BASIC

TREE PLANTING AND TENDING TECHNIQUES

IN THE ASALS (KITUI AREA)

JULY, 1995

KENYA/JAPAN

SOCIAL FORESTRY TRAINING PROJECT

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ABSTRACT

This document presents a basic systematic approach for tree planting and tending in ASALs. It is also attempting to elaborate on the chronological sequence of basic practical operations that have to be carefully obeyed if a successful tree planting exercise is to be realised.

Introductory chapters deal with the factors to be considered before one gets started in tree planting exercise within the ASALs, while the later ones deal with the field work methodology to be adopted while emphasising on intensive management approaches. Also simple illustrative diagrams have been included on most items for ease of understanding by the recipients or beneficiaries.

ACKNOWLEDGEMENT

This technical document is written purposely as a revision and update version of chapter 8 of the Social Forestry Handbook part one by Kenya/Japan Social Forestry Training Project (SFTP) through close collaboration between the Kenya Forestry Research Institute (KEFRI) and the Japan International Co-operation Agency (JICA).

This version has been developed utilising practical research and implementation experiences gained from TIVA Pilot Forest tree planting exercises.

The authors also wish to thank and acknowledge having made use of materials from other Kitui Centre internal authors of pamphlets, working papers, operation manuals and handbooks. Above all the authors also wish to extend their thanks to Kitui field technical staff for their effort in accurate implementation of trial methods and data collection which has contributed highly to the writing of this document.

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1. INTRODUCTION

An uncountable numbers of trees have been planted by rural people, however it is evident that only a few of them have survived in dry area.

Although environmental factors like harsh drought, poor soils, wildlife or grazing animals, etc. have been blamed for the low survival, in most cases low technical knowledge and inappropriate techniques to controllling such factors and to protect the trees against them are major contributing reasons accounting for such low survival of the trees.

Healthy seedlings are probably available from your own or nearby nurseries, however, if these seedlings are not planted properly, they hardly grow well. Tending is also a very important operation especially when planted trees are still young and tender. If high survival rate and fast growth of trees are to be expected, some form of intensive management operations need to be practised.

The rest of this document presents some basic approaches and technicalities that, if well practised, could raise the survival rate of field planted trees in ASAL areas significantly.

2. BACKGROUND

A) Climate

According to the Agroclimatic Map of Kenya (Teel, 1985), climate of Kitui - Kwavonza is summarised below.

Average annual rainfall (A)	: 450 - 900 m m
A verage annual potential evaporation (B)	: 1650 - 2300 m m
A/B	: 22 - 20%
Average annual temperature	: 22 - 24°C
Altitude	: 900 - 1200 m
General description	: midlands
Classification	: semi - arid, warm
Typical vegetation	: bush land dominated by thorny *Acacias* and *Commiphora* species.

B) Topography and soils

Kwavonza is located on rolling hills and the slope is generally gentle. Soils are classified basically into three types, i.e.

- Acrisols (light red soils)
- Luvisols (dark red soil)
- Vertisols (black cotton soil)

FACTORS TO BE CONSIDERED DURING TREE PLANTING

The following factors should be considered and analysed in order to be able to apply the most appropriate tree planting techniques against them.

(A) Uncontrollable factors

The environment is uncontrollable, however its limitations should be recognised so as to be able to apply appropriate techniques against it. Therefore the factors outlined below are closely related to soil moisture conditions which also determine survival and growth of trees.

(a) Rainfall pattern
(b) Duration of dry seasons
(c) Insolation and temperature
(d) Topography and soil types of the area
(e) Wind speed and direction, etc.

(B) Controllable factors or measures

Realisitic and feasible techniques should be applied in consideration of the following factors.

1) Soil moisture controls

Those could be achieved through practising:

a) Limiting competition with other vegetation for moisture
b) Practising effective water harvesting approaches
c) Practising effective irrigation techniques
d) Improving the soil condition of the planting holes.

2) Animals and termites damage controls

Those could be achieved through practising:

a) Effective fencing against domestic and wild animals
b) Controlling grazing, behaviour of domestic animals
c) Applying chemical, physical or biological control methods against termites threat.

3. Species selection

Selection should be guided by:

a) Relevance to recipients or beneficiaries
b) Its drought tolerance
c) Its termite resistance
d) Its susceptibility degree to wild and domestic animals
e) Its adaptability to the site condition

4. Technical guidance

This can be achieved through:

a) Guidance and assistance by relevant organisations
b) A survey on demand and acceptance of the tree species by the local community

