Agricultural Water Use for Homestead Gardening Systems

Volume 2: Resource Material for Facilitators and Food Gardeners

Part 2: Chapters 4-5

Report to the

Water Research Commission

by

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Agricultural Water Use for Homestead Gardening Systems

Resource Material for Facilitators and Food Gardeners

Chapter 4

Diversifying Production in Homestead Food Gardening

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Introduction to the Learning Material **(TT 431/1/09)**

Chapter 1 Rural realities and homestead food gardening options **(TT 431/1/09)**

Chapter 2 - Facilitation of homestead food gardening **(TT 431/1/09)**
- Handouts: Chapter 2 – Homestead Food Gardener's Resource Packs

Chapter 3 - Living and eating well **(TT 431/1/09)**
- Handouts: Chapter 3 – Homestead Food Gardener's Resource Packs

Chapter 4 - Diversifying production in homestead food gardening **(TT 431/2/09)**
- Handouts: Chapter 4 – Homestead Food Gardener's Resource Packs

Chapter 5 - Garden and homestead water management for food gardening **(TT 431/2/09)**
- Handouts: Chapter 5 – Homestead Food Gardener's Resource Packs

Chapter 6 - Soil fertility management: Optimising the productivity of soil and water **(TT 431/3/09)**
- Handouts: Chapter 6 – Homestead Food Gardener's Resource Packs

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Aims

This chapter aims to introduce you to some ideas for intensification and diversification of homestead food production.

We will start the discussion looking again at nutrition and how our nutritional needs are in fact also leading us to use our gardens in a more productive and diverse way.

We will then look at growing many different kinds of vegetables together or in succession to ensure a flow of vegetables throughout the year.

We will look at growing many different kinds of fruit trees to provide us with fruit throughout the year.

We will consider a few ways of storing and preserving these vegetables and fruit to help us with yearlong supply.

Keeping your own seed is vital for a food gardener. It ensures that you can keep on gardening (i.e. continuity) and that you are independent of shops and outside assistance. Thus a section on seed saving is included.

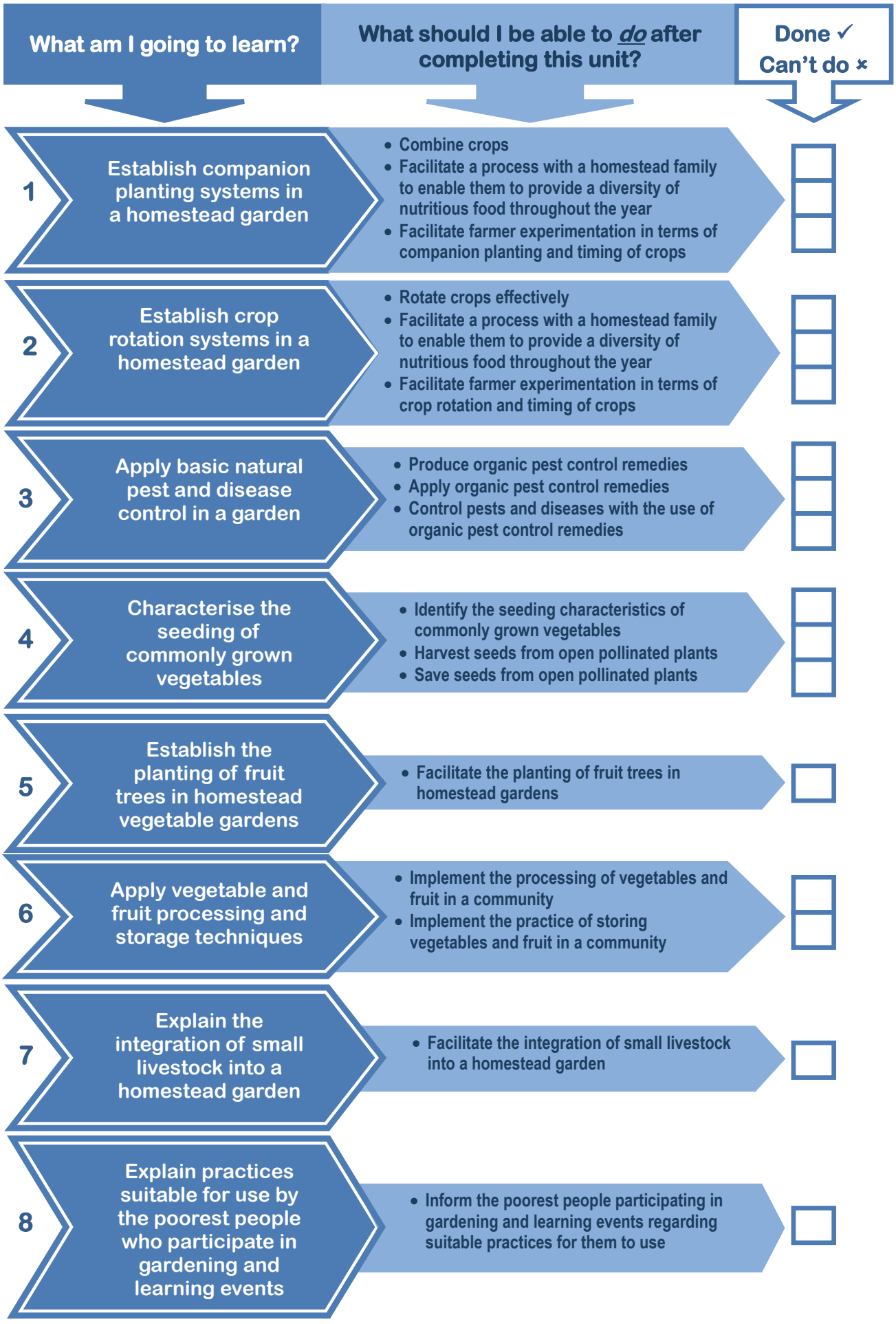
Finally we will consider briefly how to incorporate small livestock into our intensive garden, without the livestock destroying or consuming our hard work!

Throughout this chapter, you will be given practical ideas and examples of how you can implement diversification in your own garden or in the gardens of the farmers and gardeners you are working with.

What am I going to learn?

The following is a list of the things you should be able to do when you have successfully completed this chapter. This list gives you some idea of what to expect when you start working on the chapter, but, more importantly, you should come back to the list when you have completed the chapter to check if you have achieved all the objectives set out for the chapter. This means that you can monitor your own progress quite accurately.

On the following page is the list of outcomes for this chapter:


What am I going to learn?
What should I be able to do after completing this unit?
Done ✓
Can't do ×
1
Establish companion planting systems in a homestead garden
• Combine crops
• Facilitate a process with a homestead family to enable them to provide a diversity of nutritious food throughout the year
• Facilitate farmer experimentation in terms of companion planting and timing of crops
2
Establish crop rotation systems in a homestead garden
• Rotate crops effectively
• Facilitate a process with a homestead family to enable them to provide a diversity of nutritious food throughout the year
• Facilitate farmer experimentation in terms of crop rotation and timing of crops
3
Apply basic natural pest and disease control in a garden
• Produce organic pest control remedies
• Apply organic pest control remedies
• Control pests and diseases with the use of organic pest control remedies
4
Characterise the seeding of commonly grown vegetables
• Identify the seeding characteristics of commonly grown vegetables
• Harvest seeds from open pollinated plants
• Save seeds from open pollinated plants
5
Establish the planting of fruit trees in homestead vegetable gardens
• Facilitate the planting of fruit trees in homestead gardens
6
Apply vegetable and fruit processing and storage techniques
• Implement the processing of vegetables and fruit in a community
• Implement the practice of storing vegetables and fruit in a community
7
Explain the integration of small livestock into a homestead garden
• Facilitate the integration of small livestock into a homestead garden
8
Explain practices suitable for use by the poorest people who participate in gardening and learning events
• Inform the poorest people participating in gardening and learning events regarding suitable practices for them to use

Icons

You will find that several different icons are used throughout the Chapter. These icons should assist you with navigation through the Chapter and orientation within the material. This is what these icons mean:



Facilitation tools

Processes that you can use in workshop situations, to support your work in the field.

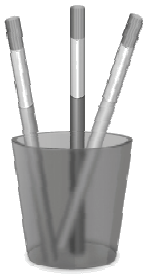


Research /Case study

The results of research or case studies that illustrate the ideas presented.



Looking at research, facts and figures to help contextualise things.



Activity

This indicates an exercise that you should do – either on your own (individual) or in a group.



Copy and handouts

These sections can be copied and used as handouts to learners / participants.

4.1 Introduction

For homestead food gardening to be most productive and to be able to withstand the uncertainties of the climate, the markets and people's situations, it needs to be intensive and diverse. This will help to reduce the homestead gardener's levels of risk in their farming and it will at the same time make it easier.

Both intensification and diversification can most effectively be carried out using natural farming systems and low external input sustainable agriculture techniques (LEISA), (See discussion in Chapter 1, section 1.4, p41). This means that we work with nature (or copy how nature works) to grow more food and more different types of food over a longer period of time during the year. The idea is that there is something to eat from the homestead food garden every day of the year.

We include annuals (different types of vegetables, fruits and herbs that grow and produce within one season), perennials (different types of vegetables, herbs, medicinal plants and fruit trees that grow and produce over many seasons) and small livestock (such as chickens, geese, ducks, rabbits and goats) in this system.

There is a point where a natural farming system will 'kick in' and start to balance itself. Most gardeners and farmers who have been practising LEISA techniques will know this. It is a law of 'more returns' that offsets what we have come to call the 'desert syndrome'. The desert syndrome is where things get drier, less fertile, less diverse, and more prone to pests and diseases. It also becomes more labour intensive to maintain. Whereas a more returns situation is one where water is retained, soil becomes more fertile, the diversity of plant and animal life increases and there is natural pest and disease control. Also, less labour is required.

The intensive homestead food production system depends primarily on resources from the farm, village and the region and has the following characteristics:

- **It aims to integrate soil fertility management and water management**. This means that we work with soil fertility and storing more water (mostly in this fertile soil), at the same time. Some examples of this include the use of trench beds, harnessing of run-off water, mulching and incorporation of organic matter generally, into the soil.

- **It makes efficient use of nutrients, water and energy and recycles them as much as possible**. Some examples are systems where manure from livestock is 'treated' to keep it as nutrient rich as possible for use in the garden, and where crops or residues from the garden are again fed to the livestock. Another example is where water is conserved using good irrigation practices, mulching and good mixes of crops growing together and where grey water (water used in the home) is also used for irrigation.

- **It uses external inputs only to compensate for local deficiencies.** Some examples may include the incorporation of lime into the soil to offset acidity and buying in of commercial fruit trees from other regions (such as peaches from the Western Cape). Fruit trees are often not available in local areas and when they are, they are expensive.

- **It aims at stable and long lasting production levels.** Some examples here include crop rotation and mixed cropping that will support the increased fertility and health of the soil and natural system, while optimising production. The system does not necessarily concentrate on the greatest production of one particular crop, but looks more at how crops can grow together and create a positive balance for all the crops and the environment. In this way a larger range of crops can be grown over a longer period of time.

- **It incorporates the best of all known farming practices in an area.** It is possible to combine elements of traditional farming in a productive way with elements of a commercial or alternative system. It is for example possible to grow a number of different varieties of tomatoes, to compensate for unpredictable weather – on the understanding that at least one of the varieties will fare well. It is possible also to use traditional remedies for pest and disease control on crops that are intended for marketing, such as brinjals and chilies that may or may not have been grown in traditional gardens.

4.2 Diversity management plans

Diversity for good nutrition



Generally, when we think about homestead food production, we think about vegetable gardens. And when we think of vegetable gardens, we may be thinking mainly of crops such as cabbage, spinach, onion, tomatoes and possibly a few others. Such gardens just provide a little extra food from time to time.

Gardens like these cannot fulfil the purpose of providing food on a continuous basis, so that there is always something wholesome and nutritious to eat from the garden. In other words, there is enough, of enough different types of food to fulfil our dietary needs and preferences.

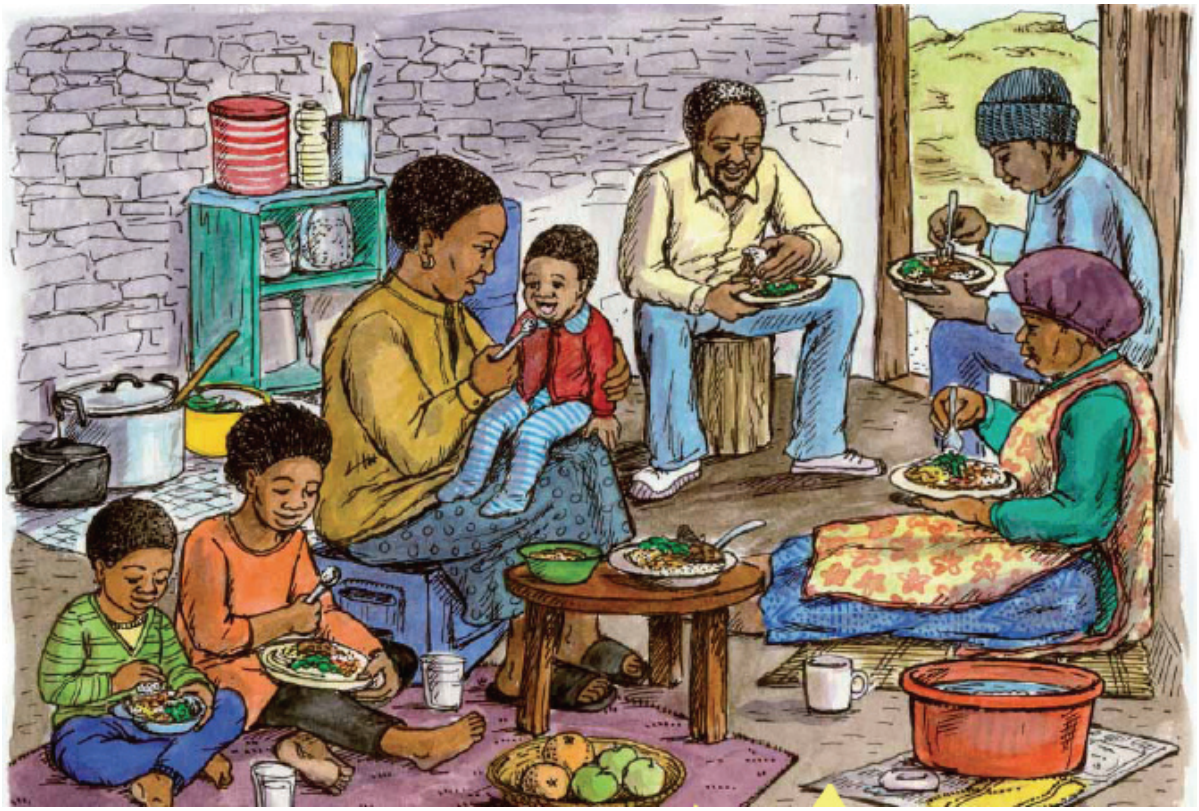
For this to be possible, we need to think of combining many different types of crops (vegetables, fruit, herbs) and plants (medicinal, protective, windbreaks, fodder for animals) in our gardening. We also need to think of including animals (small livestock could be easier – chickens, ducks, rabbits, pigs and goats). Then we need to combine all of this into a farming system that can manage itself to a certain extent and support us in the process. Sound difficult? Not really...

Let's briefly review where we started in our thinking – with food and nutrition. This will help us to plan our diversification process in the garden.

Good foods to keep you healthy

To eat well, means to eat **lots of different kinds of food** so that our bodies get all the good things that they need.

This does not mean that you need to buy expensive food. By thinking carefully about what you eat, and what you prepare for your family, and choosing food well, your whole family can eat in a healthy and affordable way.



A family eating a healthy, balanced and affordable meal

Table 1: Good Foods to Keep You Healthy (CINDI, 2004).

Good foods to keep you healthy



Drink lots of water.



Meat, chicken, fish, liver



Oranges, grapefruit, lemon and naartjies, guavas, mangoes, yellow peaches and apricots.



Tomatoes, avocado, potatoes, spinach, imifino, peas, pumpkin leaves, sweet potato, carrots, broccoli and fresh herbs.

Herbs, spices and medicinal plants

Do you use herbs and spices? You probably don't use these ones . . . These herbs and spices make food tasty, and they are an easy way to add an extra bit of goodness to your food. Why don't you try some?



- Spices, especially sweet spices like cinnamon, can help to make food taste better. You can buy cinnamon sticks which you add to food while it is cooking.
- Eating parsley after you have eaten will help to freshen your mouth and it is good for you. Its easy to grow at home too.
- Ginger helps if you are feeling nauseous and for colds. You can make a ginger tea.
- Garlic helps to fight infections. Make a tea or add garlic while you are cooking.
- Thyme helps with digestion. You can add thyme leaves to food.
- Other good herbs to eat are sweet basil, coriander, oregano and fennel. They are all easy to grow and can be added to your food.







Children in Distress CINDI

Produced for the Children in Distress (CINDI) Nutrition Working Group
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The main food types

This system of classifying food into three main types was developed by NGO's, for facilitation purposes, but nutrition experts prefer to divide food into five groups as given in Figure 1. This system of three types was used in the nutritional gap analysis explained in Chapter 3. More information is provided in the Homestead Food Gardening Resource Pack (Handouts) included with each chapter of this manual. Additional reading is also provided in LIRAPA: Living and eating well (Kruger, 2008a).

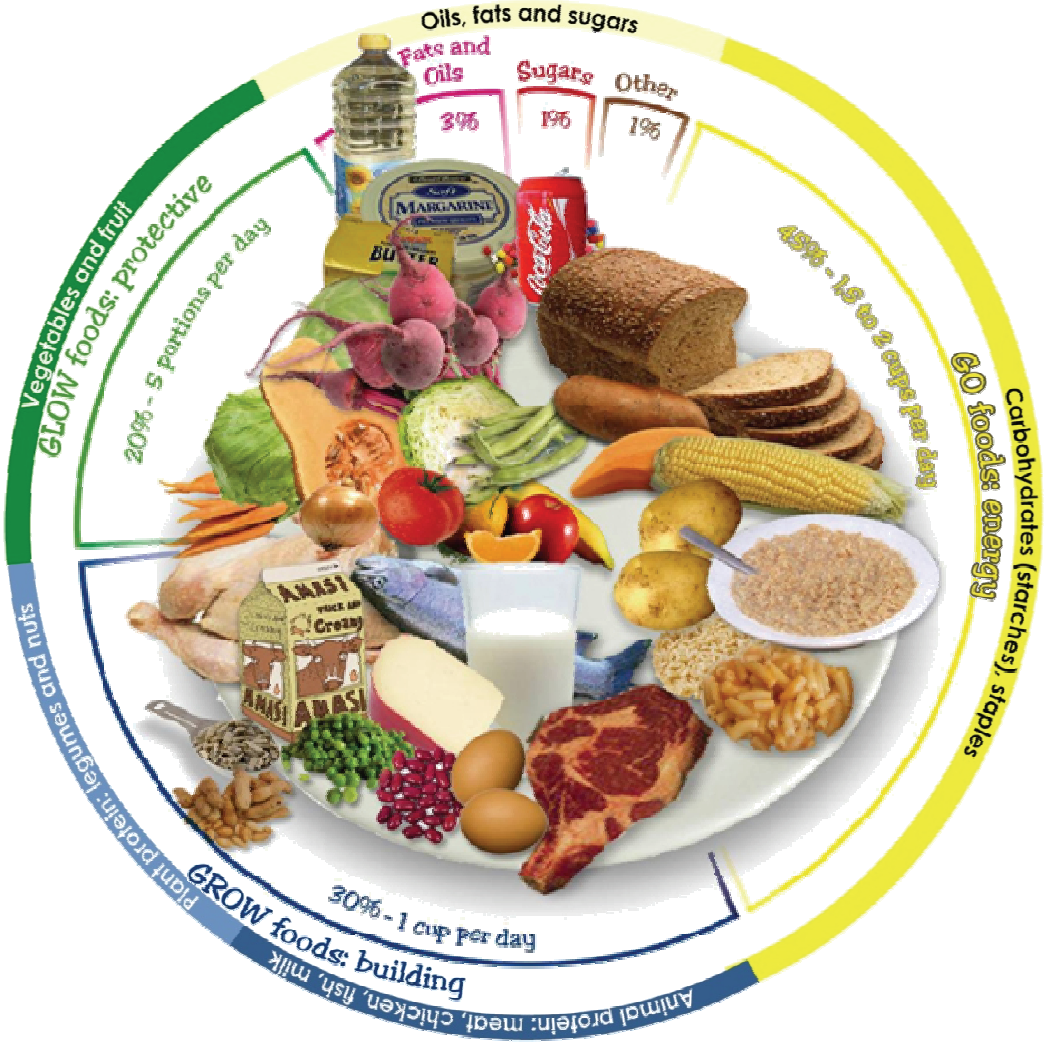


Figure1: The Five Food Groups (Diagram: M E Botha, 2009)

"Go, grow and glow" foods

You should eat foods from each of these types every day.

GO, GROW and GLOW FOODS – Eat the following each day:

Go Foods (starch) – any one of the following: 2 slices of bread, ½ cup of pasta; ½ cup rice (rather brown rice); ½ cup maize; ½ cup porridge (such as oats, sorghum maize).

Grow Foods (protein) – three of the following: one cup of beans or peas (plus one tablespoon of uncooked sunflower oil); two eggs; a large piece of meat; chicken or fish; one cup of milk or maas (sour milk); a big piece of cheese.

Glow Foods (vegetables and fruit) – three whole fruits and ½ cup of vegetables. Eat more vegetables if you do not have fruit.

Crop mixes for balanced family nutrition

Below are some suggestions of what we can do to increase the diversity of crops we grow in our gardens and thus the diversity of food we eat.

Examples of diversifying your crop production for good nutrition

For continuity:

We want to be able to have something in the garden to pick and eat throughout the year *(remembering that cabbages and onions take a long time to grow)*.

We can include crops such as:

- Sweet potato (and especially orange fleshed sweet potato for vitamin A)
- Kale, broccoli, cauliflower (for leaves as well)
- Brinjals
- Spring onions/ bunching onions
- Garlic chives
- Leeks
- Marrow (for leaves as well)
- Parsley
- Coriander
- Mustard spinach
- Lettuce
- Fennel

For protein:

We want to grow crops that can add protein to our diets, especially for the young children (age 1-5 years).

We can include crops such as:

- Sugar beans, jugo beans
- Turnip greens
- Peanuts
- Peas
- Cowpeas

We also need to include small livestock such as chickens, ducks, rabbits, goats and pigs in our farming system.

For Vitamin C and Vitamin A:

We want to be able to eat fresh green and yellow fruit and vegetables every day. This is very important for children and sick people.

