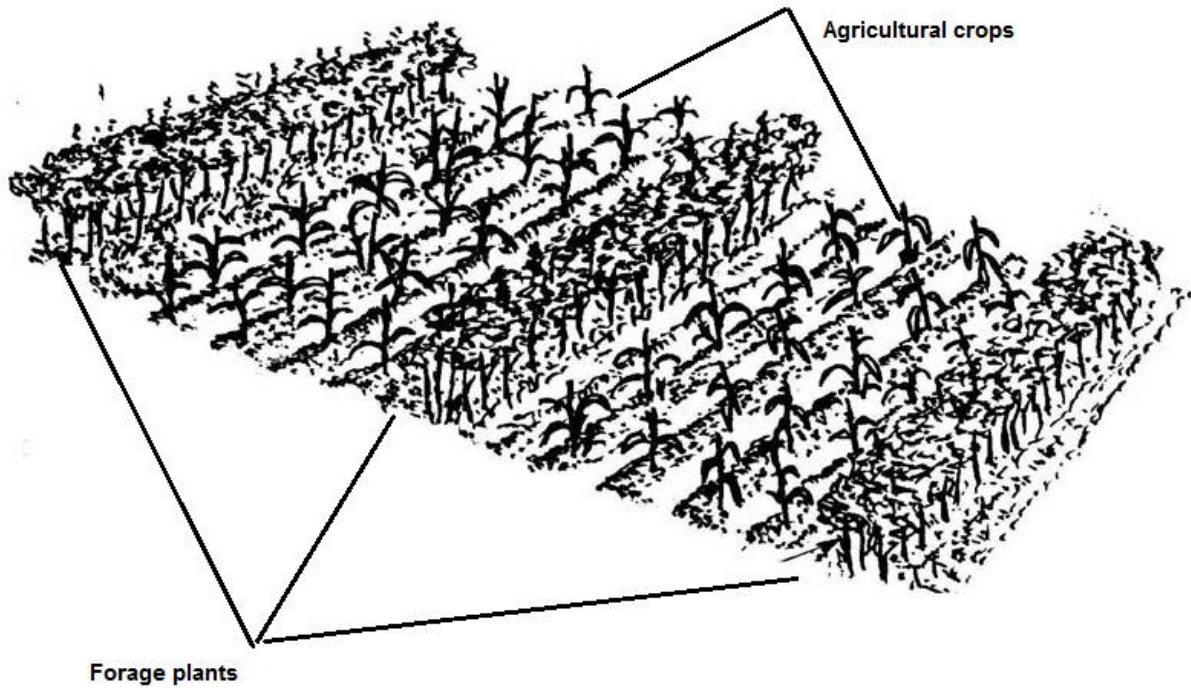


Figure 35: Tree planting for fodder

When planting fodder trees in an open field, we shall plant groups of 4-5 trees, keeping 0.5-1 m between each tree and 2-3 m between groups.

We shall plough and furrow the land carefully so that the seedlings are able to grow well.

1.2.10 Tree planting in agro-forestry systems

1.2.10.1 Agricultural land development in the slope area

In order to prevent erosion on slopes where agricultural crops are planted, we shall plant trees to stop or to slow the water run-off from removing the soil (figure A and B).