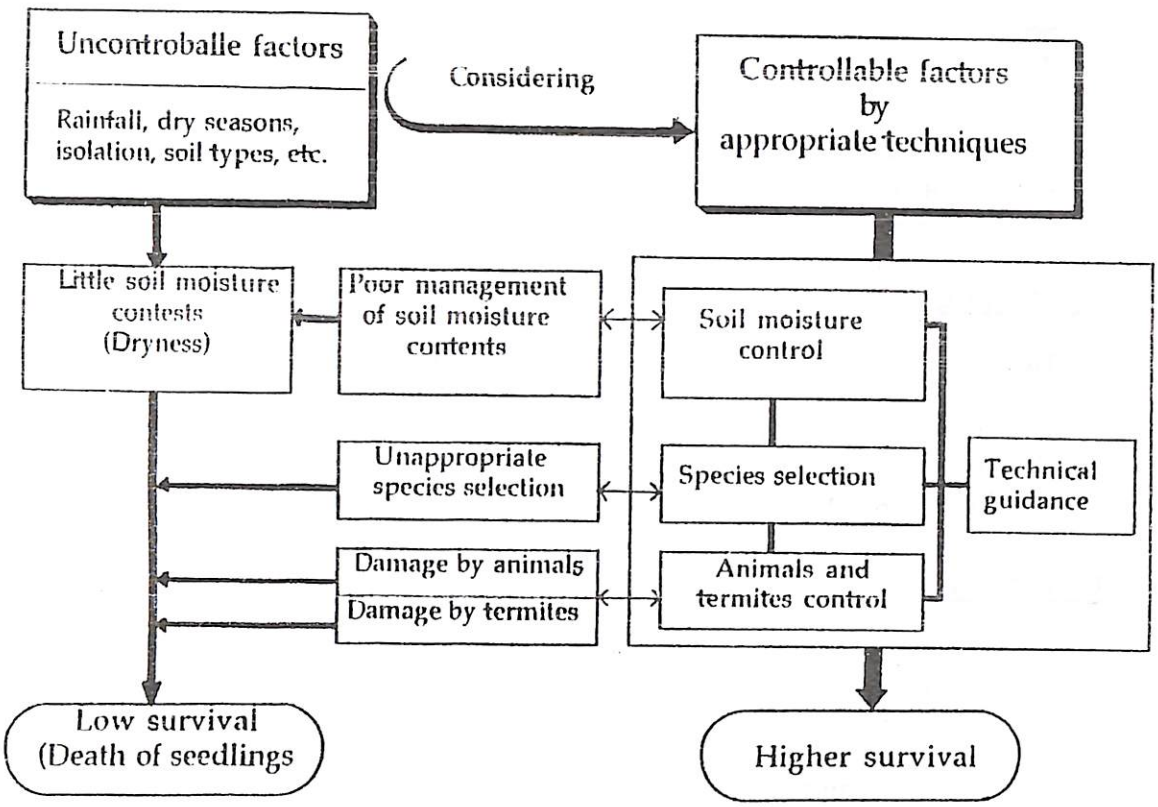

Fig. 1: Factors to be considered

4. PLANTING AND TENDING STAGES

The below systematic operations are all necessary and therefore they should be carried out carefully and precisely throughout tree planting and tending stages.

A) Preparation work

In ASALs tree planting exercises the most of the below preparatory works are undertaken.

1. Site preparation

a) Clearing (total, spot or strip bush clearing)
b) Planting hole digging
c) Refilling of the holes
d) Water harvesting structure constructions i.e. micro-catchment)

2. Seedling preparation

Seedlings preparation work just before the actual planting is effected through the below stages:

a) Suitable planting stock selection
b) Precise hardening up operation
c) Planned transportation of seedlings to the planting site
d) Planned provisional allocation after transportation to the site

B) Planting

The actual planting operation is achieved through the below stages:

a) Careful tube removal
b) Careful planting of the seedling
c) Performing soil firming

C) Tending

Tending stage is essential for effective early and later development of the planted out seedlings and may be achieved through any or a combination of the below practices:

a) Effective slashing/weeding
b) Construction of water harvesting structures (i.e. by micro-catchment)
c) Practising watering (by various techniques)
d) Practising shading (by various techniques)
e) Practising mulching (by various techniques)
f) Practising crown management techniques (e.g. pruning)

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D) Protection

Trees have many enemies especially in ASALs where green fodder is scarce in dry periods therefore protection becomes necessary and it may be taken in form of:

a) Livestock control (by fencing for exclusion of animals)
b) Wild animals control (by fencing)
c) Termite control using any of the various practical approaches
d) Insect and disease control by applying various methods

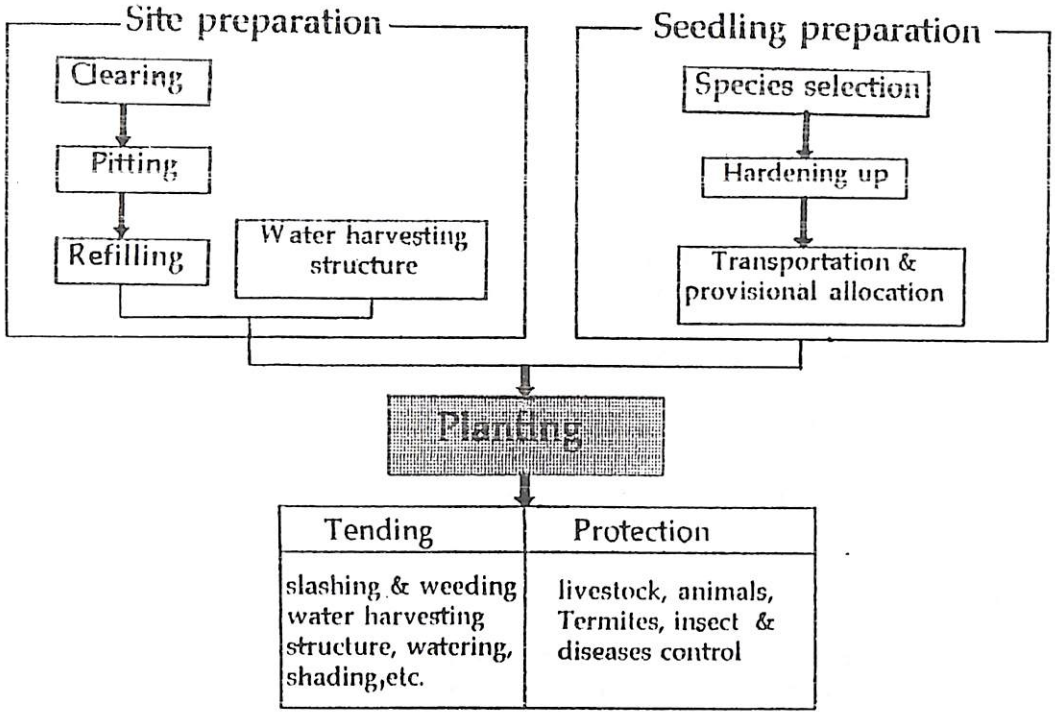

Fig. 2: Planting and tending stages

5. SITE PREPARATION OPERATIONS

A) Clearing

The bushes and grasses must be cleared off so as to ease the digging process as much as possible. If the site is totally cultivated, more water is able to infiltrate and retained in the soil with the limited rain duration in the ASALs.

B) Pitting

Holes should be pitted correctly before the rainy period commences. The advantage of a well prepared hole is to loosen the soil so that the roots of the planted seedling can be able to penetrate into it easily. It also traps more rainwater and therefore enabling the soil to store more moisture within a short time. Kitui experience shows that larger holes are more effective for achieving higher survival and early fast growth. Hole sizes adopted are 45cm (1.5 feet) diameter by 45cm (1.5 feet) depth or 60 cm (2 feet) diameter by 60 cm (2 feet) depth.