We can include crops such as:

- Tree tomatoes
- Granadilla, gooseberries
- Paw-paws, mango, banana, avocado
- Peaches, apricots, plums
- Oranges, naartjies, lemons
- Guavas
- *Butternut, pumpkins of various types*

We want to grow a range of fruit, so that there is fruit to eat throughout the year.



Tree Tomatoes

Food preservation for continuity of food supply

Processing of food helps to ensure continuity of food supply to the family throughout the year. In the section on fruit production, you can read more on methods of fruit preservation, including drying, bottling and making of jams. Here we will look briefly at the drying of vegetables, because people often forget about this option.

Drying of almost anything is possible!! Dried vegetables can be stored for two years or more before being used.

A system of drying racks made with and covered with shade cloth/ hail netting was pioneered at Dundee Agricultural Research Station.

Racks with tomatoes, brinjals, naartjies, green, red and yellow peppers drying.

The vegetables and fruit are covered with a layer of netting for improved hygiene.



Bottles of dried vegetables; including from left to right: peppers, sweet potato, ground chilies and brinjals.



Mixed cropping for natural balance



Diversity in our gardens is important for healthy family nutrition and for continuity. We also want to create as much diversity in our gardens as possible to ensure a natural balance in the garden. We want to create a living soil, use water efficiently and minimise pest and disease attack on crops.

To attain mixed cropping plants can either be **interplanted** (different crops in the same bed at the same time), or crops can be **rotated** (different crops are planted in the same place at different times. Using both interplanting and crop rotation in your garden is a good idea.

Interplanting

When planting a number of different crops together we need to consider the following:

Nutrient consumption:

We mix crops together that consume or use different amounts of nutrients. Some plants are heavy feeders and need a lot of nutrients, while some are light feeders, and some are nitrogen fixers (they provide nitrogen to the soil and other plants).

A good example here is the traditional practise of planting maize and beans together. Maize is a heavy feeder, while beans are light feeders as well as fix nitrogen in the soil.

Root depth:

Deep and shallow rooting plants should be planted together to ensure that they do not compete for nutrients and water. A good example here is planting maize and pumpkins together. Maize is an upright plant that has a deep rooting system and pumpkin is a creeping plant with a shallow rooting system. They do not compete for space either below or above the ground.

Insect repellent plants:

There are some crops, which have a unique smell that repels some kinds of insects. For example, onion has a specific smell that butterflies dislike. If onions are interplanted with cabbage, this will reduce the attack from insects. Combinations like onion and cabbage are called companion plants. Companion planting is an effective pest prevention measure.

Timing:

Some crops have a longer life cycle than others. It is possible to plant crops that mature quickly in-between crops that take longer to mature. In this way one crop can be harvested while the other crop is still growing and competition is reduced. An example is planting radish, mustard spinach and potatoes together. Radish matures quickly and is harvested within 6 weeks of planting. The leaves of the mustard spinach are harvested for 2-3 months. This reduces competition with the potato plants that are now growing large. Potatoes are harvested after 3.5-4 months. A combination such as this also includes the aspects of rooting depth, nutrient consumption and insect repellent properties.

Shade tolerance:

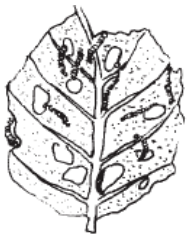
This becomes important when tall crops and perennial plants are also grown in the garden. These include fruit trees. Some crops such as comfrey, lettuce and strawberries are shade tolerant.

Below are some more examples of inter-cropping or companion planting in a vegetable garden.

Examples of mixed cropping in the garden

The following plants work well together in the same bed:

- *Plant carrots and onions together*:
  Carrots protect against onion fly and onions protect against carrot fly. Carrots root more deeply than onions and are harvested earlier, giving the onions the space they need to mature.
- *Plant cauliflower or cabbage, lettuce, fennel and onion together:*
  This combination gives complete control of aphids and diamondback moth (*shown on the right)* on the cauliflower. It takes into account nutrient consumption, rooting depth, insect repellent properties (onion and fennel), and timing and shade tolerance.



Diamond backed moth and caterpillars

- *Plant tomatoes, onion or garlic and carrots together:*
  This combines insect repellent properties, nutrient consumption, rooting depth, timing and disease control into account. Tomato plants are scattered so that do not touch each other, which reduces the incidence of early and late blight.
- *Plant Swiss chard (spinach) and beans together:*
  This combination takes into account nutrient consumption, rooting depth and disease control on the chard. Planting the chard in alternate rows with beans reduces the incidence of bacterial spot on the chard.

Many different combinations are possible. Below are two more examples:



Swiss chard interplanted with fennel and garlic chives

A bed with onions, cabbage, lettuce and swiss chard planted together.



Companion planting for plant health

There are a number of crops that grow well together and some that do not. The practise of placing plants together that have a **synergistic effect** on each other's growth is called companion planting. This synergy means that together, the plants grow better than they would separately. These relationships can be very complex and many of them are not yet well understood. What we can do as gardeners and farmers is to experiment with different combinations of **interplanting** and closely observe whether there is a companion planting effect or not.

> ***Synergistic effect:***
> *The working together of two or more things, especially when the result is greater than the sum of the two effects by themselves.*

When planting a bed, you can use the tables below to choose crops that can be grown together. These combinations have been suggested by other gardeners and farmers according to their observations.

Table 2: Companion planting

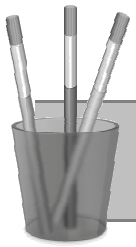
SOME PLANTS WHICH GROW WELL TOGETHER:		
Beetroot	–	Onions
Carrots	–	Peas, Lettuce, Onions, Tomatoes
Onions	–	Beetroot, Strawberries, Tomatoes, Lettuce
Eggplant	–	Beans
Cabbage	–	Potatoes, Beetroot, Onions
Green Peppers	–	All vegetables
Lettuce	–	Carrots, Radishes, Strawberries, Cucumbers
Pumpkin	–	Mealies
Swiss Chard	–	Strawberries
Tomatoes	–	Onions, Carrots
Mealies	–	Peanuts, Peas, Beans, Cucumber, Pumpkins, Potatoes
Sunflowers	–	Cucumbers
Beans	–	Potatoes, Carrots, Cabbage, Most other vegetables

PLANTS THAT DO NOT GROW WELL TOGETHER:		
These are some plants which do not grow well together. Try to avoid putting them in the same beds. Try and experiment for yourself.		
Beetroot	–	Pole Beans
Onion	–	Peas and Beans
Cabbage	–	Strawberries
Pumpkin	–	Potatoes
Tomatoes	–	Potatoes and Cabbage
Beans	–	Onions
Sunflowers	–	Potatoes

Advantages and disadvantages of interplanting

Table 3: Advantages and disadvantages of interplanting

ADVANTAGES of interplanting	DISADVANTAGES of interplanting
Efficient use of space below and above ground.	Looks "untidy".
Reduces and avoids pest and disease build-up in the soil and in the garden.	Can make harvesting of crops more fiddly.
Reduces weeds.	Some unwanted shading may occur if plants are not spaced well.
Covers the soil and uses nutrients in an effective manner. Building of a healthy, living soil is possible.	Weeding can be more time consuming initially, as crops may be scattered, rather than being planted in rows.
Plants support each other in a synergistic relationship that protects against pest and disease attack and increases vigour and growth.	Some plants may be over- or under-watered, depending on their life cycle. For example, some plants may be seeding while others are still growing.
Efficient use of water.	



Activity 1: Practise companion planting combinations

Aim

Practise making companion planting plans.

Instructions

Work in groups of 3-5 learners.

1. Make a large drawing of a garden with a number of different beds.
2. Now make a list of all the crops you would like to plant. Include in this list new crops you may want to try (including medicinal species and herbs).
3. Now add different combinations of crops to your drawn beds, according to the examples given above and the table on companion planting.
4. Give an indication for each combination how these plants support each other: Is it through nutrient consumption, insect repellent properties, rooting depth, timing, shade tolerance.....?

Crop rotation

Crop rotation means that you do not plant the same crop in the same place year after year, but you make sure that a different crop is planted in each space. This is a good idea because:

- It prevents or stops the accumulation or build-up of insects and diseases. If the same crop is planted, some insects and diseases will increase every year!
- Different crops use different nutrients or plant food stored in the soil. In this way you do not overuse some of the plant foods, while not using others.
- The soil can be covered all year round with crops.
- Some crops add nutrients or nitrogen to the soil. Examples are beans, peas, broad beans, soya beans, peanuts, cowpeas, lucerne and clover.
- Crop rotation prevents the soil from building up bad or negative reactions to specific plants. An example here is nematodes on tomatoes and Swiss chard. Nematodes are very small worms that we cannot see with our eyes. They live in the soil and feed on the roots of your plants.
- There is no build up of specific weeds.

There are a number of different crop rotation systems that can be used. Below is an example of a system that is easy to use and remember.

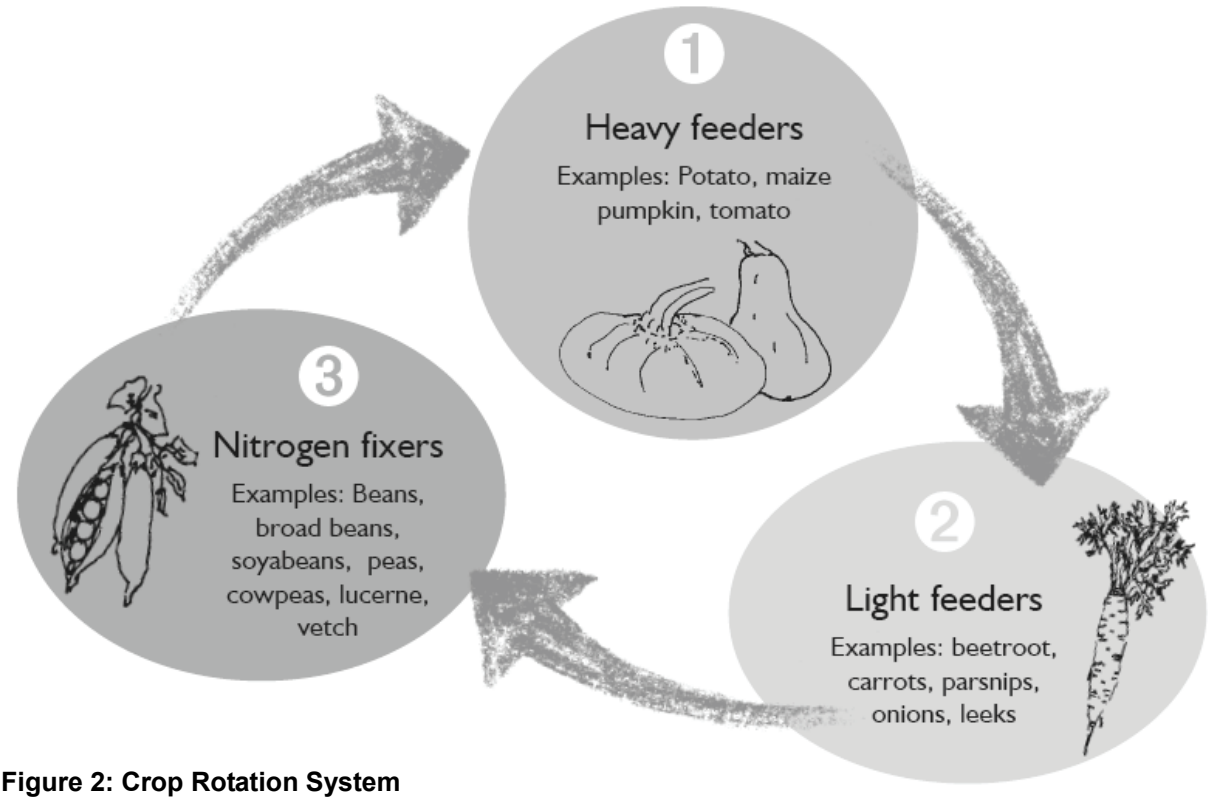


Figure 2: Crop Rotation System

①In the first season after applying compost and/or manure, heavy feeders or nitrogen consumers (users) are planted;

②In the second season the light feeders are planted; and

③In the third season legumes (nitrogen fixers) are planted.

This is followed by another application of compost or manure, and the cycle is repeated (Kruger, 2008b).

In **trench beds** (See chapter 6 in this manual and the Homestead Gardening Resource Pack for more information on how to make trench beds) the organic matter decays slowly in the soil. For these beds you may want to start with legumes, move on to heavy feeders or nitrogen consumers and then move on to light feeders. This is because during the decaying process, plant nutrients will take a while to become available for use by plants. The legumes can fix most of their own nitrogen and are thus a better starting point.

Preparing the land or bed -

To prepare the bed you can:

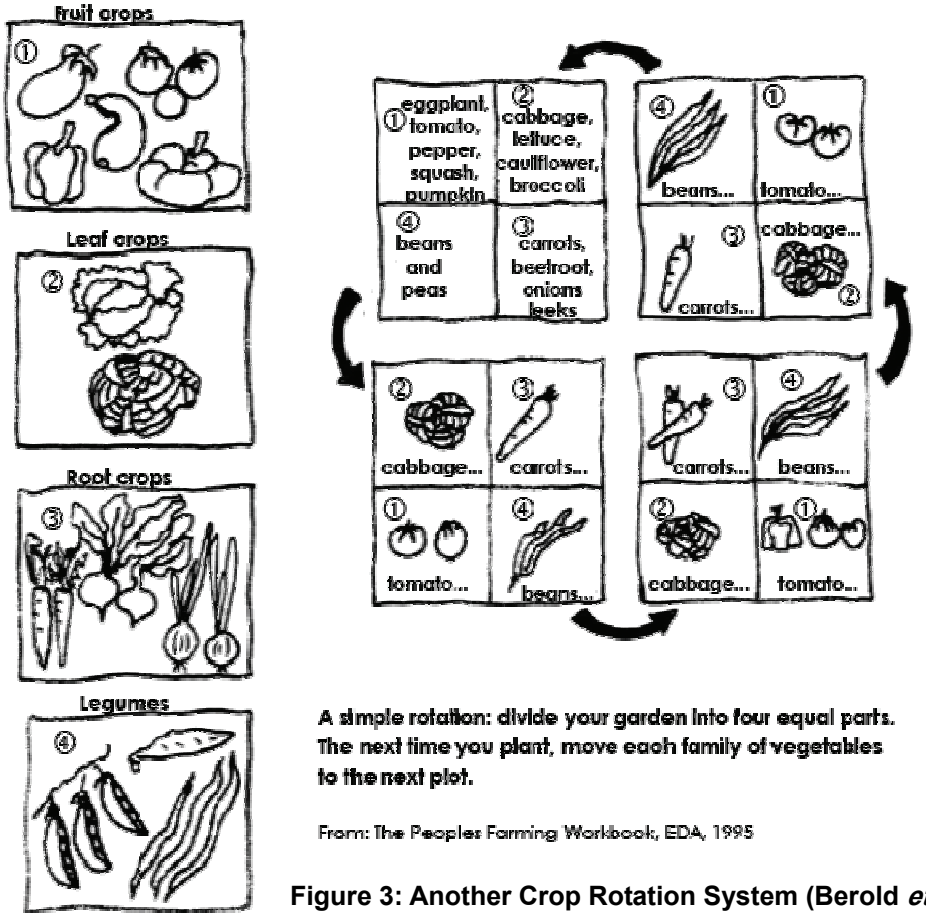
- Dig a deep trench to fill with layers of compost,
- Double-dig a bed; or
- Add a lot of compost/manure forked into the top 30cm (you will need at least 4 full spades for every square meter.

Recommendation: place ½ wheelbarrow load (4 full spades) for every square meter of garden.

Another system for crop rotation system

Another way to do crop rotation is presented below:

Prepare the land or bed well. Put a lot of compost or manure in your bed (4 full spades/ square meter). Then, start by planting a fruiting crop. These plants need the most food. Leaf crops need less and can follow fruit crops. Then root crops can follow leaf crops without much addition of plant food. Root crops like fertile soil, but do not like fresh manure or compost. It has to be well rotted. Then, nitrogen fixers can follow, with addition of little or no plant food. Then you need to prepare the land well again. Start once more with fruiting crops.



A simple rotation: divide your garden into four equal parts. The next time you plant, move each family of vegetables to the next plot.

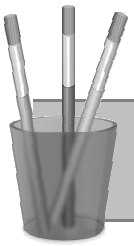
From: The Peoples Farming Workbook, EDA, 1995

Figure 3: Another Crop Rotation System (Berold *et al.*, 1995)

Advantages and disadvantages of crop rotation

Table 4: Advantages and disadvantages of crop rotation

ADVANTAGES of crop rotation	DISADVANTAGES of crop rotation
No build up of pest and diseases.	Without a plan, either drawn or written on paper, it is difficult to remember which crop is to follow.
Soil nutrients are used effectively.	
Soil moisture is used effectively.	It can be tricky to decide which rotation to follow when interplanting is also used.
A healthy living soil can be built up over time.	



Activity 2: Practise crop rotation plans

Aim

Practise to make crop rotation plans.

Instructions

Work in groups of 3-5 participants, or do this individually.

1. Make a list of all the crops you would like to plant. Include in this list new crops you may want to try (including medicinal species and herbs).
2. Now decide which of the two crop rotation systems presented above you would like to use.
3. Design a crop rotation system, using your list of plants and taking into account the different seasons when crops are planted (we are assuming here that you have some ideas of which crops to plant when in the areas where you come from).
4. Present your crop rotation drawings to each other.

Plant Succession for continuous harvesting

> ***Succession:***
> *Following one on another.*

Plant succession means that we plant a little at a time, but often. We do this to make sure that we have a succession of crops to harvest over a long period of time. If we plant the whole packet of seed in one go, we will harvest a lot of one crop all at once. An idea is to divide a standard size packet of seeds into four portions. We can then plant each of these portions every two to three weeks.

If we grow small quantities of seed at a time, we can grow these in containers such as shallow dishes or boxes. You could plant successions of small quantities of seed in containers. Make sure your container has some small holes in the bottom, so that water can drain out of these.

Soil mixture for seed germination:

Mix together:

- 1 part sand
- 1 part sifted compost
- 2 parts good sifted top soil

Sterilize this mixture by pouring boiling water over the dry mixture, then let it cool down before you plant the seeds. The boiling water will kill weed seeds and disease-causing organisms in the soil.

Plant your seeds in the same way as you would in a seedbed.

Containers for seedlings

Seed can be germinated in any well-drained container. Below are some ideas

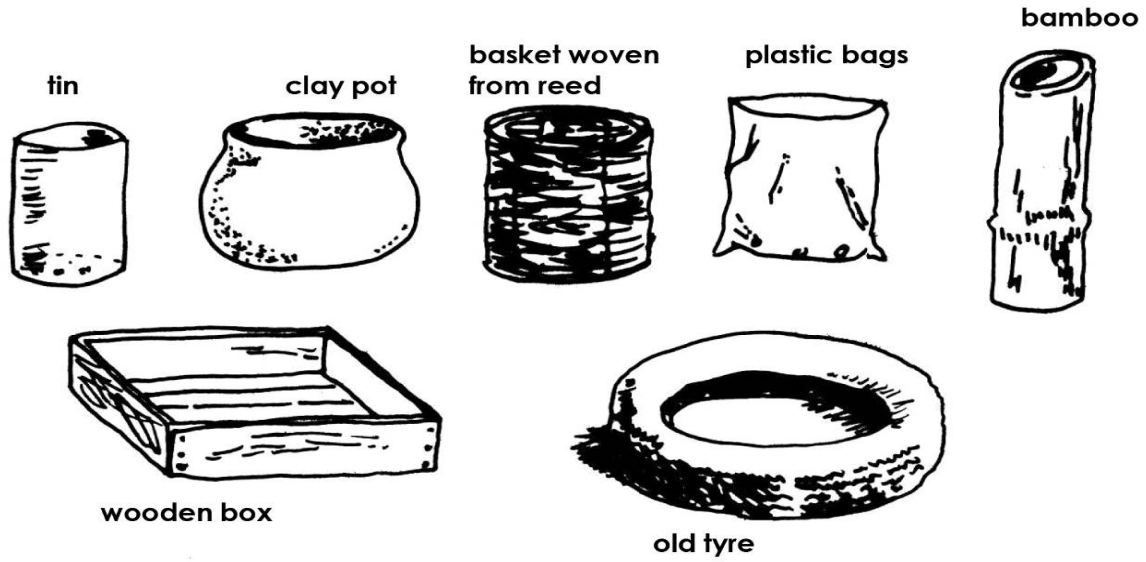


Figure 4: Containers for seedlings (Kruger, 2008b)



Facilitation Tool 1: A farmer experiment in planting a range of crops

Aim

To assist a household food gardener to do an experiment to test the effects of companion planting, crop rotation and succession planting.

Instructions

PLANNING

Start by talking through the issues of **planting a range of crops** with the household food gardener(s). You can use the information provided above for discussion, including different types of crops according to the nutritional gap analysis, and crop and food preferences of the family.

Then discuss adding of more types of plants by including **companion planting, crop rotation and succession planting** concepts. Discuss the advantages and disadvantages of each.

Next, discuss making a small **experiment around planting a range of crops**. Here you may end up having more than one experiment. Examples are:

①interplanting of a bed;

②Introducing the planting of herbs in the garden,

③A crop rotation plan.

If you undertake and experiment make sure to fill in the **Small Scale Experiment Plan** with the gardener. You will need to fill in one of these forms for each experiment that is tried. Go through the questions, work out the solutions, and discuss how to observe and monitor the experiment.

SMALL-SCALE EXPERIMENT PLAN

What is the problem?

What is the possible solution?

Why will this solution solve the problem?

How will I test this solution step by step?

What will I look for and what will I measure?

How will I measure the results or outcomes?

How will I compare my experiment to my usual way of farming?

Drawing of the experiment in the field.

MONITORING:

Now the gardener will need to monitor her experiment. Every week she will need to check how the newly planted crops are growing, compared to the normal or usual crops planted.

Companion planting experiment:

Do the crops grown together as companions grow better than the crops planted separately? Are there fewer or different kinds of pests and diseases? Is there a difference in the amount of watering that is required?

Crop rotation experiment:

A crop rotation experiment will take a few years to show a difference, therefore it is difficult to do a small scale experiment as the one shown here, on crop rotation. If possible, she can set aside a piece of the garden and start to practise rotation there (3-4 beds depending on the system you choose). Then it will be possible to compare the growth of crops in the rotated beds with those in normal beds. She will need to plant the same crops at the same time for this to work.

Crop succession experiment:

A succession experiment can also be a bit tricky. It will take 4-5 months to complete. She would need to plant a batch of one crop (e.g. carrots) all at the same time as her control, and then a separate portion spaced out (e.g. plant some every two weeks), as the experiment. Then she would need to compare the total yield and the period of time over which this yield was realised.

4.3 Natural Pest and Disease Control

The best approach to good vegetable production is to **prevent** pest and disease attack rather than trying to cure it. For this you need to ensure a **healthy soil and stable environment** for plants to grow in.