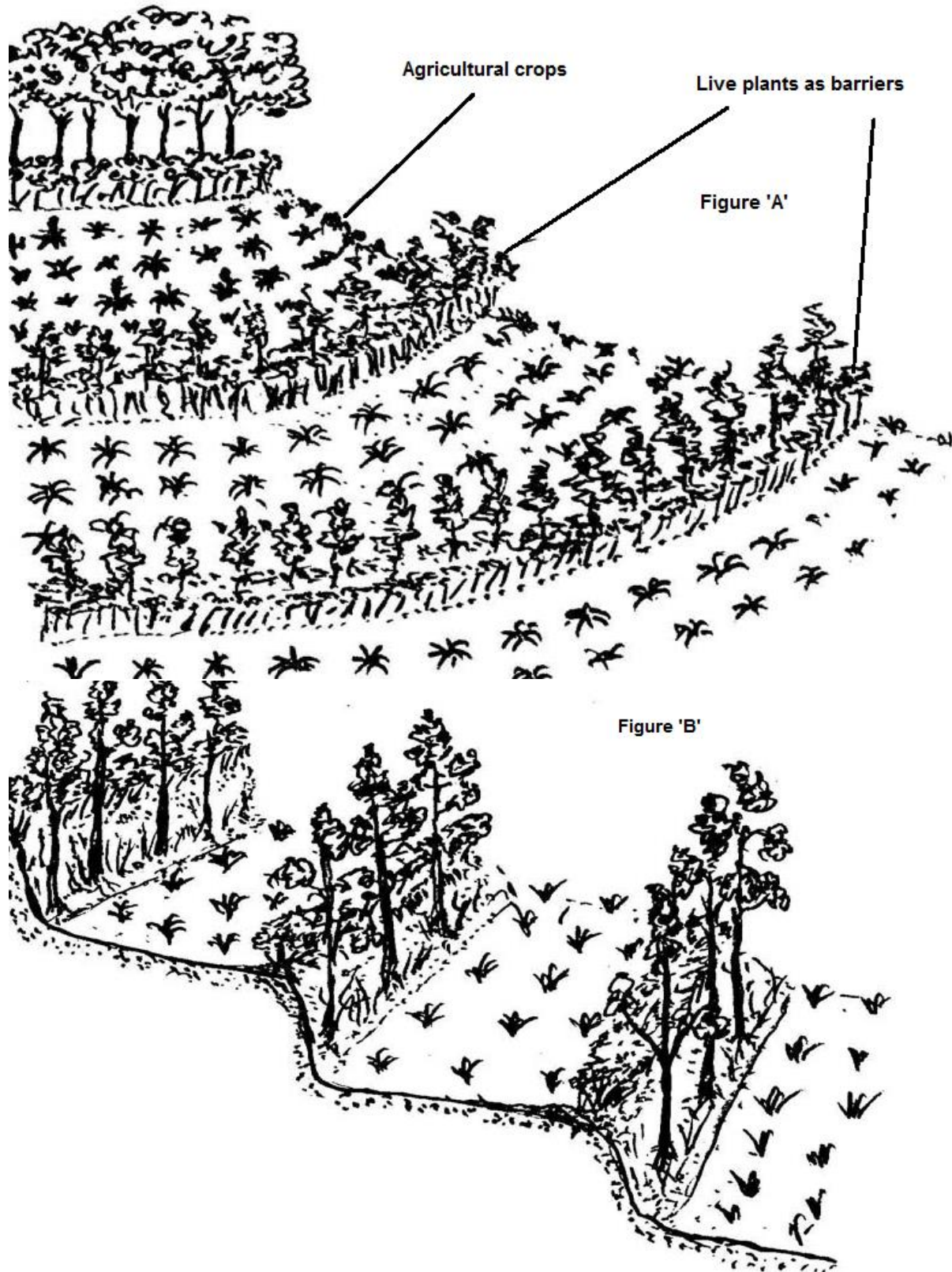


Figure 36: Tree planting in agro-forestry systems

Therefore, we should implement the methods below:

- We shall plant trees in rows of equal height and shall try to prevent each barricade from allowing water to flow into the natural valley, which could cause higher soil erosion (figure C).
- The gap between rows of trees, planted as a barricade, should be 2-3 m (figure D).