C) Refilling the holes

Refilling could be undertaken any convenient time before the rain or after a certain amount of rain. During the operation, undecomposed materials e.g. branches and grasses should not be mixed with refilling soil because they usually interfere with root development and also attract termites within the root mass area of the seedling.

D) Micro- catchment

In the process of refilling, jembes or spades are simultaneously used to cut the surrounding top-soil close to the hole with some slant. This initial micro-catchment is a very important and effective tool for early water harvesting. Microcatchment harvested water is more effective that bigger holes dug with much difficulties and at high cost. When the soil is soft with enough moisture, seedlings develop their roots deep very fast and easily before the soil become dry and hard later during dry season.

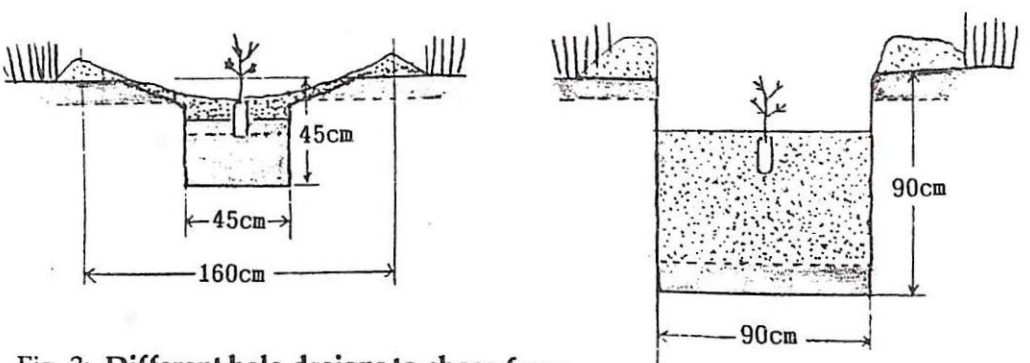

Fig. 3: **Different hole designs to chose from.**

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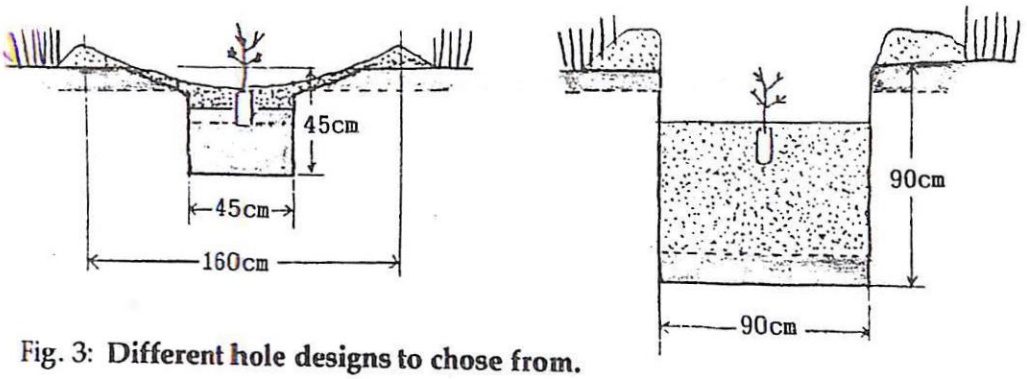


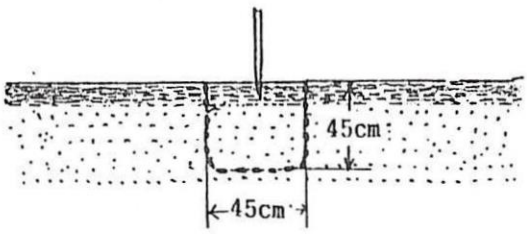
Fig. 3: **Different hole designs to chose from.**

Fig. 4: EXAMPLE OF AN EFFECTIVE PLANTING METHOD
(Circular micro - catchment design)

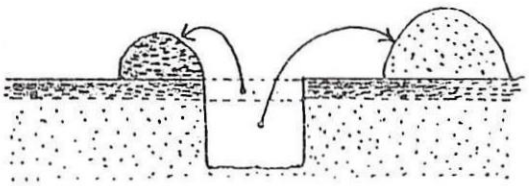
The procedure illustrated below is recommended for use when preparing holes.

(a) Dig a hole of 45cm diameter by 45 cm depth always separating top fertile soil from sub soil.

Fig. 4-1

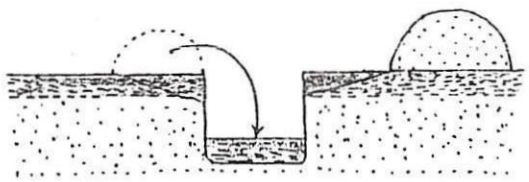


4-2



(b) Then refill the hole with dug out top-soil first.

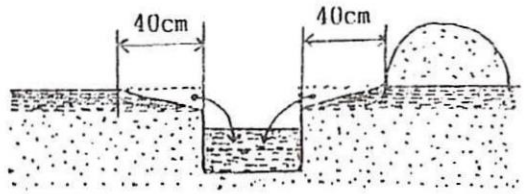
4-3



Then cut the top-soil around the hole with some slant and use this soil to refill the hole about three quarter way.

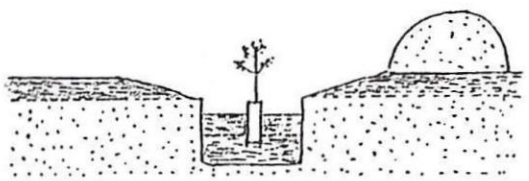
This forms the initial kind of a micro-catchment.

4-4



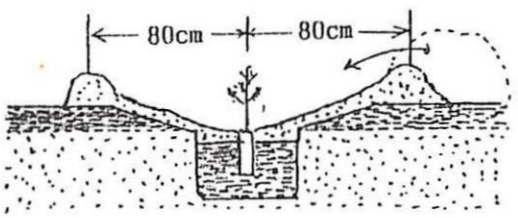
c) Plant the seedling.