Prevention is better than cure.

The main way in which this is done is to **promote diversity**.

- Work with nature and copy the natural ways in which plants grow. Insects and 'weeds' are a part of nature. We can learn to encourage those insects and plants that help us in the garden. Ladybirds, praying mantis, lacewings, wasps, frogs, lizards and birds all eat the insect pests that harm our gardens. They are called predators. If you leave them in your garden, they will help you!
- It is also possible to mix vegetables with other plants – strong smelling plants that deter pests and attract predators. In the picture below, nasturtiums and peppermint are planted with the vegetables.

Below are examples of some of the strong smelling plants that you can grow with your vegetables.

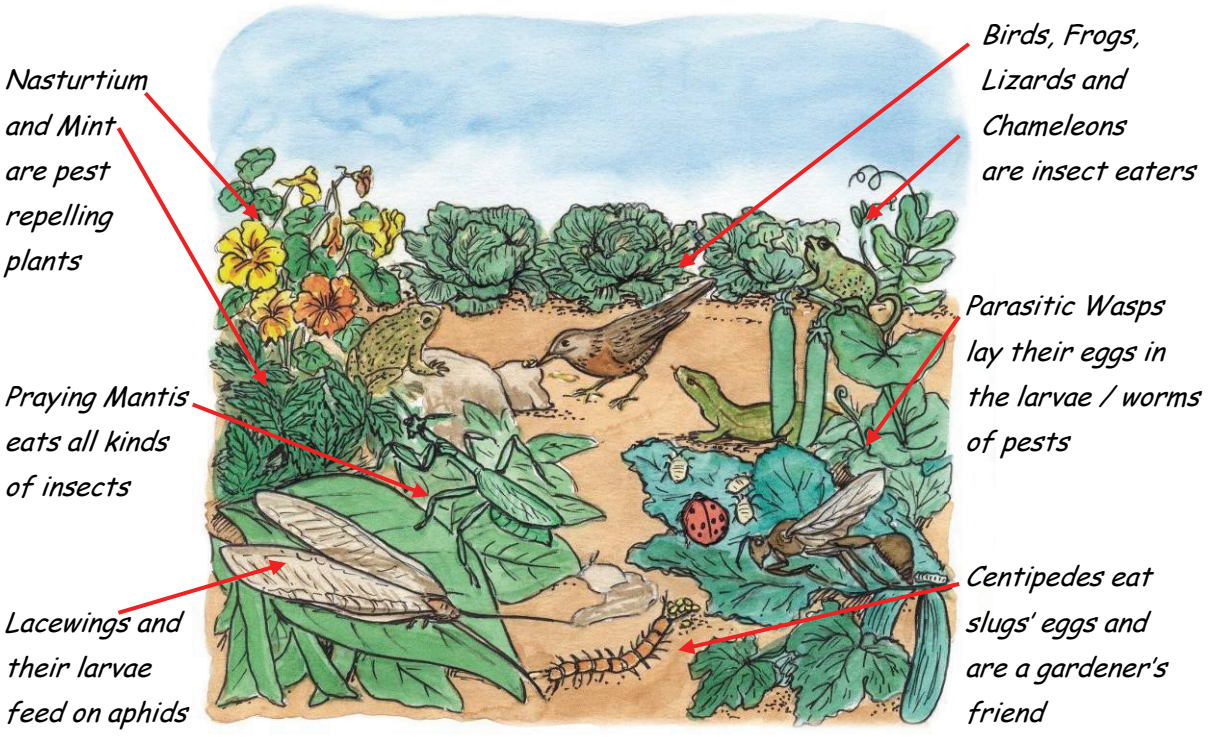


Figure 5: Natural pest and disease control using pest predators and strong smelling plants (Kruger, 2008b)

Strong smelling plants to grow with vegetables



Pyrethrum and Feverfew:

These plants belong to the *Chrysanthemum* family. They have small white flowers, which contain a poison for insects. They can be planted as borders along your beds, or dotted throughout your garden. You can buy seeds for these plants.

Marigolds (Tagetes spp):



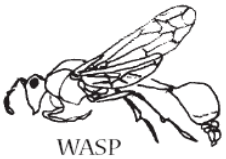
Marigolds can be used in the same way as pyrethrum and feverfew. They have the added advantage of deterring nematodes (tiny worms that attack the roots of plants in the soil.)



Nematodes under a microscope

Fennel:

Fennel is a great plant for attracting wasps. Wasps lay their eggs in caterpillars and can kill many of them in one day!



WASP

Wormwood (Artemisia affra) or Mhlonyane:

These plants grow as large bushes and should be placed at the edges of your beds, or given their own space to grow. A tea made from the leaves is also a good medicine for fevers and colds.

Khakibos/senkhane and blackjacks:

These weeds are useful to deter pests. Keep a few in the garden!

Herb and plant teas/brews

Many different plant mixtures can be used to control insects and diseases. These remedies should only be used if all the other methods to keep plants healthy, have failed. In other words, you have already used good general practises such as:

- Growing strong and healthy plants (good fertility and water management),
- Sanitation (cleaning all weeds, eaten and diseased crops away),
- Encouraging pest predators into the garden (using particular plants, small ponds, rock piles, natural plant borders and so on),
- Practised mixed cropping (companion planting and crop rotation – which avoids build up of pests and diseases, deters or chases away pests and minimizes occurrence of diseases).

Important:

These sprays are still poisons. Make sure that children cannot reach your preparations. If you boil up your mixtures use an old pot, no longer used for cooking. Wear gloves if you can!

General points for making plant sprays

- Soap (green bar soap only!) can be added to the mixture to make the spray stick to the plants and insects. Do not use liquid soap or soap powder.
- The mixtures can be filtered through thin cloth to remove the bits of plant material. They can be applied using a homemade brush from grass or twigs.
- These sprays act as contact poisons. You have to make sure that the spray actually comes into contact with the insect. You have to spray carefully and well to make sure all parts of the plants (including underneath the leaves) and insects have been covered by the spray.
- Some sprays can burn the plants if they are too strong. First test your spray on a few plants.
- The best time to spray against insects is in the late afternoon.
- These sprays are washed off in rain and have to be re-applied.

The main advantage of natural remedies is that they are cheap. They can be prepared at home.

Examples of common plant brews

Below is a list of some of the more common herb and plant brews that can be used, what they are used for and how you would prepare them (Kruger, 2008b). More information is also provided in the Homestead Gardening Resource Pack that accompanies this manual.

Aloe

Any kind of aloe can be used.

- Crush the leaves in water (1:5). This means use 5 times as much water as you use leaf material. Filter through a fine cloth and use as a spray.
- OR Dry the leaves and grind them into a powder. This can be dusted onto seeds and plants.

CONTROL:

- Insects in general; grasshoppers, aphids, caterpillars;
- Pests in stored grains such as maize, wheat and sorghum;
- Termites and ants.




APHIDS


ANTS


TERMITE


GRASSHOPPER

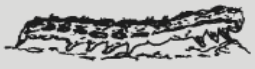
Chilli

- Chop up one cupful of hot red chillies. (Be really careful not to rub your eyes!)
- Add 2 litres of water.
- Either leave this to stand in the water for 2-3 days or boil for 15minutes.
- Add half a cup of soap shavings and mix until this has dissolved.
- Filter the solution to remove the pieces of chilli.
- During dry weather, apply once a week.




APHIDS

CONTROL:
Caterpillars, aphids and ants.


CATERPILLAR


ANTS

This mixture can burn the leaves of plants if it is too strong!



Garlic and onion

Crush 3 big bulbs of garlic (or 1-2 onions) and soak them in 2 spoons of cooking oil or paraffin for 2 days. Filter and mix with 1 litre of soapy water. Dilute this mixture 1:10 with water and use as a spray.

CONTROL:
Insects in general: aphids, mites, wireworms, termites and ants. Diseases such as leafspot, blight and damping off. Examples are bean rust and tomato blight.


APHIDS


MITES


ANTS


TERMITE



Marigolds

Use the whole plant. Take 2-4 plants and crush the leaves, roots and flowers. Pour on 1 litre of boiling water and soak for one day. Then add 1 litre of cold soapy water and spray this on your plants. The coarse plant materials remaining behind can be used as a mulch around your plants.

CONTROL:
Insects in general: ants, aphids, beetles, stalk borer.
Disease in general: leafspot and blight (early blight and late blight).

Blackjack

Cover a cupful of seeds with water and boil for 10 minutes, or let it stand overnight. Add 1 litre of soapy water and spray.

CONTROL:
Insects in general; aphids, ants, beetles, caterpillars, cutworms, mites, termites and whitefly.


WHITEFLY


MITES


TERMITE

Sometimes, when an infestation of insects is really bad, some of the above poisons do not act fast enough, as some of their action is primarily as a deterrent to stop insects feeding on the plants. It is then possible to use the following remedy.



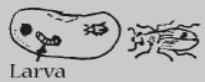
Tobacco

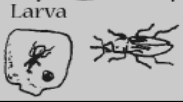
WARNING: Tobacco is very poisonous to all insects and to people. Be very careful with these preparations.

- Take 2 handfuls of dry leaves or cigarette ends. This is the same as one cup full.
- Add 5 litres of water and boil for 30 minutes. Filter. Then add soap, mix and let your remedy cool. Apply once a week.

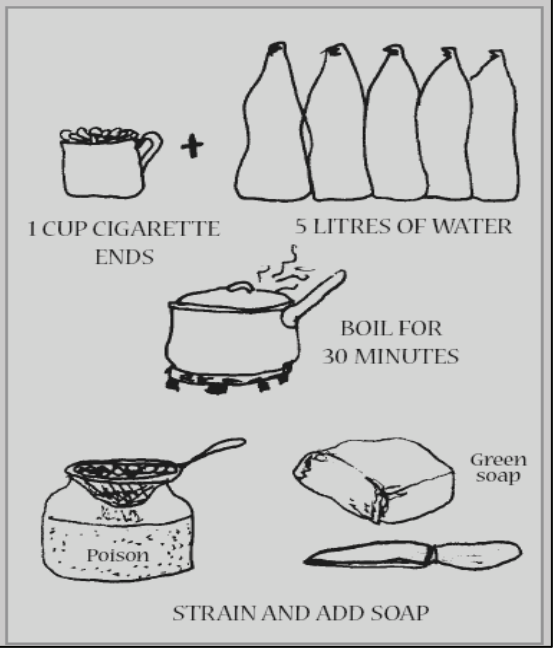
CONTROL:
Cutworms, caterpillars, aphids, flies and weevils.


CUTWORM


Larva


BEAN AND MAIZE WEAVILS

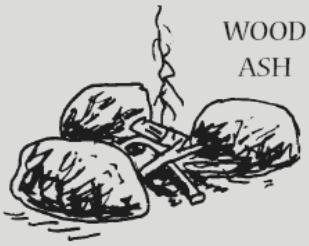

APHIDS



It is not recommended that tobacco is used regularly. It is VERY poisonous, also to people. It also kills all insects, including bees and other garden friends.

Wood ash

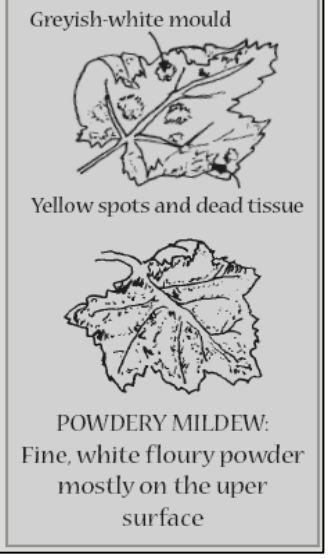
- Mix one heaped spoon of wood ash in 1 litre of soapy water. Leave it overnight. Spray against insects in general
- Mix one heaped spoon of wood ash in 1 litre of soapy water. Mix in one cup of sour milk and add 3 litres of water.



CONTROL: Mildew on plants and most insects.

- Spread the wood ash in a circle around the base of your plants and water it into the soil a bit.

CONTROL: Snails, slugs and cutworms



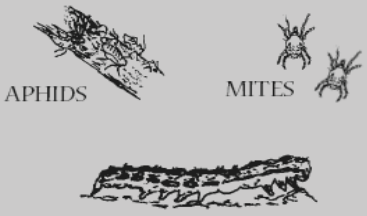
Organic remedies

These remedies are made from organic materials, not from plants. Some examples are given below.

Flour

Mix one big spoon of flour into 1 litre of water. Brush this on the underside of leaves where mites and aphids are. Apply in the morning of a sunny day.

CONTROL:
Spider mites, caterpillars and aphids.



Milk

Spray a mixture of 1 litre of milk and 10 litres of water to control spider mites and diseases such as mildew on pumpkins, blight on tomatoes and potatoes and mosaic virus on peppers. Do this every 10 days.

Advantages and disadvantages of pest and disease control brews

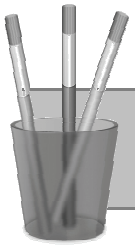
Table 5: Advantages and disadvantages of pest and disease control brews

ADVANTAGES of pest and disease control brews	DISADVANTAGES of pest and disease control brews
These brews are easy to prepare at home.	These brews can be ineffective in an environment with a high pest or disease load.
They are cheap.	Tobacco brews are effective in almost all cases, but are also toxic.
They are generally non-toxic to humans and not very toxic in the environment; as they are mostly contact poisons. They cause death when the pests eat the plants that have been sprayed.	You need to know which pests and diseases are attacking your plants. If you do not, use the chilli or garlic/onion spray as a general initial remedy.
They can be very effective in controlling outbreaks of pests and diseases.	Preparing and applying the brews takes time.



Case Study 1: Potshini – SSI and WRC learning processes

A natural pest and disease control learning and implementation process was implemented in a community called Potshini, close to Bergville in KwaZulu-Natal (2006-2007). This process was part of a larger rainwater harvesting and intensive vegetable production programme implemented jointly through two organisations; SSI (Smallholder Systems Innovation Programme and the University of KwaZulu-Natal) and the WRC (Water Research Commission, Project K5/1575/4 – Participatory development of training material for agricultural water use in homestead farming systems for improved livelihood). Two learning groups consisting of around 64 participants were set up in Potshini. Each group received 7 training or learning workshops covering themes such as nutrition, soil fertility, garden layout and design, rain water harvesting and irrigation and pets and disease control. These workshops were spaced at monthly to 6 weekly intervals and gardeners were visited at their homesteads on a regular basis to explore their implementation and issues with them. A number of different examples and some of the research results from Potshini are used here to illustrate the concepts and ideas being discussed.



Activity 3: Testing a pest control brew

Aim

To solve a problem in your garden using a pest control brew.

Instructions

1. Read through the pest and disease control brews mentioned above.
2. Choose one of the brews that will solve a particular problem that you are having in your garden (or someone you know is having in theirs).
3. Now do a small-scale experiment using this brew. Make sure you record your experiment (using the planning and monitoring sheets mentioned before) and by taking some photographs (of yourself making the brew, applying the brew and monitoring your experiment in your garden).

Resources: You will need to get the ingredients for you brew; make it up; and apply it to your crops for a period of time.

Below is an outline of a workshop that a facilitator can run in a community with a learning group, or even in a homestead. Use this workshop outline to facilitate a pest and disease management process



Facilitation Tool 2: Workshop outline - Pest and disease management

Aim

Analysis of pest and disease problems.

Instructions

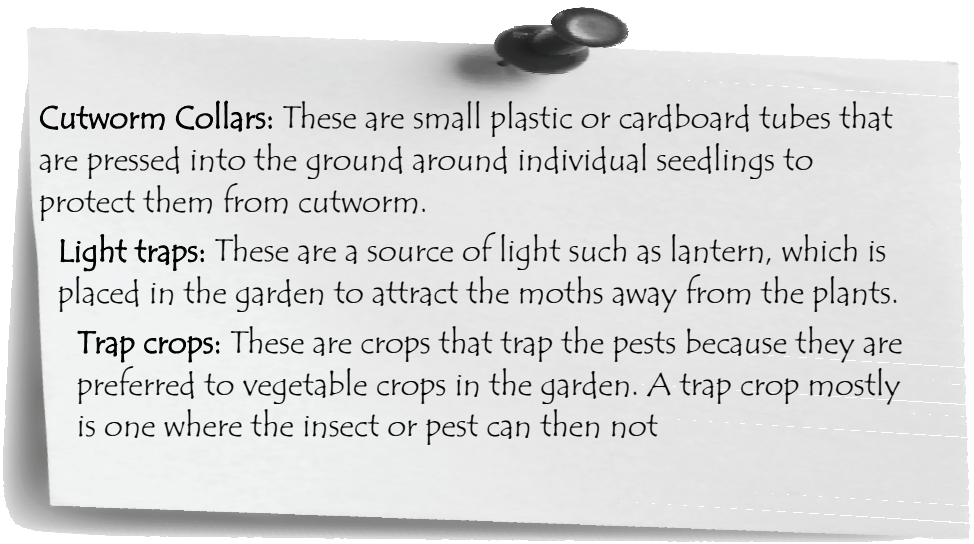
Facilitate a group discussion on the common pest and disease problems that people experience. For each problem, they should mention which remedies they have tried, and how well they worked.

Below is an example of how you can record this discussion. You do this on newsprint during your workshop session. The 'other suggestions/new ideas' column in the table includes the ideas and interventions you will offer in your workshop.

Table 6: Example of Pest and disease problems, their solutions and new ideas as analysed by learning group participants in Potshini (2006).

Problem	Solutions tried and their usefulness	Other suggestions/ new ideas
Rats eating vegetables	Rattex, traps, '**wigwams'**. The wigwams or little grass enclosures for seedlings work best	
Birds eating seedlings	- 'Wigwams' work well - Being in the garden from dawn to 8am to chase birds - Planting early winter so crops are more vigorous when birds come in July-Aug	- Using old tapes to make a criss-cross structure - Netting
Mealy bug in fruit trees	- Nothing	- Planting with compost - Pruning
Moles	Amadumbe (taro) chase them	-?
Fruit fly stings on tomatoes	- Nothing	Fruit fly traps (demonstration in workshop)
Aphids and worms	Chilli and soap spray	Chilli, garlic and soap (demonstration in workshop
Cutworms	- Eggshells around the plants - Work warm manure into the beds	- Cutworm **collars** (demonstration in workshop) - **Light trap**s for moths *
Stalkborer	- Granules (bought from a shop)	- Napier fodder as a **trap crop** (demonstration in workshop)

*More information is also provided in the Gardening Resource Pack, which accompanies this manual.



Cutworm Collars: These are small plastic or cardboard tubes that are pressed into the ground around individual seedlings to protect them from cutworm.

Light traps: These are a source of light such as lantern, which is placed in the garden to attract the moths away from the plants.

Trap crops: These are crops that trap the pests because they are preferred to vegetable crops in the garden. A trap crop mostly is one where the insect or pest can then not

Workshop input

After analysing the present situation regarding pests and diseases with the group, the facilitator provides the following input (talks about) natural pest and disease control. The facilitator covers the following topics in the workshop input:

- Predators and garden friends
- Chilli, garlic and soap spray
- Cutworm lifecycle
- Mechanical control measures
- Protection of seedlings against birds
- Windbreaks
- Fruit-fly trap
- The workshop input on these topics is covered in more detail below

Predators and garden friends:

A colour picture of garden predators is used as seen in Figure 4.

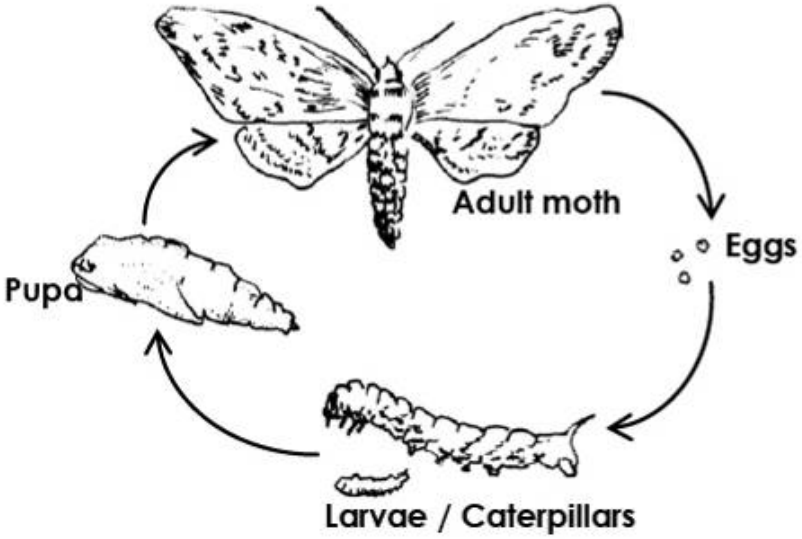
Participants identify and discuss their understanding of the roles of these animals and insects in their gardens.

The basic message is: If you can, leave these creatures to thrive in and around your gardens, as they are part of Nature's balance and will help you in your pest control efforts.

Chilli, garlic and soap spray: This brew works well against **soft-bodied** pests such as aphids and worms. Its preparation is demonstrated in the workshop (handouts in isiZulu and Sesotho on Preparation of Chilli and soap spray are available in your Resource Pack in the Pest and Disease Management section)

The Cutworm life cycle: This is explained through a life cycle drawing for a cutworm. Participants may not know that the moths and worms that appear at different times in their gardens are the same species that has changed shape (metamorphosed) (Handouts also available in your Resource Pack).

Figure 6: The cutworm lifecycle



The idea introduced here, is that any worm in your garden comes in three other forms. It is possible to deal with the pest at any one of these stages:

Eggs and pupae can be mechanically removed when found.

Worms can be sprayed with a chilli and soap mixture

Cutworms for example can be stopped by using collars

Moths can be caught in light traps

Mechanical control measures:

Here some pictures of different ways to control pests using physical barriers are shown. These could include: netting and ribbon arrangements to protect seedlings from birds, collars to protect seedlings from cutworm and light traps for moths (of all kinds).

Protection of seedlings against birds:

Here ideas that are already being used can be also discussed. As an example, the small grass wigwams used by people in the area (Potshini in this case), can be discussed, as well as grass mulching when seedlings are very small. Mostly, one would opt for protection of the seedlings, rather than attack on the birds. Scarecrows and human presence also work well, as do shiny bits of string or foil that flutter in the wind and make birds slightly nervous to land. Netting also works well, if it is affordable.