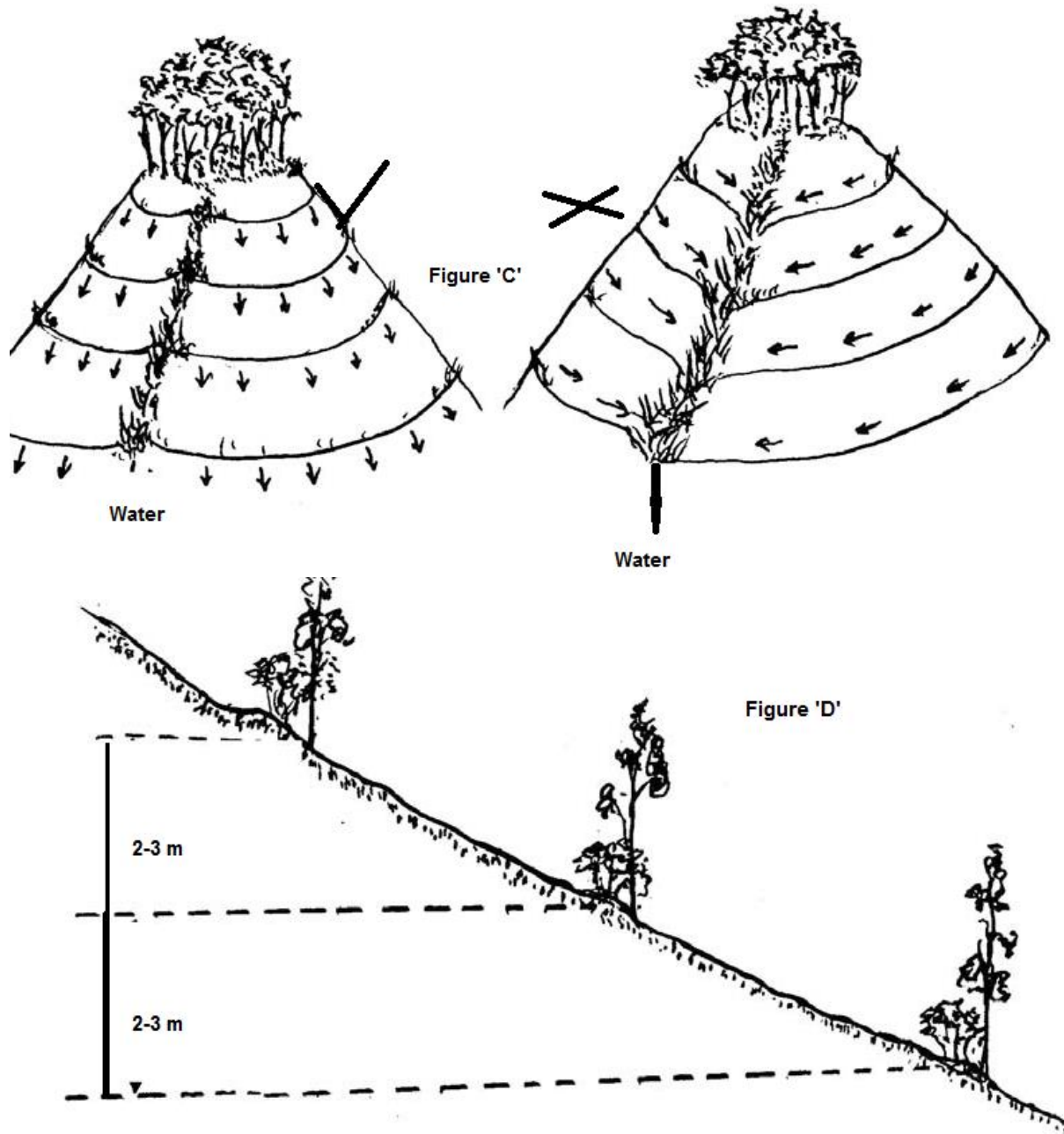


Figure 37: Planting trees in intervals of equal height

We shall plant shrub species, with 2-3 rows per block with 1 m of space between each tree, in an angled form by mixing with tall trees.

- Shrub species are those that germinate from branches or that can be cut from tree branches for planting, but tall species mostly germinate from seeds.

1.2.10.2 Multiple tree planting diversified with crops

In some cases, trees can be planted to provide shade for other agricultural crops. This technique can be practiced particularly for crops cultivated on grass land. However, we shall also seek additional advice from forest extension workers. For this purpose, we shall consider environmental and economic issues, which also require time-consuming monitoring. Thus, we shall follow the stages below:

- At first, we shall plant trees that can bear strong sunlight, which will provide shade for other plants, that we shall plant with 2-3 m spacing.
- We shall plant annual crops in between the shade providing seedlings;
- We shall apply fertilizer, and weed and trim the shade trees when they become too bushy.
- We shall continually remove unwanted plants and keep trees or crops that are more beneficial.



Figure 38: Multiple tree planting diversified with crops

2. HOLE DIGGING METHODS FOR PLANTING SEEDLINGS

- Holes shall be dug at least one week before planting, in order that sunlight can decompose the organic elements in the hole, and kill viruses or other diseases
- It is good to dig a large hole to enable the seedlings to root deeper and to absorb more nutrients. The hole shall be at least 30 square cm, with a depth of 20-30 cm.
- We shall place the upper soil in a mound separate to the lower soil, and loosen the soil at the bottom of the hole.

3. HOW TO PLANT SEEDLINGS

- One should apply fertilizer to the bottom of the hole if possible. For severely infertile soil, we shall mix the soil with one kilogram of compost but this is not necessary for fertile soil.
- One shall tear the plastic bag carefully, not to break the earth before placing the seedling into the hole.
- One shall place the seedling firmly in the hole, then put in the upper soil or soil mixed with compost, and after that we can put in the lower soil. Finally, we shall compress the soil firmly with our hands so that the soil is not compacted by rain.

You shall be careful when placing the seedling into the hole. We shall place a supportive stick to protect the seedling from the wind, which can shake the plant and disturb the rooting of the newly planted seedling. We shall cover the seedling with grass or leaves to maintain the moisture level.

References

Farmers' Tree Planting Manual, (2003). Producers: DANIDA-CTSP, GTZ-CGFP, DFW, JICA, PRASAC.

Forestry Commission (1977), E(E) Work Study Branch Report No 42, Initial Trials of the Quickwood Planting Machine in Thetford Forest E(E).

Forestry Commission (1992), Technical Development Branch Information Note 2/92, The Whitfield Planter.