4-5



d) Refill the hole with sub-soil, and finally create basin-shaped micro-catchment.

4-6



6. SEEDLINGS PREPARATIONTECHNIQUES

1) Seedlings hardening up

Seedlings selected for planting should be healthy and big enough. Hardening up operation is very important as a mock introduction of the seedlings to harsh conditions they are about to be exposed to at the planting site. This operation involves root pruning, reducing watering intensity and exposure to sun for at least two weeks preferably one month before field planting operation.

2) Transportation of the seedlings

Transportation of seedlings commences at the beginning of the long and reliable rainy season. Watering is recommendable just before transporting seedlings from the nursery to the planting site so as to secure the seedlings from drying up in the process of transportation and in the case of planting delay due to unavoidable circumstances.

Seedlings are so fragile that they must be handled carefully. They should not be piled upon each other otherwise this damages them. Boxes or bags are recommendable tools for packing and carrying seedlings to the planting site.

Fig. 5: **Transportation of the seedlings**

3) Provisional allocation site

The seedlings should be planted out shortly after arriving at the planting site. In case more time is needed before planting takes place, they must be kept in a shade and protected from dry strong wind. They also need to be watered so as to remain moist and vigorous until the time they will be planted.

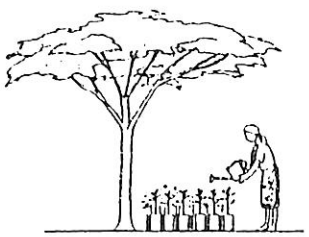


Fig. 6: **Provisional allocation**

7. PLANTING TECHNIQUES

The planting operation should start during the rainy season as soon as the soil moisture build up is deemed adequate. Within the Pilot Forest/Kitui planting operation starts when total rainfall attains 100mm. About 50cm depth of wetness or more is realised with this amount of rain depending on the soil type and water harvesting methods.

Planting should be carried out while it is still raining or soon after the rain under the cloud. Planting should not be done under strong sunshine to avoid withering of seedlings due to direct sun rays combined with high heat intensity.

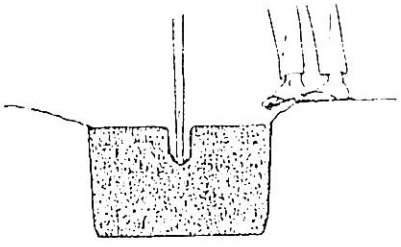
Seedlings should not be planted too deep in hole. Especially when they are small, they will be drowned and buried during the next rainfall.

The interval of each seedling should be about 3.5m (3.0 - 4.0m) in Kitui area.

The recommendable planting procedure for Kitui is:

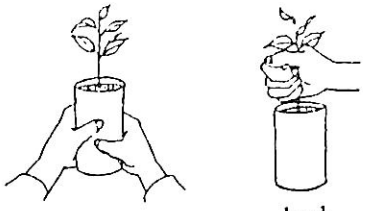
a) Create a hole same as length of the pot using a panga, jembe, stick, etc. (Fig.7-1)

Fig.7-1



b) Hold the pot and compact the soil with two hands, never hold the seedling itself. (Fig. 7-2)

Fig.7-2

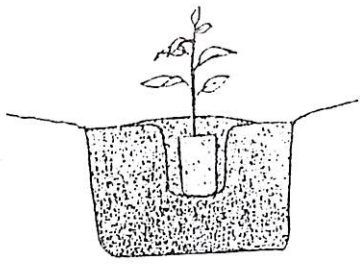


c) Slice and remove the pot carefully without disturbing the soil substrate. (Fig.7-3)

Fig.7-3

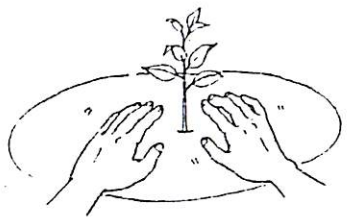
d) Insert the seedling into the hole without disturbing the pot soil substrate and cover it well. Ensure that no roots are left exposed at the same time, do not mix dry soil and grasses during covering.

Fig.7-4



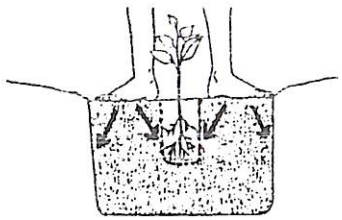
e) Firm the soil around the seedlings to ensure contact of pot soil with seedling roots together with the surrounding soil (Fig. 7-5)

Fig.7-5



f) Add more wet soil and step on the soil around the seedlings so as to improve contact. (Fig.7-6)

Fig.7-6



g) If necessary, water the seedlings.

h) Continue the firming practice so that sign of soil distruction ring appears when the first dry days.

8. TENDING TECHNIQUES

A) Slashing and weeding

Those are important tending operations which guarantee seedlings initial establishment, survival and early vigorous growth. Where grasses or bushes appear grow around the seedlings, they should be cleared to avoid their steep competition with the young seedlings for moisture, nutrients and light.

Slashing, spot cultivation and compulsive weeding could be applied and combined depending on individual site conditions as well as growth vigour of the seedlings. During slashing or weeding, operations precaution should be taken to avoid damaging seedlings' shoots or roots. At the same time advantage could be taken to reduce pest damage e.g. destroying termite nests within the planted areas.

1) Slashing

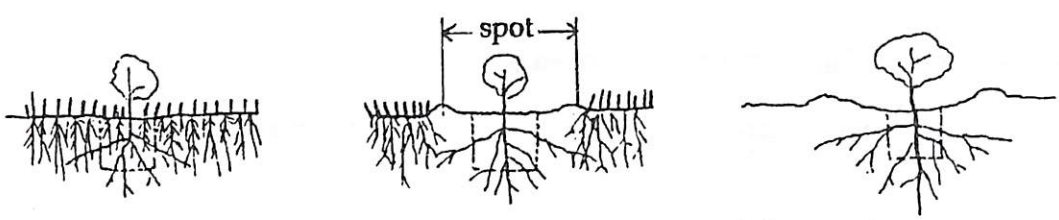
This is the commonest method of suppressing grasses, herbs and shrubs that could dominate the seedlings. However, due to the deficit of rainfall, in ASAL areas slashing is not very effective during the first to second year of establishment therefore other alternative effective methods such as intensive weeding are preferred. (Fig. 8-A)

2) Spot cultivation weeding

It is preferable to slashing because it minimises competition with grasses around planting spot and also it may keep pests a distant away. Larger spot size of about 1.6m or more in diameter is recommendable. Spaces between the cultivated spots must also be slashed. (Fig.8-B).