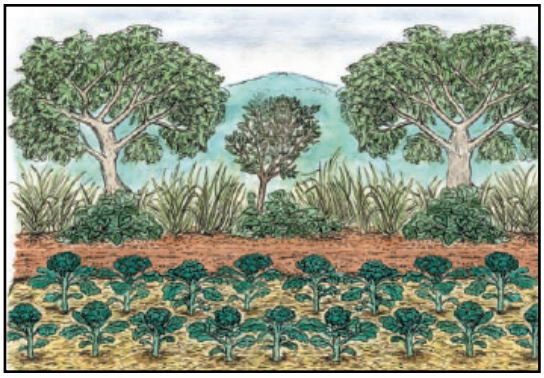


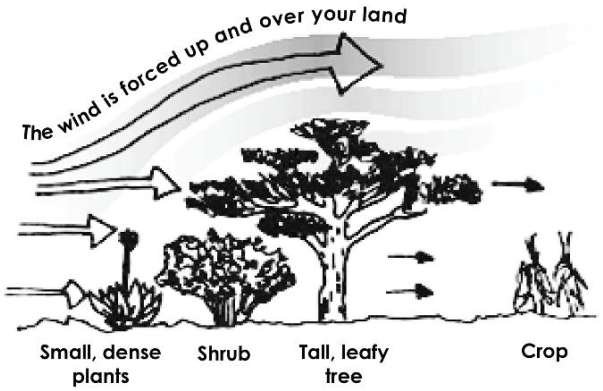
Mr Mabaso's garden showing the little grass wigwams protecting his seedlings from attack by birds. Other learning group members have come to have a look how it works

Windbreaks:

Windbreaks can have more than one purpose; to stop the wind that sucks up all the moisture in the garden and damages plants, but also to stop the wind from blowing insects into the garden. Here, strong smelling plants that deter insects can be used, as well as ones that bear fruit, such as granadillas, or that are feed for cattle, such as Napier fodder.

A discussion is held with colour pictures to show the concept. The two pictures below are examples.





Then cuttings of aromatic plants (Rosemary, Rose Geranium and Lemon Verbena) were distributed that could be grown as hedges for protection against wind and insects. Rooting stock of Napier Fodder can also be distributed. This fast growing grass (used also as a hedge), is also a livestock fodder and a trap crop for maize stalk borer moths.

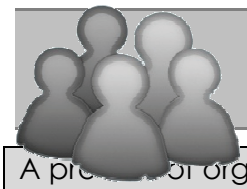
Fruit fly trap:

A demonstration is given of how to make a fruit fly trap, using empty two litre plastic coke bottles and sweet fruit pulp (e.g. oranges), mixed with sugar to ferment as a bait. Participants can be given empty bottles to make up their trap during the workshop, and a couple of oranges each for the bait.

Cut off top of an old 2-liter cold drink bottle and invert into the bottle. Fasten together by making two holes on either side. Fasten wire through holes to serve as handle and keep the two pieces together. Fill with fruit fly bait and hang close to where fruit flies are.



Figure 7: How to make a Fruit Fly Trap



Research outcome 1: Pest and disease control

A pr[illegible] of organic pest and disease control was introduced through the learning workshops in Potshini. This relies a lot more on **working with natural processes** and **creating a balance of forces** in one's garden – both of which are very new concepts to participants who have become used to the idea that there is a 'one-poison-kills-all' remedy to any problem. Afterwards, an assessment was made of whether participants observed natural processes more and tried to work with elements in nature. This was done by interviewing participants in the learning groups at their homes. A number of community members were interviewed.

The numbers given in throughout the table indicate the number of responses given for each question.

Innovation: This means the gardening or pest control practise that was introduced through the learning process.

Yes: The number of respondents that actually tried this out.

No: The number of respondents who had not tried.

Tried, but no longer in use: This column explores why respondents tried the practices but did not continue to use it.

Adaptations made: This column explores whether respondents tried the practise in any way to suite them better or had any other comment to make.

Below is an indication of how this went.

Table 7: The outcomes of a study in Potshini looking at pest and disease control interventions as practised by learning group participants (RIENG, 2007).

Innovation	Yes	No	Tried but no longer in use or did not try	Adaptations made/ comments
Toilet Paper rolls (for cutworm)	7	11	Did not try – 8 Did not work well – 3 No cutworm – 2	Real help with cutworm – 4
Chili-soap spray	14	4	Plants were healthy and did not need it – 2 Did not know – 1 Bought chemicals from Familee Save – 1	Works well – 6 Really chases bugs – 1 Got rid of aphids – 4 Did not work well –2
Fruit fly traps	0	17	Did not know – 7 Tried but it did not catch flies – 1 no fruit trees – 1 No need – 1	
Garlic cloves for planting	7	10	Not at training – 7	Grew well, but did not eat it – 4 It dried up – 1 Does not understand how it is supposed to work – 1

Innovation	Yes	No	Tried but no longer in use or did not try	Adaptations made/ comments
Rosemary/Lemon Verbena cuttings	5	14	Did not grow – 5 Not at training – 9	Did grow; do not know how to use – 1
Napier fodder	10	8	Did not grow – 2 Not at training – 5 Cattle ate them all –1	Grows well – 8
Environmental awareness in the garden; promoting presence predators and friendly insects	6	13	Did not know – 6 Heard about it but have not really tried – 4 No bugs or frogs in my garden – 3	More frogs and bugs in my garden – 1 Told my family not to kill bugs and frogs – 1 I do not kill useful insects – 1 We do not kill frogs and bugs anymore – 2 I kill frogs, the rest I don't – 1

Discussion of the outcomes for practising pest and disease control interventions

- The outcomes showed that organic brews for control of specific pest outbreaks had been introduced, as well as some physical barriers such as toilet paper rolls as well as Napier fodder. The Napier fodder was primarily introduced as a windbreak, but also as a physical barrier to pests, and a preferred habitat of maize stalk borer. The grass is a good fodder for cattle (RIENG, 2008.
- If we look at Table 7 above we can see that the innovation that was the most popular (where 14 out of 18 respondents said Yes, they are using this innovation or practise) was the use of the chilli-soap spray. Table 8 below shows this result for two different surveys: ① The SSI (Smallholder Systems Innovation) Project, 28 gardeners were interviewed at random in the Potshini Community. From the table you can see that 10 gardeners mention using the chilli-soap spray. This represents 36% of the gardeners. These people were chosen for being gardeners only, not whether they were part of the training process. ②The WRC (Water Research Commission) project tin which 18 gardeners who were also all in the learning groups and had thus attended training sessions were interviewed. Of these 14 of these 18 people (78%) were using the chilli-soap spray. These two surveys give an indication of the uptake of this innovation within the learning groups (WRC) and within the broader community (SSI).

Table 8: Use of chilli-soap mixture by garden learning group, Potshini (2006)

	SSI SURVEY		WRC SURVEY	
	No of innovators (divided by no of gardeners)	%	No of innovators (divided by no of respondents)	%
Chilli and soap spray for pest control	10/28	**36%**	14/18	**78%**

- The growing of the Napier fodder and use as a windbreak and fodder also went well (55% uptake). A few respondents did not manage to grow it (11%), but generally it is easy to grow, robust and prolific. In garden visits, facilitators had to start cautioning the gardeners to thin out and move their clumps of Napier, which were starting to grow large and thick.



Rose geranium grown from a cutting in Potshini (2006)



Napier fodder clumps growing large and thick

- The introduction of cuttings of herbs did not go that well. This was done as an alternative to planting seed, but as it turns out, participants found it almost impossible to keep their cuttings alive. Cuttings need to be in a sheltered place in well drained medium, be kept wet continuously and not be disturbed for quite a long period; a combination of factors that gardeners found very difficult to maintain.
- The fruit fly traps were a resounding failure. Most people had forgotten about them. They were introduced in July and fruit flies only become a problem around November-December. This gives emphasis to the point that **innovations need to be introduced in season to deal with an immediate problem**.
- The cutworm collars and tape for birds were tried by a few participants without much success, and was discontinued.
- What is surprising is that around 32% of the respondents actually tried to encourage pest predators in their gardens (by not killing them!). From previous experience, this point has often been dismissed by participants as a bit strange. Also, many women fear frogs, lizard, rodents and insects and do not want these creatures around them. They are killed for this reason more than any other.

Facilitator's Note:

Innovations need to be introduced in the relevant season to deal with immediate problems, e.g. introduce fruit fly traps in summer!

More on wind and frost protection

Both wind and frost protection is aspects, which do not receive a lot of attention from the average gardener. Wind, specifically, is not compensated for, and many gardeners have their vegetable patches completely at the mercy of the elements.

The limiting effects of seasonal wind on plant production were obvious in Potshini. A few small vegetable gardens had been fenced using thatch grass, and in each case the growth of the plants in these small, warm, protected, wind free environments was markedly better than in the other gardens. This can be seen clearly in the pictures below.

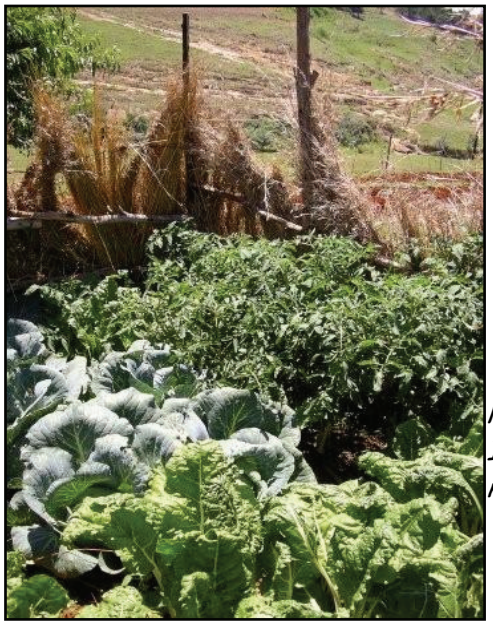
The training of learning groups in rainwater harvesting and intensive homestead food production was also carried out in other communities in and around Bergville, KwaZulu-Natal. These groups (18 people in total) were being supported by a Non-governmental Organisation called World Vision under their Okahlamba Area Development Programme, which supports orphans and vulnerable families in the Okahlamba Ward. The training team made some changes to their learning processes depending on how well they had gone in Potshini as a way of refining the learning process.



Ketiwe's garden, unprotected; her vegetables are looking a bit small and stressed.



Nelisiwe's garden, protected by a grass fence. This picture was taken in winter, at about the same time as that of Ketiwe's garden. Nelisiwe's vegetables are looking a lot better.



Nelisiwe's garden in summer, looking very healthy. It is acknowledged, though, that wind and cold would not necessarily be the only contributing factors.

Below is the frost protection structure that was introduced in Bergville. The idea was to make a triangular frame the size of a trench bed, and to wrap greenhouse plastic over this. The plastic in this picture still needs to be pulled taught over the structure and bedded into the ground around the trench.



Although scientific measurements of the effect of wind and frost were not made it seems beneficial to give wind and frost protection more emphasis in food garden learning processes.

For the purposes of a different learning group process in Bergville (World Vision), where gardens all looked a lot more like Ketiwe's garden in nearby Potshini (see photo above), frost protection structure that could double as a small greenhouses were introduced. This was something that participants could try immediately and that would have an immediate effect (given that it was July and very frosty and windy.

Wind-break plants (napier fodder, indigenous irises and rosemary) were also introduced and provided to participants, as a longer term intervention.

Attempts to have discussions with participants as to their observations around where frost forms and how they could use this information to assist them in their gardens, drew a blank. With the previous process in Potshini, a similar discussion lead to the realisation in the learning group that frost does not form on rocks, or stones, for example. It also lead to recognition that this was one of the reasons that people in the past had built rock walls around their gardens. A few participants in Potshini had tried out low stone walls in their gardens, with good success.

Further refinement of the frost and wind protection learning process

Frost and wind protection are slightly difficult to deal with in the context of household gardens. Gardeners do not give it much thought. They tend to focus on the crops they want to grow. In many parts of South Africa, gardeners do not have a longstanding habit of growing hedges, multi-purpose plants, windbreaks and trees. It is thus a topic that needs to be introduced from scratch.

There are a number of limitations to introducing frost and wind protection activities to a garden learning group process. A few are listed below:

- Introducing windbreaks, hedges and multi-purpose plants in a coherent way into gardening practise, is a **long term and intensive intervention**. It also requires a lot of plant material. It does not really help giving participants one plant or even ten. For this reason, most programmes focussing on this kind of work will include a process for plant propagation such as the introduction of nurseries in the community – which is clearly not within the ambit of a three to four month training process;
- Often, the participants themselves and the people that support them do not really see the importance of hedges, multi-purpose plants and trees, seeing them more as ornamental elements for urban gardens;
- In areas where water is limited, these plants are not given priority. They would also mostly require protection from animals while they are young;
- Resources can be limiting. It may be difficult and expensive to obtain enough grass and/or thin sticks to make a fence that can act as a windbreak and frost protection structure; and
- The use of stones and low rock walls in gardens to protect plants against frost and wind is no longer a well-known concept, although some people may remember it from long ago. It is only an option to try and experiment with these ides when there are rocks in the area. The facilitator will need to have some experience of how this works.

Facilitator's Note:

The introduction of wind and frost protection learning processes will need to be done at the discretion of the facilitator.

The frost protection structure can safely be introduced into most environments as a way of growing at least a few beds of vegetables in conditions where otherwise very little would grow. The financial outlay for this could be carried by the support agency, rather than participants.

Processes should be introduced as a coherent experiment that is monitored by the gardener and supported by a local facilitator.

4.4 Seed Saving

Keeping your own seed is central to your independence as a homestead food gardener. You can choose which varieties and types of crops you like and keep these seeds. You do not need to go to the shop to buy seed. There are still many varieties of seed that farmers keep or that you can buy from a shop that you will be able to keep for yourself once you have grown the crop.

Growing from seed to seed, involves the following process:

- **Germinating** seeds,
- **Transplanting** seedlings,
- Looking after **selected healthy plants** until they mature, so that
- Their seeds can be **collected**, and
- **Stored** for the following year.

Plants adapt to the environment they are grown in and produce seeds that carry those adaptations, producing healthier plants that are better able to cope with the local environment.

There are a few things about how plants work that you need to understand to help you to successfully keep your own seed. In the sections below we will discuss pollination (self-pollination and cross-pollination), how pollination happens (pollinators), and how you select and store seed.

We will then use the example of the learning process used in Potshini to see how people can grow their own seedlings and the role of traditions like seed exchange and harvest celebrations. The latter also provides a wonderful opportunity for local knowledge sharing on food processing, and for the broader community and leadership to recognise the efforts of families who grow their own food.

Pollination

Pollination occurs in plants when pollen from the male parts of the flower (stamen = filament + anther) is deposited on the female parts (pistil = style +stigma). Fertilisation occurs when the pollen grain reaches the ovum (egg = ovary + ovules).

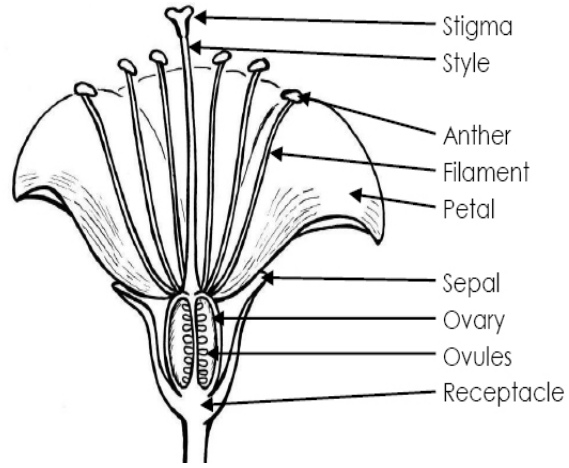


Figure 8: The parts of a flower

In some vegetables, herbs and flowers, the male and female parts are found in the same flower. These are called complete flowers.

Exceptions are:

- The cucurbits such as pumpkins, melons, gourds and cucumber and maize. Here the male and female parts are on different flowers, but on the same plant
- Asparagus and papaya. Here male flowers are on one plant and the female flowers on another

Open pollinated and hybrid crops:

Open pollination refers to self-pollination of crops by natural processes such as wind and insects of various kinds (mostly bees).

Hybrid crops have been cross-pollinated by humans in a controlled environment. These are crops that will **not normally cross.** This means that you cannot keep seed from hybrid plants. The seed will either be sterile, or will produce many surprises. The plants grown from hybrid seed will not look like their parents and are often not strong.

You know that a packet contains hybrid seed when the sign on it says:



:

Self-pollination

In self-pollinated plants, pollen is transferred from the male to the female part of the same flower. Some crops that self-pollinate are tomatoes, lettuce, capsicum (green pepper) and okra. Beans, cow peas, peanuts and peas self-pollinate even before the flower has opened.

Generally, plants that self-pollinate can be grown quite close together without them crossing with each other. It is still a good idea however, to separate different varieties of the same plant from each other (e.g. different varieties of lettuce), as some crossing can still occur.



Figure 9: Self-pollination – pollen being transferred by a bee

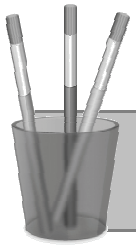
Cross-pollination

In cross-pollinating varieties, pollen is transferred from one flower to another on the same plant, or to the flower of another plant of the same type. Cross-pollinated plants produce more varied offspring that are better able to cope with a changing environment. Cross-pollination occurs when the pollen is carried between flowers by the wind, bees, other insects, birds and bats. Honeybees are by far the most important pollinators.

Pumpkins are an example of a cross-pollinating plant. If you have two different types of pumpkin, planted close together, they will cross with each other. The seed that is produced will grow and produce a plant with a fruit that is a mixture of the two types of pumpkin you have grown. This happens with all cross-pollinated crops.

Other examples of cross-pollinated crops are: brinjal (eggplant), cabbage, carrot, chilli, kale, leeks, maize, mustard greens, onions and spinach (Swiss chard).

Many grains (such as sorghum and maize), grasses (such as Napier fodder and sweet reed or *imfe*) and trees are dependent on the wind for pollination. Pollen picked up by the wind can travel very far (many kilometres) on air currents before coming to a rest.



Activity 4: Identifying different types of seed

Aim

To check a number of different seeds to see whether they are open pollinated or hybrid seeds, and to work out whether they are self- or cross-pollinated.

Instructions

For this exercise, the best thing to do would be to go to a shop that sells seed, and if you could to speak to gardeners and farmers in your area whom you know keep their own seed.

You will need to make a list of at least 10 different types of crops/ vegetables.

Then write down the name of each variety (the name on the packet), e.g. tomato (as your type of crop) and *Floradade* (as the name of the variety).

Then work out whether it is open- pollinated or not: Look for the tell-tale F1 sign on the packet. *Floradade,* for example, is open pollinated, because it DOES NOT have the F1 sign.

Then look at your notes above and find out whether your crop self-pollinates or cross-pollinates. Or ask the farmer you are interviewing.

Then make a few comments about what this means in terms of keeping seed of that variety. For example, *Floradade* is a self-pollinating crop and can thus be grown quite close to other tomatoes without crossing with them.

How to take control of cross-pollination

Any insect or wind pollinated plant will need to be isolated from other varieties of the same plant to stop them from crossing with each other. Below are four techniques you can try to achieve purity in your seed.

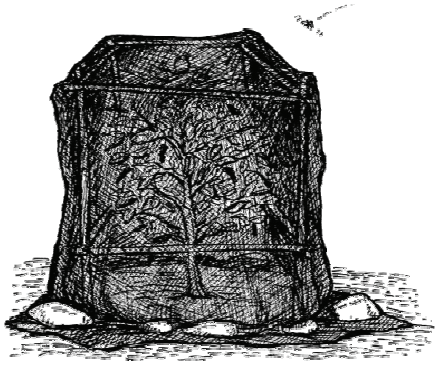


Figure 10: Controlling cross-pollination

- **Grow them apart**:
  Grow two varieties that cross-pollinate at least 500 m or more apart. This is how far most insects fly, although bees can fly up to 4 km. Obstacles that deflect wind or insects such as hedges, buildings and ridges can greatly reduce cross-pollination.
- **Isolate them in time**:
  This is possible for crops where all the plants flower at the same time, such as maize and sunflowers. Crossing can be avoided by growing early, mid- and late season varieties that shed their pollen at different times.
- **Cage them**:
  Caging is needed for species that flower over a long period of time, such as cabbages and chillies. Put cages made of fly or nylon netting over the flower stalks of the different varieties to exclude all insects. Pollinate by hand.
- **Cage one and then the other variety:**
  This can be used instead of hand pollinating varieties that are flowering at the same time. Cage one variety while insects pollinate the second variety.

  Then cage the second variety while insects pollinate the first one. Once they have been pollinated, both varieties should be caged until flowering has stopped.

Criteria for selecting seed

- The seeds should possess the same quality as the variety that was planted. If you planted a long, purple brinjal, collect seed from a long purple fruit. If the fruit looks different, the seed will also be different.

- Take out plants with undesirable characteristics before they start flowering. Examples are slow growers, sick/diseased plants or ones that bolt (start seeding) too early.

- Harvest seed only from strong, good looking plants.

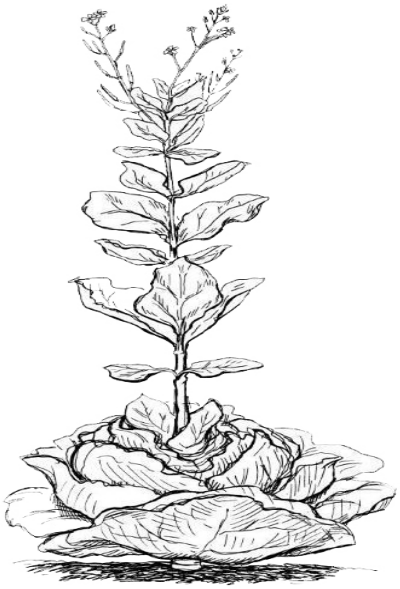


Figure 11: Cabbage plant with seed

- Harvest seeds from plants that perform well under stress, such as extreme weather conditions, and plants that resist disease or insect attack.

- Harvest seed only from healthy plants. If the leaves or fruit have rotten spots or a mottled appearance, do not use seeds from these plants. These diseases are carried in the seed and will appear next time.

- Also do not harvest seeds that have diseases such as brown blotches or mould growing on them.

- Do not harvest seed from plants that have bolted. Bolting is when the plant goes to seed much quicker than it normally should. It could be due to stress, such as hot and dry conditions, but is also in-built. So, if you take seed from plants that have bolted, you are selecting for a plant that bolts, or goes to seed very easily. This is particularly important for crops such as mustard spinach and lettuce where you are looking for a prolonged leaf stage.

- Harvest the seed when it is ready. Immature seed will usually not germinate, as it has not fully formed (if the seed is still green or wet when picked). Over-mature seed tend to go rotten before you plant them.

- Do not harvest seed that has been damaged by insects or in any other way. They can only germinate if they are whole.

Seed storage conditions

Darkness

Find a way to keep the seeds in darkness. Use paper bags, dark coloured plastic and glass jars and place them in cupboards. DO NOT place the seeds on a shelf in clear glass jars.