3) Compulsive weeding (clear weeding)

This is the most intensive and effective method that guarantees least competition between seedlings and grasses for moisture, nutrients and light. So it should be carried out frequently before weeds become mature and harder established and difficult to control. Most importantly soil erosion should be minimised by creating micro-catchment structures. Compulsive weeding has indicated the highest survival and vigour of growth in most Kitui field experiments and plantations (Fig.8-C).



(A)Slashing (B)Spot cultivation weeding (C)Compulsive weeding

Fig. 8: Slashing and weeding

B) Water harvesting techniques

In order to utilise the limited amount of rainwater in ASAL areas, various types of water harvesting and conservation's designs in form of microcatchments are available. They all aim at harvesting water efficiently and conducting it to the seedlings. They also serve as controls of water run-off and soil erosion.

Usually the size of the water catchment structures should become larger in less rainfall areas. The most commonly practised designs in Kitui are as in Fig. 10.

1) Circular micro-catchment design

It is applicable for individual seedling planted in flat areas here a basin of about 160cm diameter is created around the seedling. (Fig. 10-A1)

2) V-shaped micro-catchment design

These are practised on a sloppy sites. Individual catchment is open to the upper side of the slope in a V-shape so that it collects water downward to the seedling. (Fig.10-B1).

3. Shallow trenches micro-catchment design

These take from of V-shaped trenches that collect and conduct the run-off to the planting holes. They are practised when labour or time is limited to allow for construction of the V-shaped micro-catchments. (Fig. 10-C1).

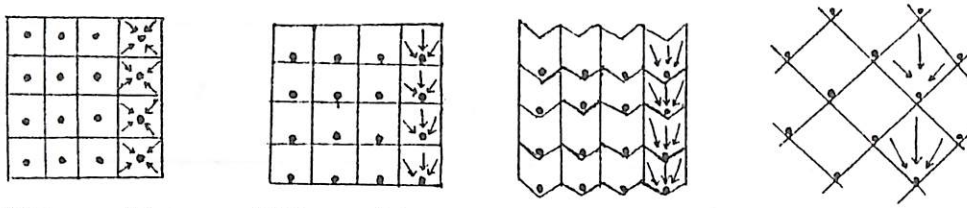
4. Micro-catchments formulated in the Kitui plantation area

In these designs individual microcatchments are interlinked in order to confine all the harvested water within the area of interest and any excess water is drained into another areas down slope. Plural kinds of catchments can be constructed depending on site conditions. Examples of designs that have proved worthy are:

a) Ground divisions micro-catchments

Circular catchments can be modified to ground divisions micro-catchments or modified Turkana method (Fig.9).

NB: Turkana method uses 10m by 10m square micro-catchment and trees are planted in the lowest corners of the squares. (Fig. 9-D)



(A)Square/flat (B)Square/slope (C)Scale (D)Turkana

Fig. 9: **Various types of ground divisions micro-catchment**

b) W-shaped micro-catchment

In this design, neghbouring V-shaped catchments are connected to form continous W-shaped micro-catchment. (Fig. 10-B3).

c) Networked micro-catchment

Trench catchments can be connected to form network micro-catchment. The beginning of the trenches could be expanded to the outside of the target area using trenches so as to feed in more water. (Fig.10-C3)

Where rainfall intensity is minimum, surface run-off can be harvested through directorial furrows from areas such as roads, roof catchments, sports fields, erosion gullies, etc. into the targeted areas to reinforce the microcatchment water supply.