Moisture

Even if the seeds are dry, if you store them in a damp environment they will absorb moisture. This seriously affects how long your seeds will be viable. Mostly we can only dry our seeds in the air. Do not dry them in the sun, but in a shady place where the air can move (well ventilated). When the weather is very wet with a lot of rain and mist, it will be difficult to dry seeds, especially the larger ones, like beans and peas. The life of seed doubles when the moisture content is lowered by 1%.

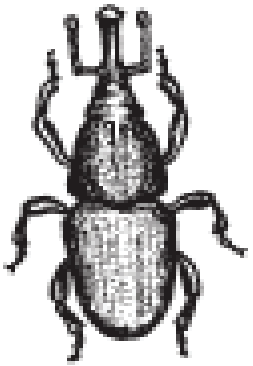


Figure 12: Seed storage conditions

Temperature

Seeds last longer in cold, but not freezing conditions. Choose a cold place such as near a river, under trees, under the ground or inside a clay jar. The life of a seed doubles when the storage temperature is lowered by 5°C.

Figure 13: Weevil



Seed-preserving materials

Use materials that stop the growth of pests such as **weevils**:

- **Dry ash**:
  This absorbs moisture inside the container and also prevents the growth and increase of weevils. Add ½ kilogram ash to 1 kg seed.
- **Lime**:
  Can be used in the same way as dry ash. Mix 15 teaspoons (50 grams) with every kilogram of seed.
- **Cooking oil**:
  Mix cooking oil with your seeds to prevent increase of weevils. Use only 1 teaspoon of oil for every kilogram of seeds.
- **Dried and powdered leaves of different aromatic plants**:
  Weevils are sensitive to aromatic or strong smelling plants.
  Try the following:
  - CHILLI:
    Mix 4-6 teaspoons of chilli powder with 1 kilogram of seed.
  - WORMWOOD (MHLONYANE):
    Dry and crush the leaves and mix with seed. Use 4-6 teaspoons for every kilogram of seed.
  - ALOE:
    As for wormwood.

Research outcome 2: Food processing, seed saving and celebration

A food processing and seed saving learning and implementation process was implemented in a community called Potshini, close to Bergville in KwaZulu-Natal (2006-2007). This process was part of a larger rain water harvesting and intensive vegetable production programme implemented jointly through two organisation,; SSI (Smallholder Systems Innovation Programme at the University of KwaZulu-Natal) and the WRC (Water Research Commission – Project k5/1575/4: Participatory Development of Training Material for Agricultural Water Use in Homestead Farming Systems for Improved Livelihoods).

The idea with this session is to: ①celebrate the achievements and learnings of the group, ②cook and eat some of the food that has been grown and/or ③exchange seed.

This builds on various traditions, such as harvest festivals, seed sharing, and even *mantlwantlwane*. This is where the children 'play house' to show off their cooking and housekeeping skills to their elders and neighbours in a fun-filled environment.

These celebrations build a sense of ownership of the process and pride in one's work. It can be focused around: ①making a meal from food grown, ②running a food processing workshop to make preserves (pickles and jams), or ③a seed swapping workshop. In many ways, the focus would depend on the season and timing.

In Potshini, because the learning process covered a whole growing season, it was possible to focus on seed saving and seed exchange. This was very exciting.

Pictures of the seed exchange are shown below:



Seeds grown by learning group members (in this case carrots and mustard spinach) that they offered to swap.



A selection of seed can be seen that was brought by the facilitator (e.g. coriander, fennel, mustard spinach, spinach, peanuts, jugo beans, black hopi beans, pumpkins, gourds, cowpeas, etc) to swap with participants.

Comments on celebration learning process

It is important to provide some form of closure to the learning group process from the facilitator's side, and also to create a sense for participants that their own involvement will continue, and that they can strengthen this among themselves. How this is done is not too crucial, as long as it entails a celebration of the participants' achievements and a way of helping them to understand their continued role of mutual support and co-operation.

Seed saving is crucial to real sustainability of homestead food gardening, as it puts the control back into the gardener's hands.

Facilitator's Note:

Have some fun!

Seedling production



Research outcome 3: Growing crops from seeds saved

This process was introduced in Potshini, so that people could grow their crops from seed and also so that they could keep their own seed and could be more independent in terms of their gardening activities.

The overall outcomes of this process were very encouraging. The following extracts from the interviews give an indication. It also shows people trying to garden during winter, which has previously not been attempted, but which has been promoted in this learning process.

Table 9: Seedling production and seed saving interventions as practised by learning group participants in Potshini (2006).

Innovation	Yes	No	Tried but no longer in use or did not try	Adaptations made/ comments
Growing own seedlings	15	4	Do not know how – 1 Still going to try – 1	Saves money – 2 Works well – 1 I do not buy any more – 1 Grow well – 3
Growing during winter	9	10	Livestock a problem – 2 Frost a problem – 4 (black frost was bad this year) No water – 4 Fencing is old – 1	Planted spinach, cabbage, onions, carrots, beetroot – 2 Some problems with chickens –1 Yes, but rats are causing a problem – 1
Kept seed	8	11	Harvested peanuts too late –1 Did not wait long enough – 2 Goats ate everything – 1 Only kept masihlalisane as my garden is too small – 1 Did not think about it – 1	Masihlalisane – 7 Carrots – 5 Beetroot – 1 Peanuts – 3 (2 of the 3 ate all their seed as well) Green pepper (own) – 1 Exchanged seed with other learning group members – 2
Peanut seed	10	9	Not at training; did not receive seed – 7	Do not know how to plant; did not get a lot of them – 3 Did not grow – 1 Got rotten – 1 Harvested a lot – 3 Kids really liked that –1
Jugo bean seed	2	12	Not at training – 9 No space – 1	Did not plant them – 1
Mustard spinach seed	7	12	Not at training – 7	Grows well – 6 NOTE: Mustard spinach is the same as masihlalisane!

The headings in Table 9 above have the following meanings. A number of community members were interviewed. The numbers given throughout the table indicate the number of responses given for each question.

Innovation: This means the seedling production or seed saving practise introduced through the learning processes.

Yes: The number of respondents that tried out the practise.

No: The number of respondents who did not try.

Tried but no longer in use: This column explores why respondents tried the practise but did not continue to use it.

Adaptations made: This column explores whether respondents changed the practise in any way to suite them or had other comments to make.

From the table it can be seen that quite a few of the learning group participants kept seed. They were most successful at keeping the Mustard Spinach (Masihlalisane) seed. These plants seed easily and quickly. More than half of the respondents grew peanuts from the seed provided, but only 3 of the 10 respondents managed to harvest and keep seed from their peanut crop.

Facilitator's Note:

- An input on seed saving can be given to start a seed exchange activity.
- This is unfortunately the one session that drops off the table as time and budget constraints make themselves felt.
- It may thus be necessary to put together inputs on seed saving and food processing and to ensure that these are added to the agenda of other workshop sessions.

4.5 Fruit production

Fruit production as an aspect of homestead food gardening should be introduced in all the learning processes. This is because during community work undertaken, fruit comes up again and again as a gap in people's diets.

Fruit is expensive to buy from shops, and often not easily available locally. Fruit trees themselves are expensive to buy. The facilitator and support agencies for the participants thus work together to supply fruit trees to the participants as a service within the training process. The trees are provided at cost, or are subsidised by the support agency to make them affordable for participants.

In one case (World Vision), a decision was made to provide two trees for free to each participant, and that they could then buy more if they wanted them. This was based on the observation that some of the really poor people in Potshini had not bought trees, as they could not afford them.

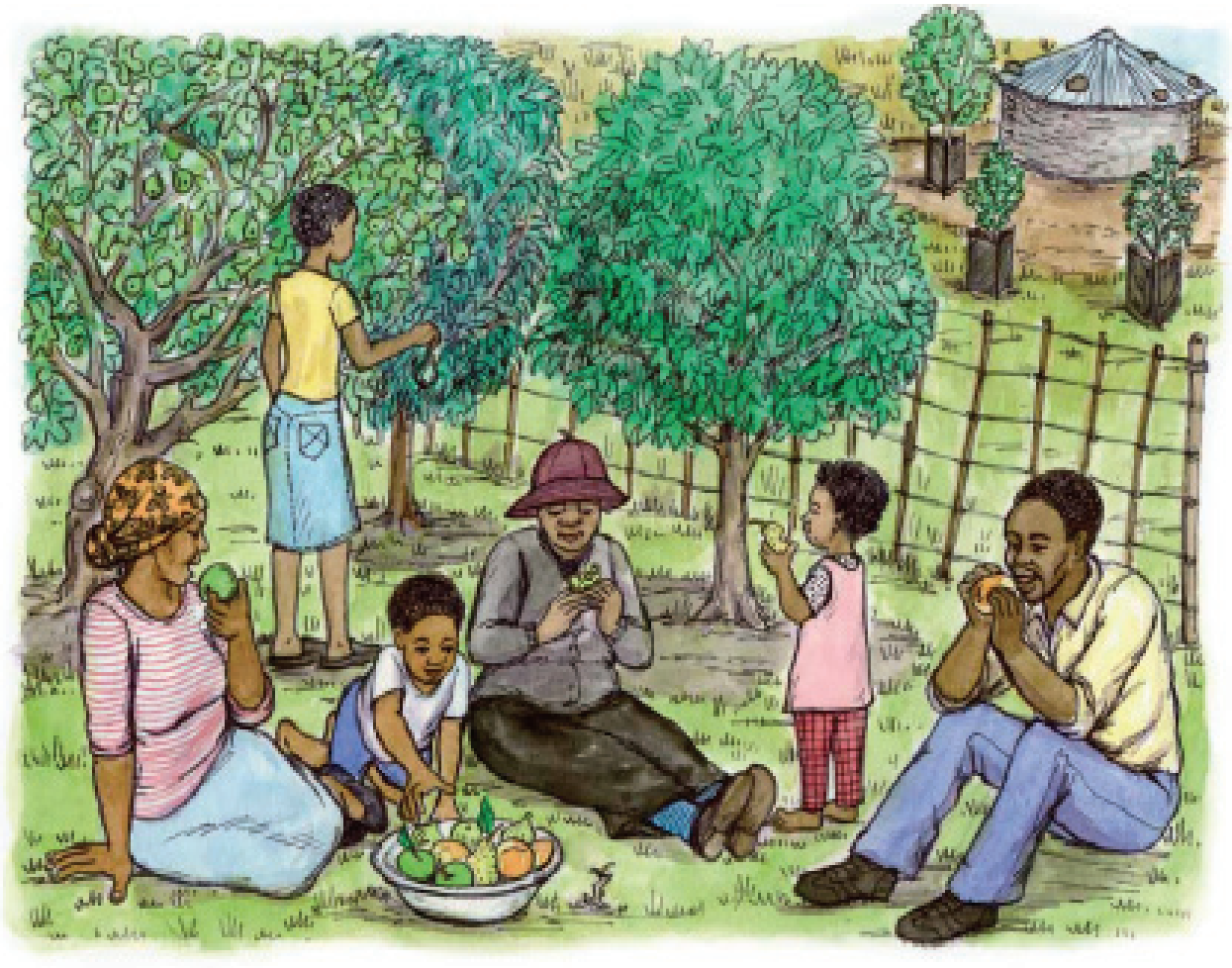


Figure 14: Fruit for the family

It is possible to grow many different types of fruit trees around your homestead. You can acquire your trees by growing them from seeds or cuttings, or buying grafted trees from nurseries.

Choosing a site for fruit trees

Different trees grow better in different climates. The table below will give you some ideas of which trees will grow in your area.

Table 10: Trees to grow in different areas

VERY COLD AREAS (Has frost in winter and sometimes snow)	NOT SO COLD AREAS (Has frost sometimes in winter and rarely snow)
Apples, pears, peaches, nectarines, plums, almonds, grapes, cherries, apricots, pecan nuts and walnuts	Apples, pears, peaches, nectarines, plums, almonds, grapes, cherries, apricots, pecan nuts and walnuts
	Also: figs, granadillas and citrus fruit (lemons, oranges, naartjies and grapefruit)

Your trees will grow for a long time, so it is important to choose the right place. You need an area with:

- Well drained and deep soil;
- That has enough sun (preferably a north facing slope); and
- Where fruit trees can be protected from wind.

Choosing fruit tree varieties

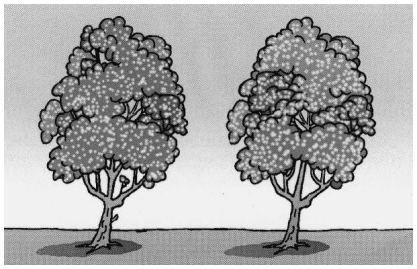
Each type of tree has many different varieties and you will need to choose a variety that is suited to your area and climate. Some varieties grow better in very cold areas and others in warmer areas.

Another consideration for choosing a variety: Pollinators

Here you will need two different varieties of the same type of tree. Thus two different varieties of apple tree for example. These are varieties that will specifically pollinate each other; not just any two varieties. For example you will need to plant a Granny Smith (green variety of apple) and a Golden Delicious (Yellow variety of apple) to be able to get fruit from BOTH varieties.

- They will help each other bear fruit, as they pollinate each other. The blossom of the one cultivar/variety will need to be fertilized by the pollen of the other cultivar/variety. They need to flower/blossom at the same time, and they need to be compatible, so that both types can bear fruit.
- These trees must not be planted more than 30meters apart, so that the pollen can be transported from tree to tree with the help of bees and the wind.
- You can plant 1 tree of one type (cultivar/variety) and 4-5 of the other, depending on which variety you prefer. This means that you can have more of one variety of trees, than another.

Yes:
Apples
Pears
Pecans
Some plums
Paw paws



No:
Citrus
Mangoes
Grapes

Figure 15: Which trees need pollinators?

Interplanting fruit trees and vegetables

It is more natural for trees and other plants to grow together, rather than to stand-alone. If you only plant one crop, insects will have a feast.

Growing vegetables and other crops between your trees encourages 'good' insects that control the 'bad' ones, and a better balance is maintained.

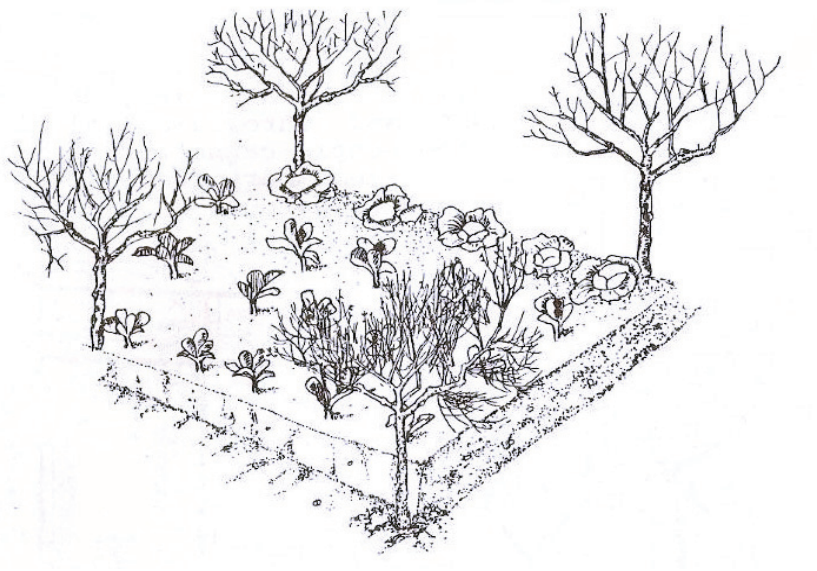


Figure 16: Interplanting

It is possible to grow a mixture

of other **annual** crops with your fruit trees, such as grasses (oats, annual rye grass) and legumes (vetch, lupins). These grow through winter and die down in early summer to provide mulch and compost.

OR it is possible to grow **permanent** crops between your rows of trees. Here you would mix grasses (rye grass, fescue), legumes (clover, lucerne) and herbs (comfrey, chicory). These plants can be cut short regularly, and the cuttings can be used as mulch, compost or animal feed. A variety of species always attracts a variety of organisms that may help in pest and disease control.

Pest and disease control for fruit trees

Growing healthy trees is a good starting point to combat pests and diseases. They are stronger and more resistant to insects and diseases. Use lots of compost, manure and mulch, and weed your trees regularly.

Other ways to grow strong, healthy trees include:

- Growing **marigolds, leeks and comfrey** nearby, deters insects.
- Promote the presence of **bees**. Bees help to pollinate the flowers of the fruit trees, and thus to bear fruit.



Figure 17: Marigolds

- Promote the presence of **insect predators** (good insects). These insects live off other insects and provide a natural way to control pests (bad insects). These include ladybirds, lacewings, wasps, praying mantis, dragonflies and frogs.

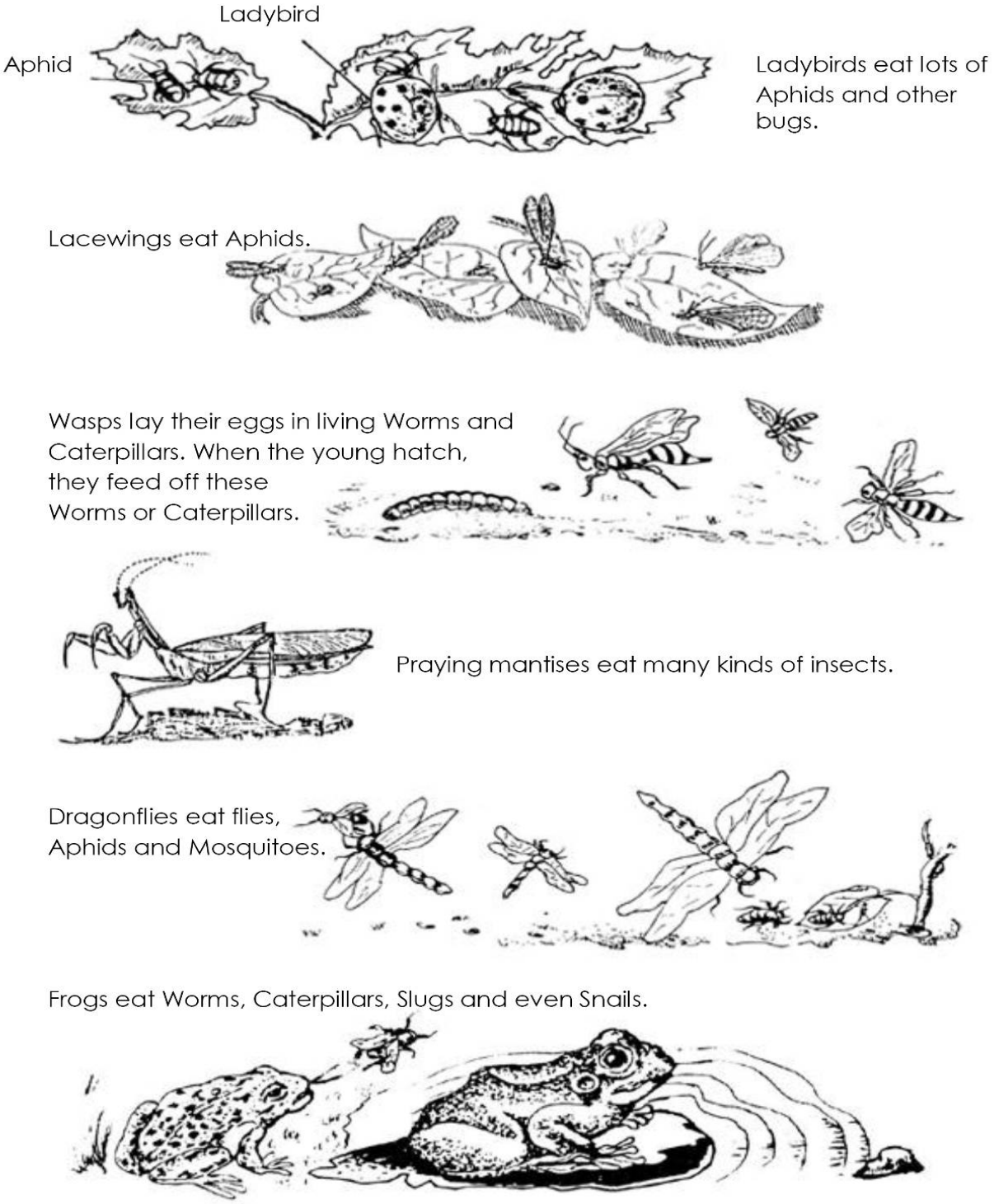


Figure 18: Insect predators

- Make up simple mixtures or brews that will get rid of insects and diseases
  - **Garlic and onions sprays** (deter most insects):
    Chop up 1 whole garlic or onion bulb. Soak it for 1 day in two teaspoons of paraffin. Add 0.5 litres of water and strain off the onion or garlic from the liquid. Add a medium bar of green sunlight soap and mix it in until it has completely dissolved. This will help to stick the mixture to the leaves of the trees. Dilute this mixture 1:10 with water and splash or spray on the tree.
  - **Tobacco mixture**:
    This should be used carefully as it is a strong poison and can kill bees and useful insects as well. Boil up 0.5 cup of cigarette ends or tobacco in 1 litre of water. Strain off the liquid and mix with 2 litres of water. Splash or spray on the tree.
  - **Fruit fly traps**:
    Fruit flies spoil fruit later in the season by stinging them and laying eggs inside the fruit. Small worms hatch in the fruit and make them rotten. Fruit flies like eating ripe fruit like plums, grapes and oranges, but you can use any sweet smelling fruit to make a trap. Fill a trap with some water mixed with fruit, water and sugar. The fruit flies will fly into the traps to feed and will not find a way out again.

- Fruit flies can also be controlled by **picking up fallen and rotten fruit** beneath the trees **every** day. The fruit is collected in buckets of water, which will drown the small worms. The fruit can also be fed to chickens and pigs. It is important that the small worms do not make contact with the ground. They burrow out of the fruit into the soil and rest there to start a new cycle of fruit flies.

- Diseases such as mildew (a white powdery fungus on the leaves, mostly on apples, pears and vines), black spot (little black spots on leaves and fruit) and leaf curl (mostly on peaches and nectarines), can all be controlled by dusting the trees and fruit with **sulphur or copper-oxychloride.** These chemicals can only be obtained from gardening shops and some hardware stores.

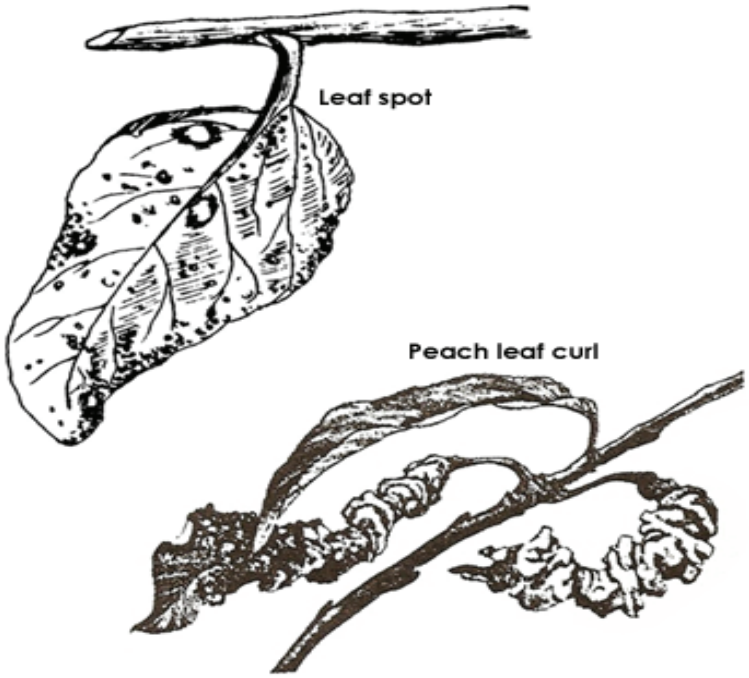


Figure 19: Leaf diseases

Preserving and storing fruit

Preserving fruit by drying, bottling or making jam is an excellent way of making your fruit useful for longer periods.

Drying fruit

No special equipment is needed for drying fruit, although some simple drying frames might help. Fruit is properly dry when no moisture can be squeezed out of it.

Bottling fruit

Bottling is a simple way of having sweet and tasty fruit available in your home throughout the year.

You will however need to buy some good storage bottles to ensure the fruit does not go rotten. The best bottles are the preserving bottles with metal lids and rubber seals or other bottles with metal screw tops that can make an airtight seal.

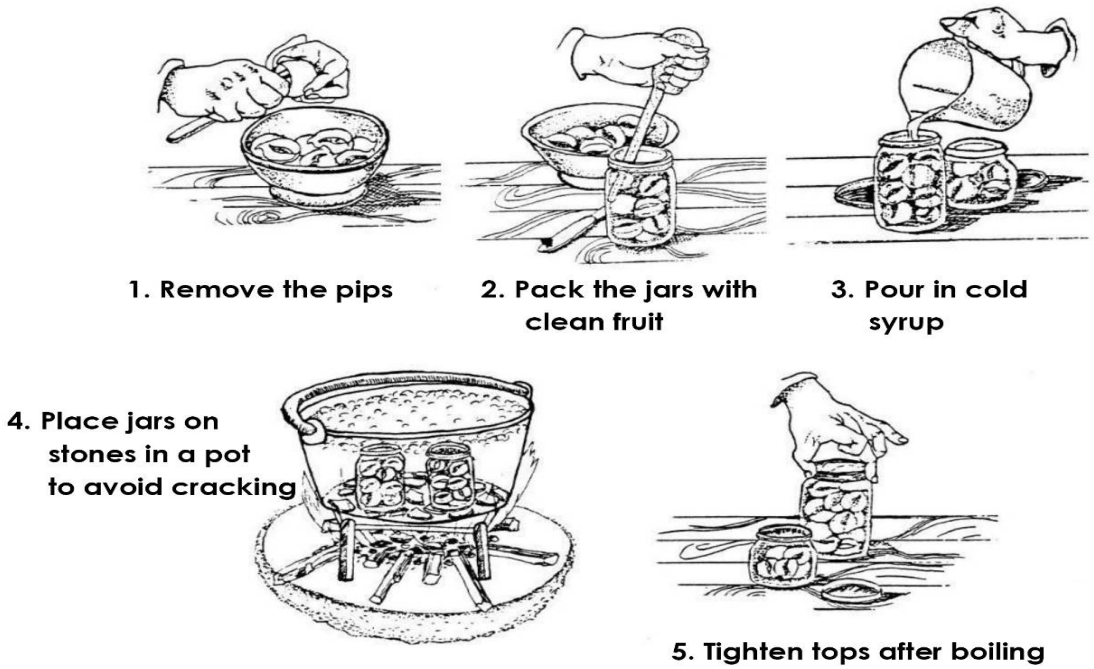


Figure 20: How to bottle fruit

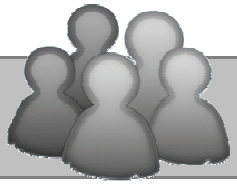
Making jam

Fruit sets when boiled with sugar because of a substance inside the fruit known as pectin, which is released during boiling. Some fruits make jam more easily than others, because they contain more pectin.

Good jam fruits: apples, plums, peaches and apricots.

Some fruit will need extra pectin in the form of lemon juice (1 lemon /kg of fruit). These fruits include cherries, figs and grapes.

The fruit production learning process



Research outcome 4: The fruit production learning process.

A fruit production learning and implementation process was implemented in a community called Potshini, close to Bergville in KwaZulu-Natal (2006-2007). This process was part of a larger rain water harvesting and intensive vegetable production programme implemented jointly through two organisation,; SSI (Smallholder Systems Innovation Programme at the University of KwaZulu-Natal) and the WRC (Water Research Commission – Project k5/1575/4: Participatory Development of Training Material for Agricultural Water Use in Homestead Farming Systems for Improved Livelihoods).

During the learning process in the first nutrition workshop, each participant lists the crops and fruit that they would like to try and grow, to fill their nutritional gaps and enrich and diversify their diets. From this, a list is then compiled of fruit trees that people would like to **order** through the facilitator. These trees include deciduous trees that are ordered bare rooted from commercial nurseries in the Western Cape. They need to be ordered in time for delivery in early August. Other fruit trees are also sourced and provided (e.g. citrus and avocados).

Secateurs:
Pair of pruning clippers.

Deciduous tree:
Deciduous trees shed their leaves every year (annually). The opposite of evergreen. Most fruit trees are deciduous.

In July-August, a session is held on **pruning** of deciduous trees, such as peaches, plums, apples and pears. This session is held in a participant's garden. Secateurs, cutters and wound sealant are provided. After a demonstration, participants have a go at pruning. During a theoretical session the facilitator explains the reasons for pruning and how it is done and gives a handout to participants.

In August, a **fruit tree planting workshop** is held when the trees are delivered. Handouts are provided to participants, explaining how to plant fruit trees, both from bags and as bare rooted trees. Input is also given on how to care for fruit trees.

In summer, a session is held around the **growing of fruit from seed**. Examples are brought and shown, for example, granadillas and tree tomatoes, and participants are provided with seed or small plants.

A further session can be given on **caring for fruit trees** (ongoing composting and soil fertility, and pest and disease control), and on **processing fruit**. Handouts are provided to participants.



A granadilla in Mr Thabani Madondo's garden (Potshini), that he had grown from seed.

This can be combined with a short session on **preparation of the fruit fly bait** (as fruit flies are the major pest problem in most areas).

Inputs around fruit production are generally spread across a number of workshops to make sure that the topics are discussed during the right season and months of the year. Pruning for example should be done in winter, when the deciduous trees have lost their leaves. The points above describe a possible process.

Comments on the fruit production learning process

These sessions are generally fun and are appreciated by participants. Two small surveys to ascertain the adoption of planting and growing trees were carries out. The results are shown in Table 11 below. For the SSI (Smallholder Systems Innovation) project 28 gardeners were interviewed at random in the Potshini community. From the table you can see that 13 gardeners mentioned that they were growing trees. This represents 46% of the gardeners. These people were chosen for being gardeners only, not for whether they were part of the learning process.

For the WRC (Water Research Commission) project, 19 gardeners that were also all in the learning group and thus attended training sessions were interviewed. Of these 19 people, 12 (63%) were growing fruit trees. The two surveys thus give an indication of the uptake of this innovation within the learning groups (WRC) and within the broader community (SSI).

The gardeners were interviewed about eight months after planting their trees (WRC). 63% is considered a good survival rate for the trees. This is much higher when compared with interventions where fruit trees are simply handed out within any learning or support process. Group members had fruit trees that were still growing, eight months after planting. This is a good survival rate compared to what happens when fruit trees are simply handed out without any learning and support processes.

Not all members bought trees, and a few forgot to water and weed their trees, or they were eaten by livestock or had to be removed again for cultural reasons.

Table 11: Number of gardens where fruit trees were still growing 8 months after planting.

Innovation	SSI SURVEY		WRC SURVEY	
	No of innovators (divided by no of gardeners)	%	No of innovators (divided by no of respondents)	%
Fruit trees	13/28	**46%**	12/19	**63%**



Two peach trees that were planted about 8 months earlier as bare rooted trees in a garden in Potshini. Hidden in the right hand corner is an apple tree. These trees grew very well indeed.

Facilitator's Note:

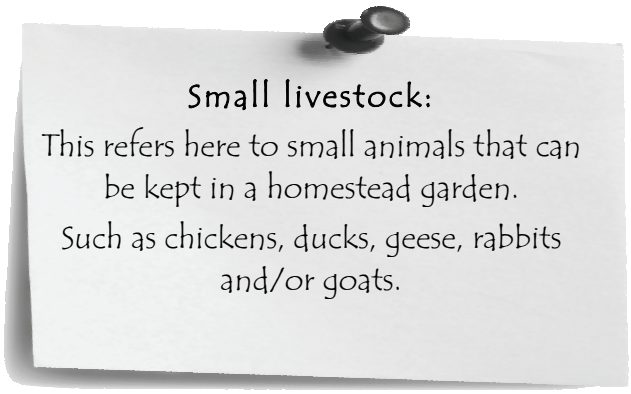
The main effort in providing trees lies with the facilitator. S/he has to find the trees, place the orders, arrange the transport and delivery and get the money from the participants. This demands focus, as the seasons have to be taken into account as well. Suitable trees for the area in question need to be found.

The effort is well worth the service it provides to the participants!

4.6 Integration of small livestock

Diversity and intensification of the garden through livestock

Integrating small livestock production (chickens, ducks, geese, rabbits, goats and pigs) is important to be able to intensify and diversify the rest of your gardening.



Why is integrating small livestock into homestead food gardening important?

- Small livestock provide manure to the garden and are also important for human nutrition. People get meat and eggs from their small livestock.

- Small livestock can be very destructive in vegetable gardens. It is much easier to keep them enclosed and bring food to them than it is to enclose your garden. As your garden is usually much bigger. It does however require extra work and diligence in feeding the small livestock.

- If small livestock are roaming around, it is not possible to collect and use their manure in your garden. This is a valuable resource and worth keeping them closed in for.

- If chickens and ducks are roaming around, it is also not possible to monitor the laying of eggs by the hens (ducks), as you need to go and search for the eggs. By the time you find the nests, you will not be sure how old those eggs are. Keeping the hens (ducks) enclosed, helps to know where the eggs are and makes it possible to collect some of the eggs to eat and leave some of the eggs for the hens (ducks) to hatch out.

One way that to enclose your chickens (ducks or geese), but also makes it much easier for them to forage and get at least some of their own food, is to use a mobile shelter also called a' chicken tractor'.

'Chicken tractors' or mobile shelters

These are shelters for 20 or fewer chickens that you can move around your homestead. You can move the shelter to a fresh patch of grass or bushes or weeds every two to three weeks. A cheap, portable shelter (chicken tractor) can be made from wood and wire.

The 'chicken tractor' or 'mobile ark' does not have a floor, to allow the chickens the freedom to scratch around wherever you place this shelter. Think about the following when you make the shelter:

- The more lightweight it is, the easier it would be to move around. You can move it with the chickens inside, by lifting it up only slightly and 'walking' the chickens across to the new position you have chosen for your 'chicken tractor'. This saves a lot of effort for you, and stress for your chickens, as you will not have to catch and release them every time you move the shelter.

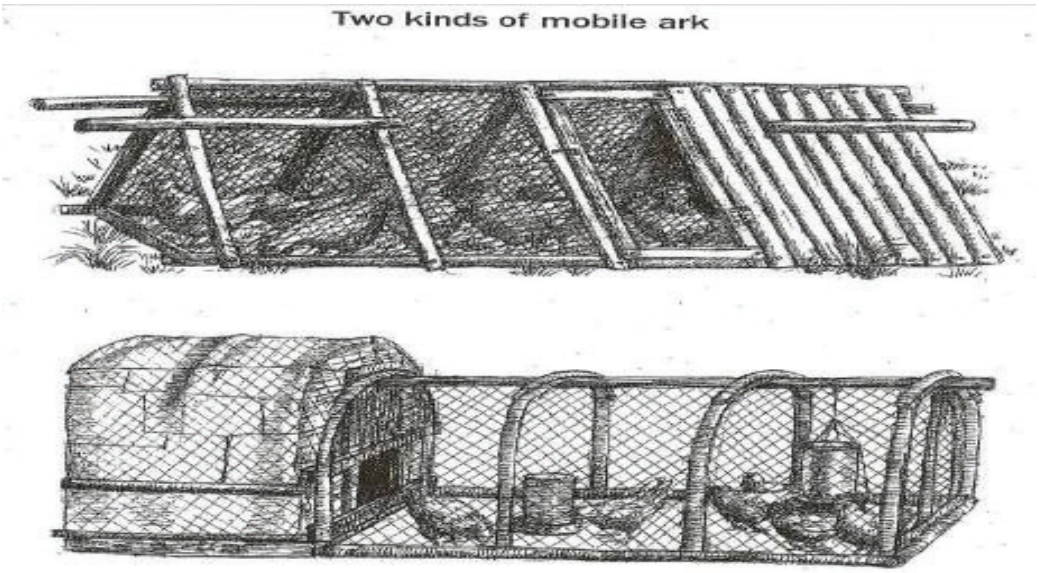


Figure 21: Examples of 'chicken tractors'

Why is it called a 'chicken tractor'?

Chickens scratch over the soil like a tractor. It is a good idea to position the 'chicken tractor' where you want to develop your next vegetable bed. While scratching and scavenging, the chickens do an intensive soil preparation job for you, by:

- Loosening and aerating the soil;
- Fertilising the area through their droppings, and by scratching that into the soil as well; and
- Clearing the soil of bugs and pests that may damage your new plantings.

You can move the shelter every two to three weeks, or as soon as your chickens have accomplished the job you wanted them to do in that portion of your yard.

You can protect your chickens cheaply as follows:

- Against rain and excessive sunshine, by roofing a portion of your 'chicken tractor' with thatch or a sheet of plastic; and
- Against wind, by tying some grass bundles to the side of the shelter that faces the prevailing wind direction.



Chicken tractors covered with tarpaulin to protect chickens. Note: earth, logs and plastic around the base to prevent predators from getting into the chicken tractor



An important advantage of using a mobile shelter is that you don't have to spend money on expensive chemicals to disinfect it, because shifting it regularly prevents the build-up of conditions favourable for common chicken diseases.

Feeding chickens (Kagiso, 2003)

Chickens can be let out of their shelters during the day to scavenge for some of their food themselves. Putting up a fence for a chicken run in which the birds will be placed is a good idea, but will add to your costs. Keeping them in a lightweight 'chicken tractor' which you can easily move around, you can control and protect them (and your garden), while still giving them all the advantages of being able to scavenge.

Besides water, chickens need four things (the four G's): **Grain, Greens, Grit and Grubs**

- **Grain:**
  This is seed, like wheat, oats, maize, sorghum, soya or sunflower seeds. You can grow all these grains and let your chickens into the field when you have finished your harvesting. Maize is probably the best and cheapest grain to feed your chickens.
- **Greens:**
  Greens keep chickens healthy. They will get greens themselves if you let them scavenge during the day, or you can feed them cabbage, comfrey, herbs and most kinds of fruit. They also like eating vegetable scraps. A good idea is to feed the chickens weeds from your vegetable garden.

  Remember that, just as with people, a greater variety of greens promotes better health for chickens. Such variety is easily achieved by growing and feeding them a variety of herbs, and many of these also have medicinal value.
- **Grit:**
  This is small stones that chickens need to help them digest their food. They can collect their own grit if they have somewhere to scratch around, or if you let them out of their shelter, or if you keep them in a 'chicken tractor'.
- **Grubs:**
  Bugs and insects provide the chickens with most of the protein that they need so that they can grow. They need protein to make muscles in their bodies and to make eggs. Growing soya beans and feeding this to the chickens is another way to give them protein. If they are kept in a 'chicken tractor', they can help you clear a new planting bed of bugs, prior to planting.

In winter you should feed them mash (bought food), because there are fewer insects and less grass for them to eat outside.

4.7 Suitability of the learning group and workshop approach for the really poor

In this section we look at really poor or vulnerable families. Can they engage in the learning group process in a positive way, or do they need a different intervention, or a more focused one?

Household visits to a few of the vulnerable families were conducted in Potshini (2006) to assess the impact of the gardening intervention for them and how this differed from some of the impact of the intervention for the other participants.

Table 12: Impact of the learning group approach for the really poor

Heartening points	'Need more attention' points
The tower garden is an appropriate intervention for really poor people (see the section below for more information on tower gardens).	The really poor families were unable to buy fruit trees; specific support for these poorer families is required.
The food supplied by the garden is seen as very valuable.	Their gardens are very small due to lack of resources and labour.
Keeping seeds is possible e.g. mustard spinach and peanuts were kept. This means that there is seed for next season. This is very significant, because people cannot afford to buy seed and seedlings.	Gardens were left for periods of time when things were really bad and the family could not focus. For this purpose it would be useful to promote plants that keep growing without being attended to, like fruit, wild spinach, pumpkins, comfrey, lucerne.
Attendance of training sessions: One old lady came to almost all the sessions. Teenagers (child headed households) were encouraged to attend and permission for this was granted by the school. The schoolchildren themselves were included in the learning process, visited homesteads and joined in some of the workshops.	Attendance can also be haphazard. The facilitator may need to identify vulnerable families upfront and visit these households during the training. Take the extra effort.
Materials for experimentation (such as seed, manure, orange sacks for liquid manure, chilli and soap for sprays) are provided during the sessions. Therefore the household does not need to spend any cash to be able experiment with these new ideas.	Vulnerable families tended to forget more of the information. A process of repetition at their homesteads could be a good idea.

Tower Gardens or Bag Gardens

'**Bag gardening**' is a specific gardening technique that provides a small intensive food garden at the kitchen door, which can use grey water, and is easy to maintain once constructed. It became known in South Africa through contact with Kenyan examples.



In its simplest form, it is an upright 'gunny bag' filled with a fertile soil mixture, with a porous core made down the centre to ensure that water distributes evenly throughout the soil. Vegetables are planted through holes made in the sides of the bag, and on the top surface.

Left: A recently planted bag garden. Another two weeks, and the cloth would be almost completely hidden by the extent of the plant growth in this bag! Note the sticks protruding from the centre of the bag. This creates a porous core from top to bottom, so that the water can soak through all the soil in the bag garden.

In mountainous Lesotho, which has an effective growing season of only about three months, women carry their 'gunny bag' gardens indoors at night and during cold spells. This provides them with a source of vegetables when crops planted outside cannot survive the severe climate.



Mrs Mahangu of Ndonga, Eastern Cape, can reach most plants in her Tower Garden without having to bend down

Two further variations of bag gardening is found in South Africa, namely:

- The larger upright bag garden, in South Africa this is called a '**Tower Garden**'. Instead of a single bag, several bags are sewn together, or other suitable cloth like shade-netting is used, if available. The porous core is constructed of flat rocks. Tower gardens can increase the planting space fourfold compared to conventional ground level gardens;
- The horizontal or '**Flat Bag' Garden**, which is filled like the gunny bag, but placed down flat on its side. This obviates the need for a porous core; instead, it is watered by inverting a two-litre plastic cool drink bottle in the centre of the bag. The bottle supplies a slow trickle of water to the bag garden, and may take up to a week before it needs refilling. Up to fifteen spinach plants can be grown in each Flat Bag, which shows the intensive nature of production in these bag gardens.



This 'Flat Bag' Garden belongs to Mrs Linda Ngatsane, Female Farmer of the Year 2007. Note the upturned plastic bottles (circled in red) for watering.

Making the most of grey water

Grey water refers to water that had already been used for domestic purposes; such as washing of dishes and clothes. In many cases, water has to be carried from the nearest stand-pipe in plastic containers, not for the purpose of gardening, but for cooking and washing. This water can successfully be re-used for growing vegetables. This is a way of saving water, especially as water is very scarce in most areas.

Gardeners in Potshini were initially very skeptical that vegetables could be grown successfully with soapy water. However, the results speak for themselves and once they mastered the management of the system, the results were good,

> Gardeners were convinced:
> Vegetables can grow in soapy water!

Every day the available grey water is poured into the Tower or Bag Garden. The soapy water is cleared out of the system by pouring two buckets of clean water into the column, once a week.

One can also reduce the soap in grey water by spreading some wood-ash on the water surface and leaving it in a container overnight to settle before using it for the plants.

This is lazy gardening

One of the main attractions of bag gardening is that little labour or attention is required, and this appeals to all busy gardeners. Once people have become familiar with the bag gardens, they prefer to position them right at the back door so that it is easy to pour the wastewater into the tower, and quick and easy to pick the vegetables needed for cooking.

It is difficult to predict how much water is required: in full production, two to three 20 litre buckets per week will be needed, while one bucket should suffice in winter. If water forms a puddle around the bottom of the tower or bag, it is an indication that too much water is being applied and the obvious answer is to make a second tower!



Participants in Potshini are planting spinach into the sides of the newly prepared tower garden. Tomatoes and onions will be planted on the top surface.

What vegetables can be grown?

Bag and Tower Gardens are ideal for leafy crops, typically the various varieties of **spinach**, which are planted through holes made in the sides of the bag or cloth. Ideally, the holes should not be directly above one another, but should be staggered diagonally for more sunlight and space for root development.

Tomatoes and **onions** can be planted in the top layer and, if crops require trellising, this can be provided by extending the vertical uprights and joining them with wire or string.

Where possible, companion crops should be grown for biological control of disease and pests. **Garlic** and **onions** are particularly useful.



Here Mrs Mdeltshe in Hlabisa (KZN, 2007) inspects her tower garden with Mr Madondo. He came from Potshini community in KZN to help construct and monitor the tower gardens.

Notice the spinach planted in the sides and the taller tomatoes planted in the top of the bag.

Facilitator's Note:

It is worth constructing a few tower gardens in an area as part of the learning group process. Participants can monitor the progress of these bag gardens and make their own conclusions about their usefulness. Construction of these gardens should be demonstrated and handouts made available.

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Homestead Food Gardeners' Resource Pack (Handouts) –

Chapter 4: Diversifying production in homestead food gardening

Resource Material for Homestead Food Gardeners

Chapter 4: Handouts (English)

Handout 1 Mixed Cropping
Handout 2 Crop Rotation
Handout 3 Pest and Disease Management
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1. Mixed cropping

We want to create as much diversity in our gardens as possible. Diversity ensures a natural balance in the garden. This includes creating a living soil, using water efficiently and minimising pest and disease attack on crops.

Mixed cropping involves planting various crops together in one plot. Plants can either be inter- planted at the same time or crops can be rotated. This means that different crops are planted in the same place at different times. Using both inter-planting and crop rotation in your garden is a good idea.