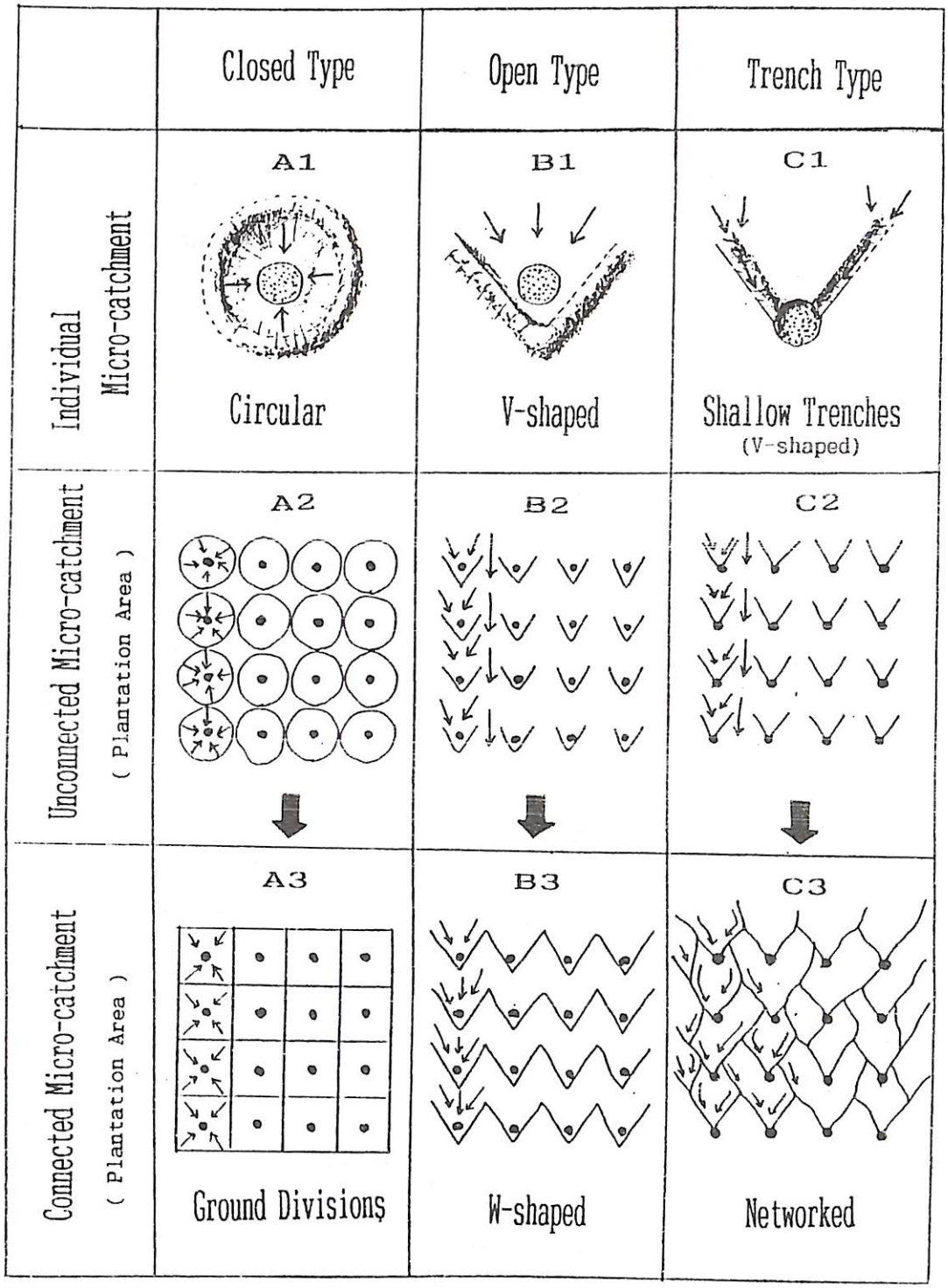
5) Horizontal terraces or trenches

Terraces or trenches are constructed along the contour lines so as to minimise surface water run-off while improving infiltration and conservation. Trees are then planted along the contour lines between terraces or trenches. Microcatchment could then be constructed for individual seedling.

6) Cultivation

Cultivated soil permits efficient infiltration of rain water. Here cultivation is usually carried out manually using jembes, forked jembes or machine or oxen plough. Cultivation is a very costly operation but it has proved to be the most effective for enlighting early seedlings growth and survival. Here micro-catchments may also be created around individual seedlings.

Fig.10: **Basic micro-catchment designs**



C) Watering

Watering may become necessary sometimes soon after planting, especially in cases where the rain period shortens unexpectedly. When water is available close to the planting sites, irrigation can be practised to enable the planted trees establish themselves. Some of the possible irrigating methods are:

1) Direct watering

In this technique, water is supplied directly to the ground around the seedling. It is the most straight forward method, however, it is not so effective because valuable water is wasted through excess evaporation. Also it is not able to supply water deep enough in the ground as compared to other underground watering techniques.

2) Underground watering

In order to utilise the limited quantity of water effectively, bottle watering and other underground watering methods are preferable. 1 litre or 2 litres of water of water could be fed to each seedling, weekly until seedlings establish well. Watering must be done at regular intervals. This is until aimed at only sustaining the seedling through the drought period which usually results into tremendous growth as soon as it rains.

a) Bottle watering

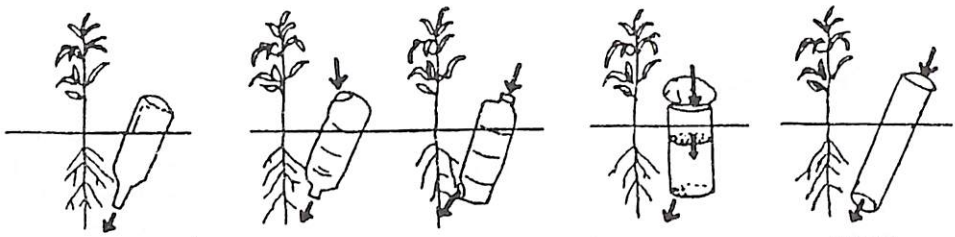
In this technique a bottle is buried into the soil such that only the top part of it remains exposed above the surface. The bottle size recommendable is about 1 litre (0.75-1.5 litre). Both plastic or glass bottles could be used.

b) Can watering

In this technique, two empty cans are prepared, by removing their tops and perforating their bottoms with tiny holes. They are then buried while connected to each other next to the seedling root level. They are then both filled with water and covered with a stone or any convenient object.

c) Pipe watering

This consist of circular cylinder made by chloroethlene, earthware, etc. It is then buried next to the seedling roots. (Fig.11)



(A) Glass bottle (B) Plastic bottle (C) Can (D) Pipe

Fig. 11: **Underground watering methods**

D) Other tending techniques

1) Shading

When trees are still young and the first dry season is setting in, it is advisable to shade them so as to protect them against strong sunshine which is likely to damage them through excessive evaporation of soil water and plant desiccation. (Fig. 12)

Fig.12: **Examples of shading**

2) Mulching

In this technique the soil surface around the planting holes is covered with some material that reduces evaporation rate. Small stones or grasses are recommendable for this purpose. However the use of dry branches or grasses is not advisable because they often attract termites in dry areas. But if grasses to be used are soaked in a termite repellent e.g. chemical, plant extractives or manure solutions, it is advisable to use them as they add soil nutrients to the tree as they decompose.

Mulching seems to be effective only when compulsive weeding is applied around the mulching spot in Kitui area.

Fig. 13: **Stone mulching**

3) Supporting young trees

Some specific tree species spindle as they grow therefore in areas with strong directional wind it is recommendable to support young trees by fastening them on ground firmed sticks or poles. The tree should be loosely tied against the pole with soft string or rubber tube to avoid stranglelation as they increase their diameter.

4) Pruning the branches

Pruning is carried to remove unnecessary branches and to encourage good stem form, it may also be carried out as an early harvest. It is not recommendable to prune too young trees before they attain a reasonable height and diameter when doing this, overpruning should be avoided as it robs the tree of leaves which manufacture food and also inflicts more bruises to the tree. The recommendable height is half to two thirds of tree height. (Fig.14).