Inter planting

When planting a number of different crops together we need to consider the following:

- **Nutrient consumption:** We mix crops together that consume different amounts of nutrients. Some plants are heavy feeders and need a lot of nutrients. Other plants are light feeders and some even add nitrogen to the soil. A good example is the traditional practise of planting maize and beans together. Maize is a heavy feeder, while beans are light feeders as well as fixing nitrogen in the soil.
- **Root depth:** Plant deep and shallow rooted plants together to ensure that they do not compete for nutrients and water. A good example is planting maize and pumpkins together. Maize is an upright plant that has a deep rooting system and pumpkin is a creeping plant with a shallow rooting system. They do not compete for space either below or above the ground.
- **Insect repellent plants:** There are some crops which have a unique smell that repels some kinds of insects. For example, onion has a specific smell that butterflies dislike. If onions are inter planted with cabbage, this will reduce the attack from insects (worms). Combinations like onion and cabbage are called companion plants. Companion planting is an effective pest prevention measure.
- **Timing:** Some crops have a longer life cycle than others. It is possible to plant crops that mature quickly in-between crops that take longer to mature. In this way one crop can be harvested while the other crop is still growing and competition is reduced. An example is planting radish, mustard spinach and potatoes together. Radish matures quickly and is harvested within 6 weeks of planting. The leaves of the mustard spinach are harvested for 2-3 months. This reduces competition with the potato plants that are now growing large. Potatoes are harvested after 3.5-4 months. A combination such as this also includes that aspect of rooting depth, nutrient consumption and insect repellent properties.
- **Shade tolerance:** This becomes important when tall crops and perennial plants are also grown in the garden. These include fruit trees. Some crops such as comfrey, lettuce and strawberries are shade tolerant.

More examples of inter-cropping in a vegetable garden

In the beds

Plant carrots and onions together: Carrots protect against onion fly and onions protect against carrot fly. Carrots root more deeply than onions and are harvested earlier; giving the onions the space they need to mature.



Plant cauliflower or cabbage, lettuce, fennel and onion together: This combination gives complete control of aphids and diamondback moth (*shown on the right*) on the cauliflower. It takes into account nutrient consumption, rooting depth, insect repellent properties (onion and fennel), timing and shade tolerance.

Plant tomatoes, onion or garlic and carrots together: This combines insect repellent properties, nutrient consumption, rooting depth, timing and disease control. Tomato plants are scattered so that they do not touch each other, which reduces the incidence of early and late blight.

Plant swiss chard (spinach) and beans together: this combination takes into account nutrient consumption, rooting depth and disease control on the chard. Planting the chard in alternate rows with beans reduces the incidence of bacterial spot on the chard.

Many different combinations are possible. Below are two more examples:



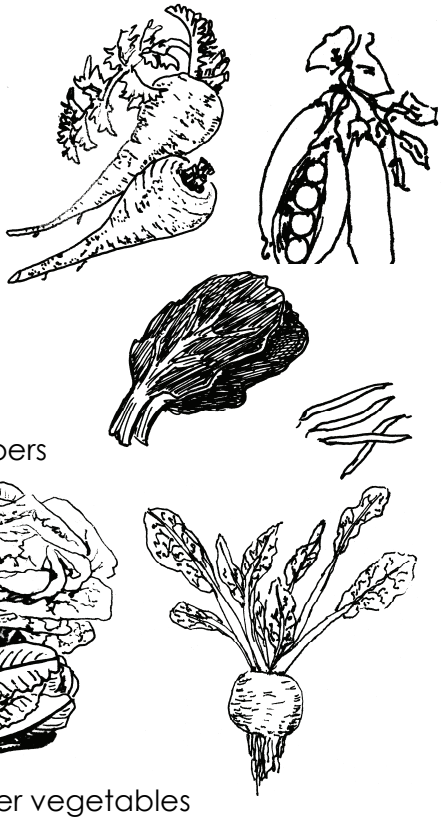


Left: Swiss chard inter-planted with fennel and garlic chives

Right: A bed with onions, cabbage, lettuce and swiss chard planted together.

There are a number of crops that grow well together and some that do not. When planting a bed, use the diagrams below to choose combinations of crops that suite each other.

Some plants which grow well together:



Beetroot	-	onions
Carrots	-	peas, lettuce, onions, tomatoes
Onions	-	beetroot, strawberries, tomatoes, lettuce
Eggplant	-	beans
Cabbage	-	potatoes, beetroot, onions
Green Peppers	-	all vegetables
Lettuce	-	carrots, radishes, strawberries, cucumbers
Pumpkin	-	mealies
Swiss Chard	-	strawberries
Tomatoes	-	onions, carrots
Mealies	-	peanuts, peas, beans, cucumber, pumpkins, potatoes
Sunflowers	-	cucumbers
Beans	-	potatoes, carrots, cabbage, most other vegetables

Plants that do not grow well together:

These are some plants which do not grow well together. Try to avoid putting them in the same beds. Try and experiment for yourself.

Beetroot	-	pole beans
Onion	-	peas and beans
Cabbage	-	strawberries
Pumpkin	-	potatoes
Tomatoes	-	potatoes and cabbage
Beans	-	onions
Sunflowers	-	potatoes



Advantages and disadvantages of inter-planting

ADVANTAGES of inter-planting	DISADVANTAGES of inter-planting
Efficient use of space below and above ground	Looks "untidy"
Reduces and avoids pest and disease build-up in the soil and in the garden	Can make harvesting of crops more time-consuming
Reduces weeds. Covers the soil and uses nutrients in an effective manner. Building of a healthy, living soil is possible.	Weeding can be more time consuming initially, as crops may be scattered, rather than being planted in rows
Plants support each other in a synergistic relationship that protects against pest and disease attack and increases vigour and growth	Some shading may occur if plants are not spaced well
Efficient use of water	Some plants may be over or under watered depending on their life cycle. For example, some plants may be seeding while others are still growing.

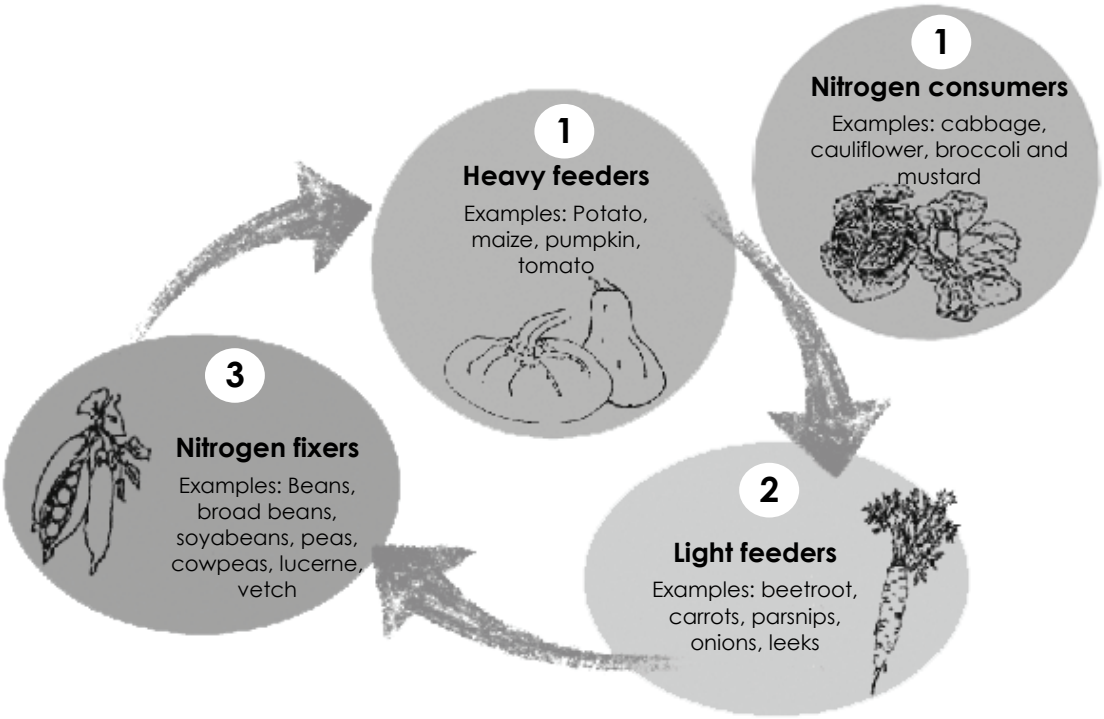
2. Crop Rotation

Here you do not plant the same crop in the same place year after year, but you make sure that a different crop is planted in each space. This is a good idea because:

- It prevents or stops the accumulation of insects and diseases. If the same crop is planted some insects and diseases will become more every year!
- Different crops use different nutrients or plant food stored in the soil. In this way you do not overuse some of the plant foods, while not using others.
- The soil can be covered all year round.
- Some crops add nutrients or nitrogen to the soil. Examples are beans, peas, broad beans, soya beans, peanuts, cowpeas, lucerne and clover.
- It prevents the soil from building up bad or negative reactions to specific plants. An example here is nematodes on tomatoes and swiss chard. Nematodes are very small worms that we can not see with our eyes. They live in the soil and feed on the roots of your plants.
- There is no build up of specific weeds.

There are a number of different crop rotation systems that can be used.

Below is an example of a system that is easy to use and remember.

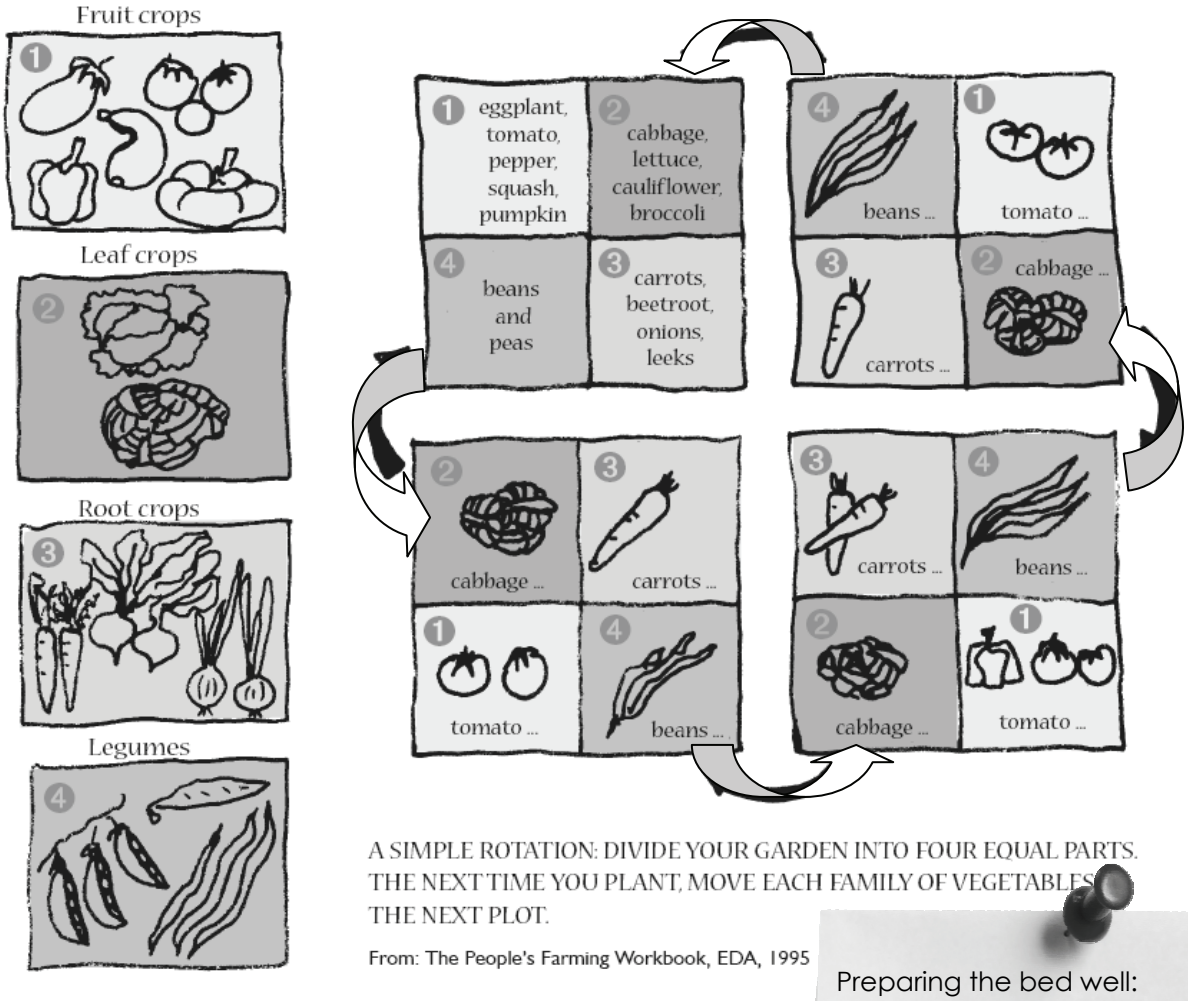


In the first season after applying compost and or manure heavy feeders or nitrogen

consumers are planted. In the second season light feeders are planted and in the third season legumes are planted. This is followed by another application of compost or manure and the cycle is repeated.

In trench beds, where the organic matter is decaying slowly in the soil, you may want to start with legumes, move on to heavy feeders or nitrogen consumers and then move on to light feeders. This is because during the decaying process plant nutrients will take a while to become available for use by plants. The legumes can fix most of their own nitrogen and are thus a better starting point.

An alternative system is presented below:



A SIMPLE ROTATION: DIVIDE YOUR GARDEN INTO FOUR EQUAL PARTS. THE NEXT TIME YOU PLANT, MOVE EACH FAMILY OF VEGETABLES TO THE NEXT PLOT.

From: The People's Farming Workbook, EDA, 1995

Prepare the land or bed well. Put a lot of compost or manure in your bed (4 full spades/ square meter). Then, start by planting a fruiting crop. These plants need the most food. Leaf crops need less and can follow fruit crops. Then root crops can follow leaf crops without much addition of plant food. Root crops like fertile soil, but do not like fresh manure or compost. It has to be well rotted. Then, nitrogen fixers can follow, with addition of little or no plant food. Then you need to prepare the land well again. Start once more with fruiting crops.

Preparing the bed well:

This would mean trenching, or double digging or addition of a lot of compost/manure forked into the top 40cm of soil. You will need at least 4 full spades for every square meter.

A general recommendation is to place 30 tons of compost to a hectare of land. This comes to about one half of a wheelbarrow load for every square meter (which is about the same as 4 full spades!)

Advantages and disadvantages of crop rotation

ADVANTAGES of crop rotation	DISADVANTAGES of crop rotation
• No build up of pest and diseases • Soil nutrients are used effectively • Soil moisture is used effectively • A healthy living soil can be built up over time	• Without a plan, either drawn or written on paper, it is difficult to remember which crop is to follow • It can be tricky to decide which rotation to follow when inter-planting is also used

3. Pest and disease management



Above is a picture showing some of the useful insects, predators and animals in your garden. All these creatures are our friends and help to control pests

Diversity is good

- Work with nature and copy the natural ways in which plants grow. Insects and "weeds" are a part of nature. We can learn to encourage those insects and plants that help us in the garden. Ladybirds, praying mantis, lacewings, wasps, frogs, lizards and birds all eat the insect pests that harm our gardens. They are called predators. If you leave them in your garden, they will help you!
- We have talked of planting different vegetables together (companion planting) and of rotation. It is also possible to mix vegetables with other plants- strong smelling plants that deter pests and attract predators

In the picture above, nasturtiums and peppermint are planted with the vegetables.

Below are some strong smelling plants that you can grow with your vegetables



Pyrethrum and Feverfew

These plants belong to the *Chrysanthemum* family. They have small white flowers, which are also very decorative in the garden and contain a poison for insects. They can be planted as borders along your beds, or dotted throughout your garden.

You can buy seeds for these plants. Write to the following address:

Mahlathini Organics, PO Box 807, Richmond, 3780, KZN, South Africa.



Marigolds (*Tagetes spp*)

These plants can be used in the same way as pyrethrum. They have the added advantage of deterring nematodes (tiny worms that attack the roots of plants) in the soil.



Different kinds of nematodes



Fennel

Fennel is a great plant for attracting wasps. Wasps lay their eggs in caterpillars and can kill many of them in one day!



Wasp

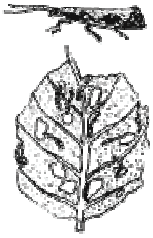
Wormwood (Artemisia affra)

These plants grow as large bushes and should be placed at the edges of your beds, or given their own space to grow. A tea made from the leaves is also a good medicine for fevers and colds.

Khakibos and blackjacks

These weeds are useful to deter pests. Keep a few in the garden!

An inter-crop of cauliflowers, lettuce, fennel and onion can give complete control of aphids and diamondback moth. This means you will have no attacks!!!



Diamond back moth and its larvae

Grow strong, healthy plants

Pests and diseases do not attack healthy plants.

- Fertile soil, fed each year with compost and manure will produce healthy plants.
- Make sure that your plants are not short of water.
- Select the best plants at harvest time from which to collect seeds.
- Use strong, healthy seeds and seedlings. If your plants do not have a good start,

they will not get better later! Rather start again.

- Plant the vegetables in the correct season. Early planting of some crops can protect them from the worst attacks. Examples are stalk borer in maize and blight in potatoes.
- Mulch!
- When you are weeding, do not let the rubbish lie around your garden. The smell attracts pests. The best liquid manures are made from weeds. Otherwise, place the weeds on your compost pile.

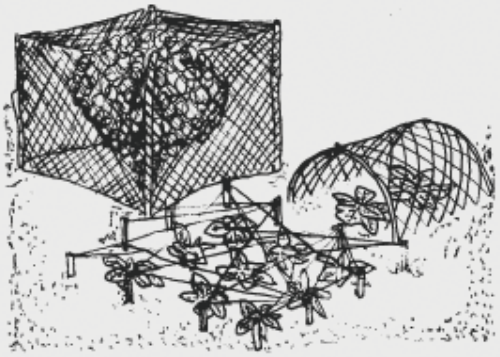
If prevention does not totally succeed in a pest and disease free crop, then there are a number of ways in which to control these problems.

Physical controls

Birds

Birds can be kept away from your crops in the following ways:

- Use 4 sticks and some netting to make a cage
- Cover seedlings with netting or wire stretched across a hoop
- Or make a mesh of string wound around wooden pegs.
- Scare crows still work well, as long as you move them quite often. The birds will get used to them after a while



Seedlings and plants are protected by netting and string

Cutworms

These are fat brown or grey worms that live just under the surface of the soil and cut the stems of small plants as they are feeding.

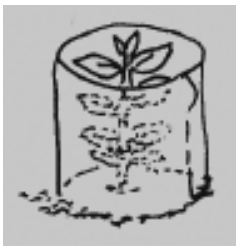




Cutworm and moth

- Cutworms can be collected in the early morning by digging with your finger in the soil, around the small plants that have been cut. The worm can be removed and fed to your chickens or destroyed.

- Collars can be made for the seedlings. These are placed around the seedlings when they are planted. Be sure to press the collar quite deep into the soil (at least 3 cm, which is the width of 2 fingers), otherwise the worms will burrow underneath the collar. Collars can be made from stiff paper, cardboard or rings of plastic cut from bottles.

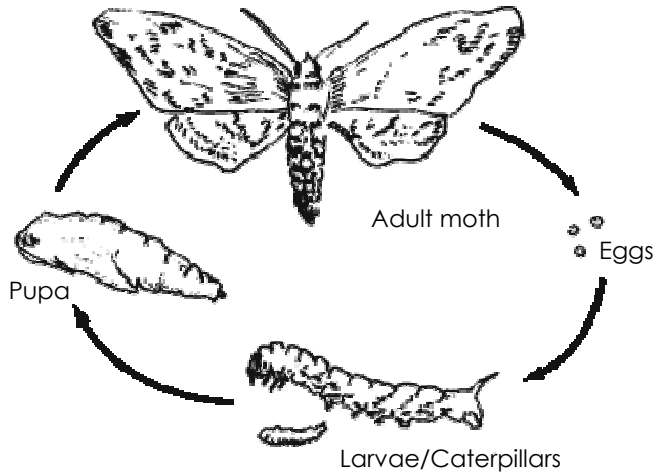


Cutworm collar around seedlings

From: Production without Destruction, 1995

Many worms/caterpillars have the following life cycle:

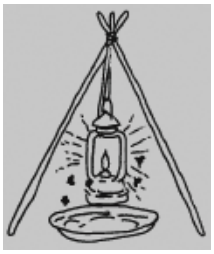
A moth lays eggs, which hatch into larvae/worms/ caterpillars. They feed on the plants. They then turn into pupae, which do not feed. The pupae turn into moths, which do not feed, but lay eggs. And so on.



Life cycle of some insects

It is possible to attract many different kinds of moths with light traps. These are put out at night. Using a light trap will reduce the egg laying of many different moths.

From: Production without Destruction, 1995

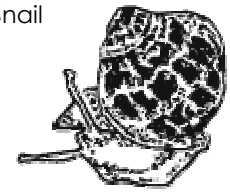


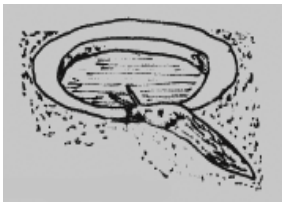
Light trap for moths and other insects

Snails and slugs

From: The Complete Book of Self Sufficiency

Snail





Dish set in the ground with fermented liquid, to attract slugs and snails

- They can be picked off by hand and placed in a bucket of water, or feed them to your chickens. They will love to eat them.
- A saucer or shallow dish with beer or any fermenting liquid can be placed so that the rim is level with the ground. Slugs and snails will be attracted to this liquid. Here they will either fall in, or they can be collected and fed to your chickens, or destroyed.

Herb and plant teas

Many different plant mixtures can be used to control insects and diseases. These remedies should only be used if all the other methods fail. The main advantage of natural remedies is that they are cheap. They can be prepared at home.



Controlling pests and diseases

General points for making plant sprays

- Soap (green bar soap only!) can be added to the mixture to make the spray stick to the plants and insects. Do not use liquid soap or soap powder.
- The mixtures can be filtered through thin cloth to remove the bits of plant material. They can be applied using a homemade brush from grass or twigs.
- These sprays act as contact poisons. So make sure you cover the insects or disease symptoms well.
- Some sprays can burn the plants if they are too strong. First test your spray on a few plants.
- The best time to spray against insects is in the late afternoon.
- The sprays are washed off in rain and have to be re-applied.

IMPORTANT:

These sprays are still poisons. Make sure that children cannot reach your preparations. If you boil up your mixtures, use an old pot no longer used for cooking. Wear gloves if you can!