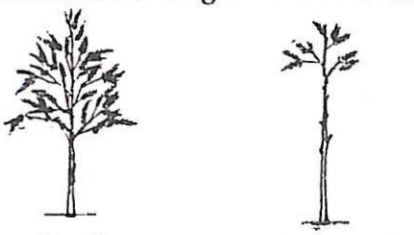


Fig. 14: **Pruning**

5) Fertilizer

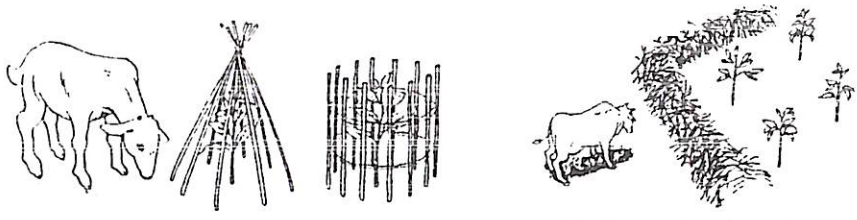
This encourages initial growth of seedlings. When the soil of the planting site is poor, manure can be mixed with soil and refilled in the hole to be planted. If water harvesting structure is properlly made, manure can be put additionally around the seedlings so that it can be dilluted by rain water and infiltrated underground.

9. PROTECTION TECHNIQUES

Various animals, insects and diseases attack young seedlings and cause significant damage. The commonest are wild animals, livestock and termites. These pose serious damages as observed from most field mortality data and field inspection surveys.

A) Wild animals and livestock

In order to protect seedlings against damages caused by livestock and other wild browses e.g. antelopes, fencing is the most effective. Where the numbers of trees to be protected is small, fencing around individual tree is advisable (Fig. 15-A). However, where large scale plantations are to be protected, perimeter fencing to keep animals out is recommendable (Fig. 15-B). Branches of thorny trees e.g. *Acacias* that are readily available locally are piled on the perimeter.



(A) Individual fencing (B) Perimter fencing

Fig. 15: **Fencing**

B) Termites

1) Digging out queens

Digging out queens of threatening colonies (termite hills) has proved to be easy and effective. However, it is necessary to observe the colony area closely after picking out the queen since some termite species substitute the lost queens with their daughters immediately and continue their activities. A guide to nest identification is as in Fig. 16.

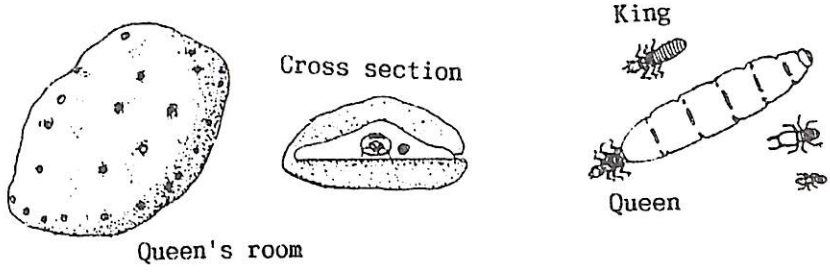


Fig.16: **Termites and queen's room**

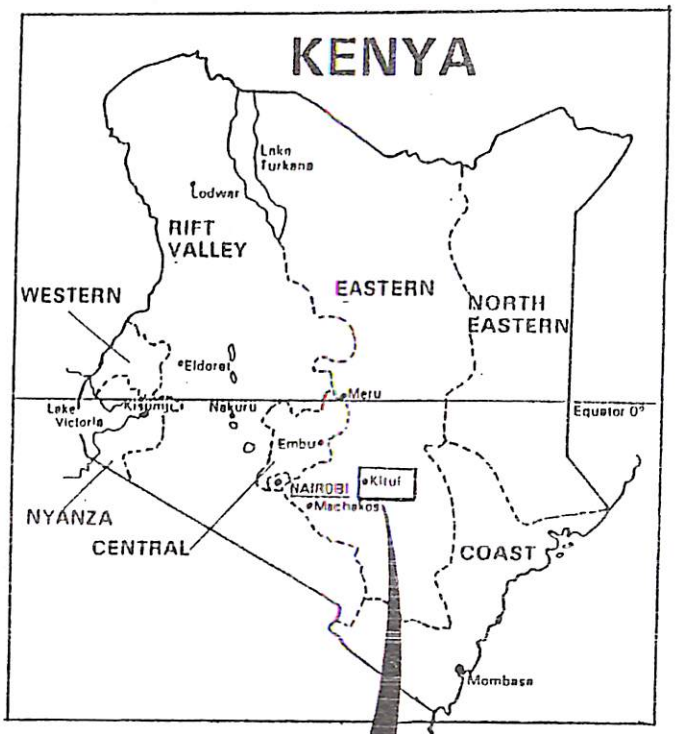
2) Repelants

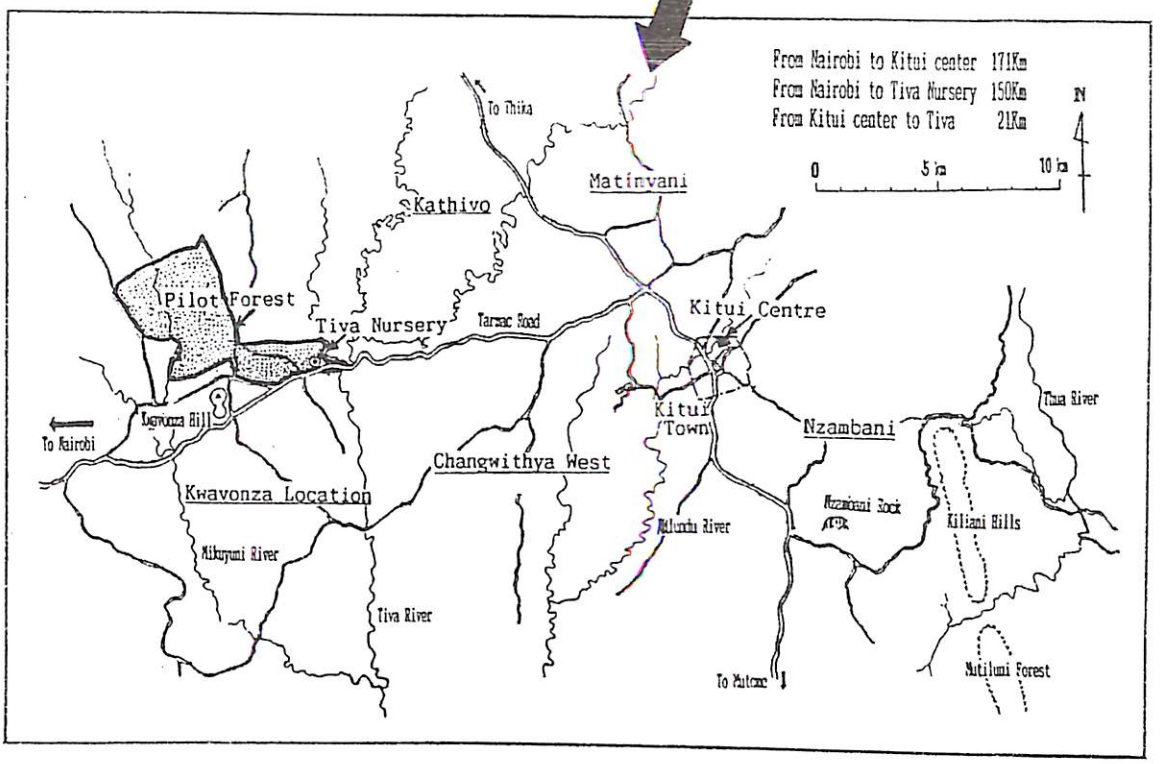
Oil, Cigarette tar, wood vinegar, plant extractions, etc. are effective to keep termite away from seedlings from seedlings for some time but not long term.

3) Use of chemical insecticides

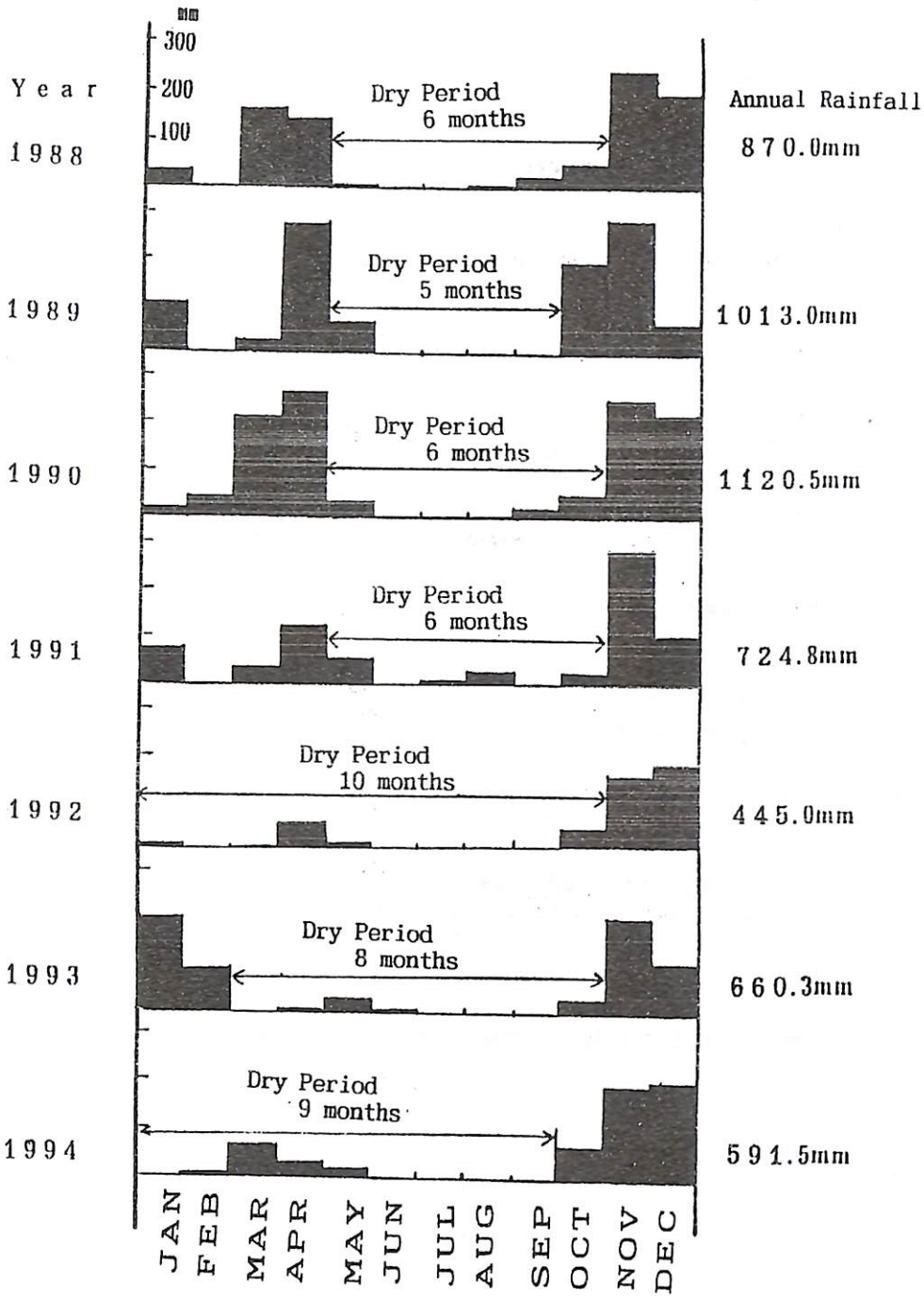
To exterminate all the termites in a colony, insecticides is of course more effective. But chemicals are costly and which need to be used carefully because they contain poisonous components which may be harmful to human being, livestock, wildlife and to other insects useful to the ecology.

Appendix 1: Location of Kitui Area





Appendix 2: Monthly rainfall (Tiva nursery)



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