Below is a listing of some of the plants, how the remedy is prepared and what it is used for:

Aloe

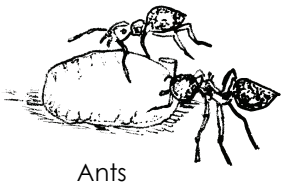


Any kind of aloe can be used.

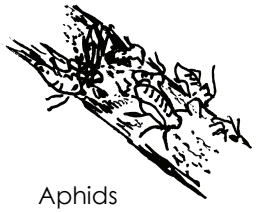
- Crush the leaves in water (1:5). This means that you use 5 times as much water as you sue leaf material. Filter this mixture through a fine cloth and use the liquid as a spray OR
- Dry the leaves and grind them into a powder. This can be dusted onto plants and also onto seeds for storage.

Control:

Ants, aphids, termites, grasshoppers



Ants



Aphids



Termite



Grasshopper

Amaranthus

Extract the juice from 1kg of leaves (1 kg is about one plastic shopping bag full of leaves). This can be done by cutting the leaves and then pounding them with a stone. Then mix this juice with 3 litres of soapy water and spray.



Control:

Various spotty diseases caused by fungi such as leaf spot and blight.

Wormwood (Lengana/ Umhlonyane)

Cut up the leaves into water (1:4) and stand for 2-7 days before using. Add some soap to the mixture.

Snail



Control:

Insects in general and snails.

Blackjack

Cover a cupful of seeds with water and boil for 10 minutes, or let it stand overnight. Add 1 litre of soapy water and spray.

Whitefly



Mites



Termite



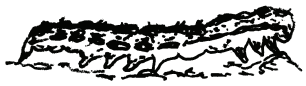
Control:

Insects in general; aphids, ants, beetles, caterpillar, cutworms, mites, termites and whitefly.

Chilli



- Chop up one cupful of hot red chillies.
  (Be really careful not to rub your eyes!)
- Add 2 litres of water.
- Either leave this to stand in the water for 2-3 days or boil for 15 minutes.
- Add half a cup of soap shavings and mix until this has dissolved.
- Filter the solution to remove the pieces of chilli.
- During dry weather, apply once a week.



Caterpillar

This mixture can burn the leaves of plants if it is too strong!

Control:

Caterpillars, aphids and ants.

Garlic and onion



Crush 3 big bulbs of garlic (or 1-2 onions) and soak them in 2 spoons of cooking oil or paraffin for 2 days. Filter and mix with 1 litre of soapy water. Dilute this mixture 1:10 with water and use as a spray.

Control:

Insects in general: aphids, mites, wireworms, termites and ants. Diseases such as leaf spot, blight and damping off. Examples are bean rust and tomato blight.



Ants



Aphids



Termite

Marigolds

Use the whole plant. Take 2-4 plants and crush the leaves, roots and flowers. Pour on 1 litre of boiling water and soak for one day. Then add 1 litre of cold soapy water and spray this on your plants. The coarse plant materials remaining behind can be used as mulch around your plants.



Control:

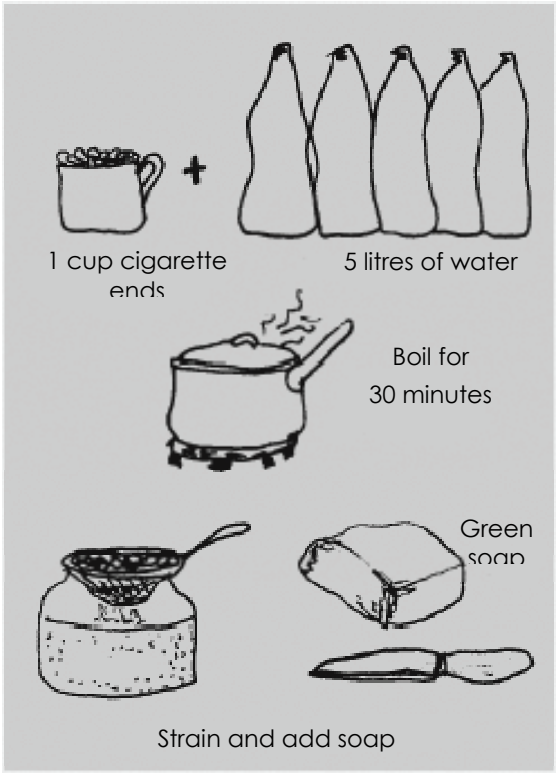
Insects in general: ants, aphids, beetles, stalk borer.
Disease in general: leafspot and blight (early blight and late blight).

Tobacco



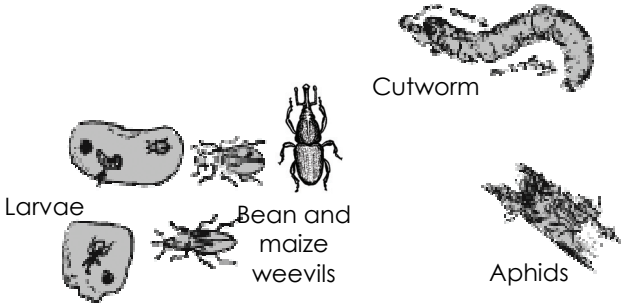
WARNING: Tobacco is very poisonous to all insects and to people. Be very careful with these preparations.

- Take 2 handfuls of dry leaves or cigarette ends. This is the same as one cup full.
- Add 5 litres of water and boil for 30 minutes. Filter. Then add soap, mix and let your remedy cool. Apply once a week.



Control:

Cutworms, caterpillars, aphids, flies and weevils.



Organic remedies

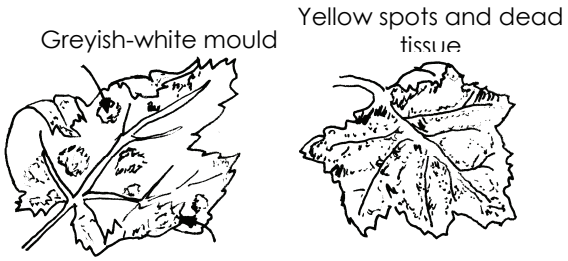
These remedies are made from organic materials, not from plants. Some examples are given below:

Wood ash

- Mix one heaped spoon of wood ash in 1 litre of soapy water. Leave it overnight. Spray against insects in general.
- Mix one heaped spoon of wood ash in 1 litre of soapy water. Mix in one cup of sour milk and add 3 litres of water.

Control: Mildew on plants and most insects. Also snails, slugs, and cutworm

- Spread the wood ash in a circle around the base of your plants and water it into the soil a bit.



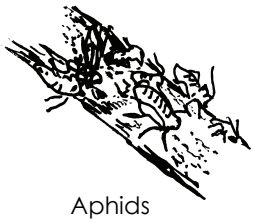
POWDERY MILDEW:

Fine, white floury powder mostly on the upper surface

Flour

Mix one big spoon of flour into 1 litre of water. Brush this on the underside of leaves where mites and aphids are. Apply in the morning of a sunny day.

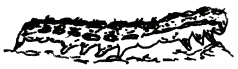
Control:
mites, caterpillars and aphids.



Aphids

Spiders, Mites





Caterpillar

Milk

Spray a mixture of 1 litre of milk and 10 litres of water to control spider mites and diseases such as mildew on pumpkins, blight on tomatoes and potatoes and mosaic virus on peppers. Do this every 10 days.

Liquid manures/compost teas

See Chapter 6, Handout 3; Brews for Plant Nutrition. This explains how to make liquid manures.

- Mix one spade full of compost or manure in 10 litres of water.
- Let this mixture stand for 10-14 days.
- Dilute animal manures 1:4. Use compost tea as is.
- Spray these onto your plants every 7-10 days.

Control:

Generally protects against insect and disease attacks. Can repel aphids, caterpillars, grasshoppers, beetles, mites and cutworms.

4. Wind and frost protection



Shelter belts or rows of different plants and trees grown together can protect your garden from wind and frost. A windbreak/shelterbelt is a physical barrier that we place across the path of the wind. It serves to slow the wind down and to make the negative effects of heat, cold and dust less. Above is an example of such a shelter belt that contains fodder species for livestock; the plants grown in these rows can all be used as feed for goats, cattle, sheep and chickens!! Shown here are cow peas climbing up the trees, napier fodder (grass), pigeon pea (the small tree) and Acacia karroo. These plants are also good for improving your soil fertility. The leaves of all these plants can be used as mulch. The leaves can also be included as green material in compost. They can be used in the making of trench and keyhole beds.

Wind protection

The movement of air is important to plants. It prevents diseases caused by too much moisture/wetness and lack of air. It also helps to spread pollen (which is necessary for fruit production on some trees and plants) and helps plants to seed themselves.

Wind can affect your plants in negative ways:

- Strong winds can blow over or break your crops and trees
- Dry winds cause the soil and plants to dry out.
- Very hot or cold winds can destroy crops.
- Dust carried by the wind scratches plants like sandpaper.
- Wind can also cause soil erosion, especially in the dry months. Your topsoil can be blown away by the wind, leaving you with the less fertile subsoil.

Where to place a windbreak

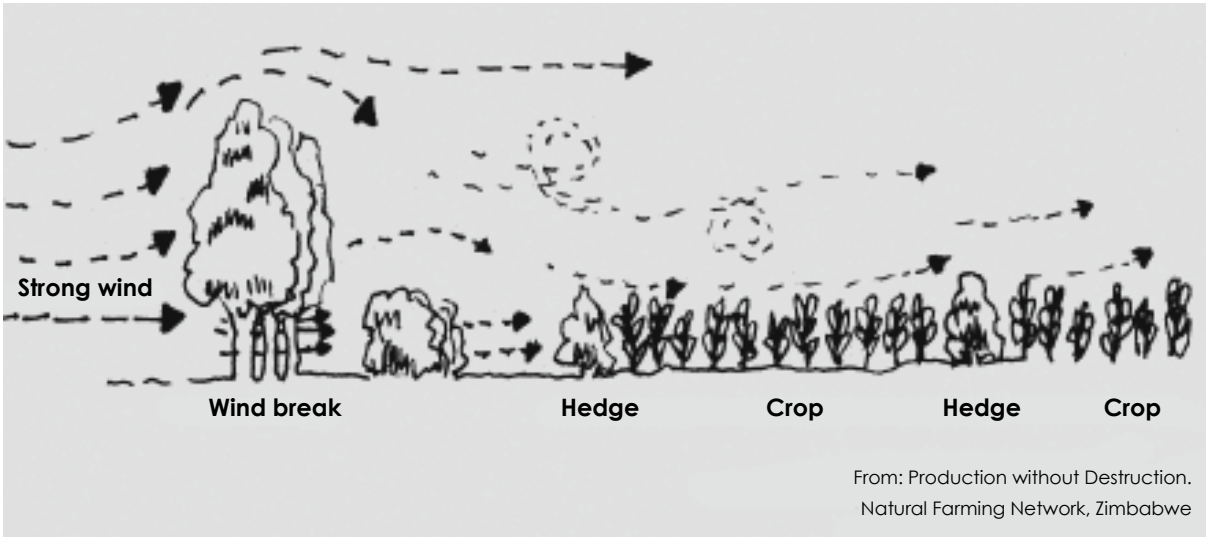
Windbreaks are planted across the path of the main hot, cold and dry winds in your area. Windbreaks are good around homesteads. They can also be planted along roads and paths and also as boundaries around your fields and gardens.

Some extra advantages of windbreaks

- Can provide firewood
- Can provide fruit
- Can be thorny for protection
- Can provide fodder for animals
- Can provide medicine

How to make a windbreak

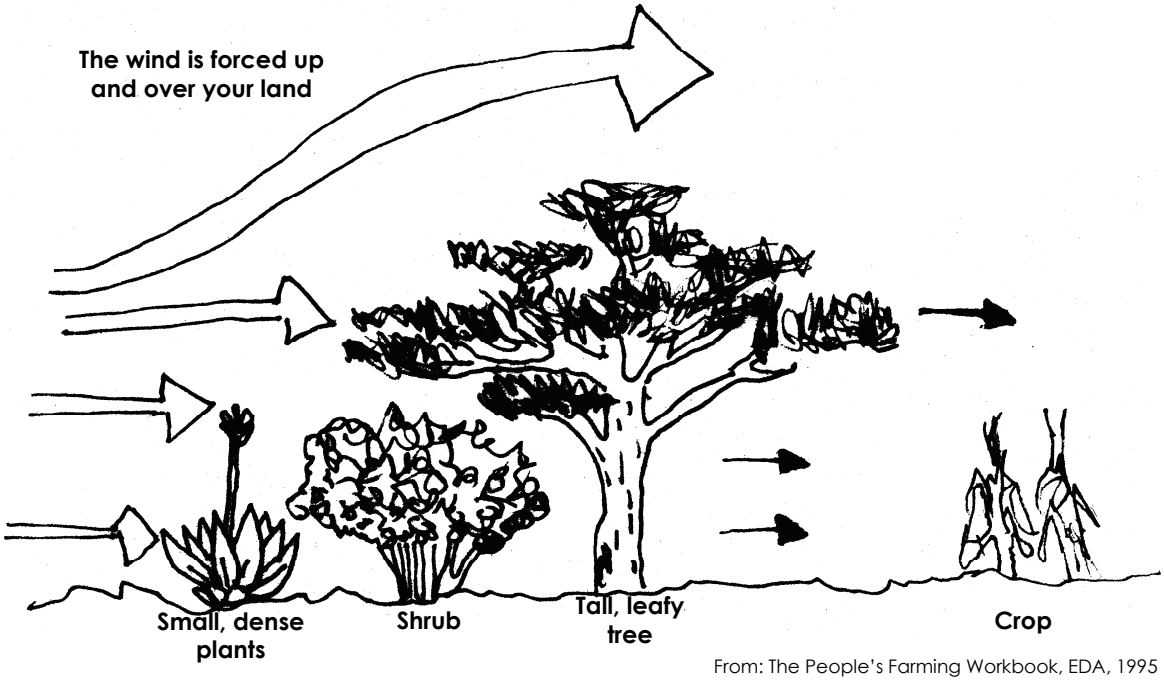
It consists of rows of trees and shrubs, usually of various kinds and heights. They are planted as a semi-solid barrier. This means that some air can still move through the windbreak, but it will be slowed down. The best windbreaks consist of at least three rows of shrubs and trees of different heights.



From: Production without Destruction.
Natural Farming Network, Zimbabwe

The trees and shrubs can also be planted in 1 or 2 rows. If you can, make sure that branches and leaves still grow close to the ground. With tall trees only, the lower branches die back over time. The wind will then "tunnel" past these bare stems and damage your crops. The shorter shrubs and plants can be planted on the side the wind is coming from as well.

Here are some examples of plants, shrubs and trees that you can use!



From: The People's Farming Workbook, EDA, 1995

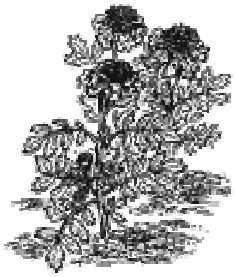
Small plants	Shrubs	Trees
❖ Aloes ❖ Comfrey ❖ Wormwood ❖ Herbs such as rosemary, thyme, lavender, etc. ❖ Marigolds ❖ Fennel ❖ Runner beans ❖ Vines such as grapes and passion fruit	❖ Napier fodder ❖ Pigeon pea ❖ Buddleja or Sagewood ❖ Halleria or Tree Fuchsia ❖ Dovyalis or Kei-Apple ❖ Carrissa or Num-Num ❖ Euclea or Blue Guarri	❖ Casuarina or Beefwood ❖ Acacia or Sweet thorn ❖ Mulberry

More about some of the suggested small plants, shrubs and trees

Aloe

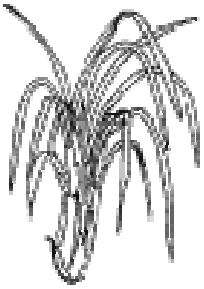
These are good for protection as they often are thorny. They also provide some protection against fire, as the leaves are fleshy and hold a lot of water. They can be used for medicine. A good kind to use is Aloe maculata. This is a low growing aloe with white speckles on the leaves. The gel in the leaves is very good as a medicine for constipation and contains a trace element known as selenium. Selenium is a very important supplement for your immune system.

The aloe often grown around homesteads, Aloe striatula, which has long, thin leaves, can be a bit invasive.



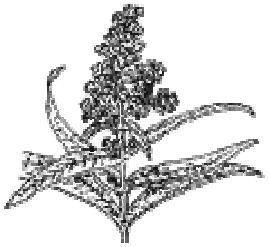
Marigolds and Fennel

These are small strong smelling plants that help to protect your garden from insect attack. The white umbrella-like flowers of fennel help to attract insects (predatory wasps) that eat the pests in your garden (worms and aphids). Marigolds can be used to make a poison that will kill small worms (nematodes) in your soil.



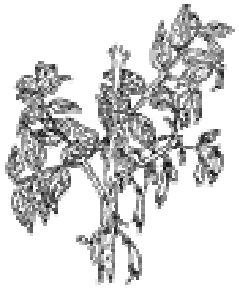
Napier fodder

This is a tough, hardy fodder grass that can be used for hay and silage. It is also good for mulching. It grows fast. It is propagated by taking small rooted clumps from a "mother" plant. It is also possible to lay the canes/grass stems in shallow furrows. These will grow from the nodes/notches in the stem. In cold areas the plants will die back in winter (the dry leaves remain as a windbreak). They will re-shoot in spring.



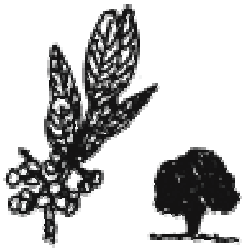
Buddleja salvifolia; Sagewood; Lelothwane

These are tough, fast growing, evergreen shrubs. This means they do not lose their leaves in winter. They are frost resistant. They will need to be protected when young, but are robust when older. The flowers attract birds and bees. The leaves can be used as tea or as a medicine for eye complaints.



Halleria lucida; Tree fuchsia; Lebetsa

This is a shrub, but can also grow into a small tree. It grows up to about 3-10metres high. It has multiple stems that can be cut for firewood, garden stakes and fencing. It has tubular orange/red flowers that attract birds and bees. The fruit is edible.



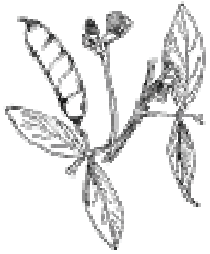
Euclea crispa; Blue guarri; Mohlakolo, Motsoetla

This is a shrub or bushy evergreen tree that grows between 1 and 5 metres high. It has small, black pea-like berries that are edible. It grows wild in some places.



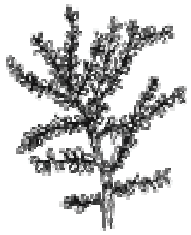
Carissa bispinosa; Num-num

This is a branched, spiny evergreen shrub. The leaves are small, shiny and thick. Fruit are small oblong red berries that are good to eat and for making jams.



Cajanus cajan; Pigeon Pea

This is a small tree that is native to Africa. It fixes nitrogen in the soil and has deep roots. It can be used for firewood. It is frost tolerant, but needs to be protected when young. The young leaves can be eaten as spinach and the seeds are eaten as beans or "dahl". The leaves are also good fodder for animals; especially cattle and goats.



Dovyalis caffra; Kei Apple

This is a very thorny small tree with fleshy leaves. It makes a good protective hedge. It grows a bit slowly. It is resistant to drought and frost. It needs to be protected from frost when young. The fruit is good to eat and can be made into jams and jellies. The flesh needs to be washed off the seed before planting.



Mulberry

These are large deciduous trees. This means they lose their leaves in winter. The leaves are good animal fodder. The small black berries are very sweet and can also be used for making jam. Mulberries are easy to grow from cuttings. They can be pruned and these branches can be used for fences, stakes and firewood.

It is possible to plant fruit trees together with some of the trees and plants mentioned here. This helps to protect your fruit from pest attack and wind and frost damage. On the right is an example of a peach tree planted with runner beans, marigolds, fennel and Pigeon Peas. Different combinations of plants can be used.



Runner beans Peach Pigeon pea



Casuarina Cunningham; Beefwood

This tree originally comes from Asia and Australia. It is a large shady tree with leaves that look like pine needles. It grows very fast and can grow in poor soil. It provides good timber and firewood. It can be planted easily from seed. It is moderately frost resistant and should be protected when young.

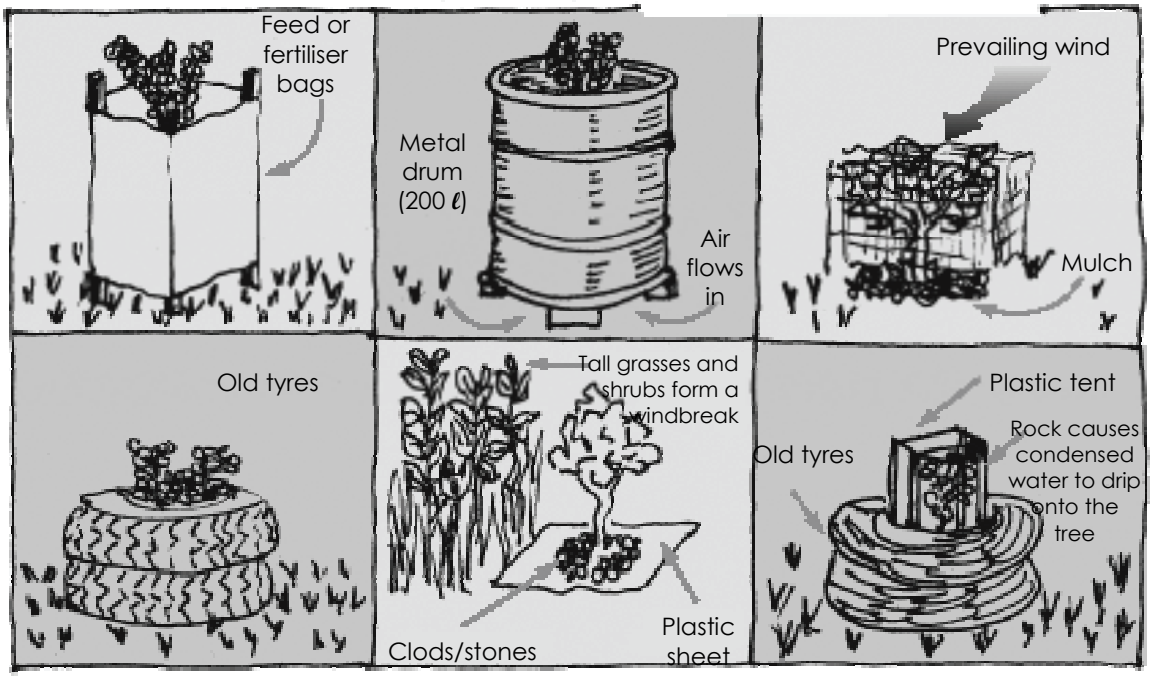


Acacia karroo; Sweet Thorn

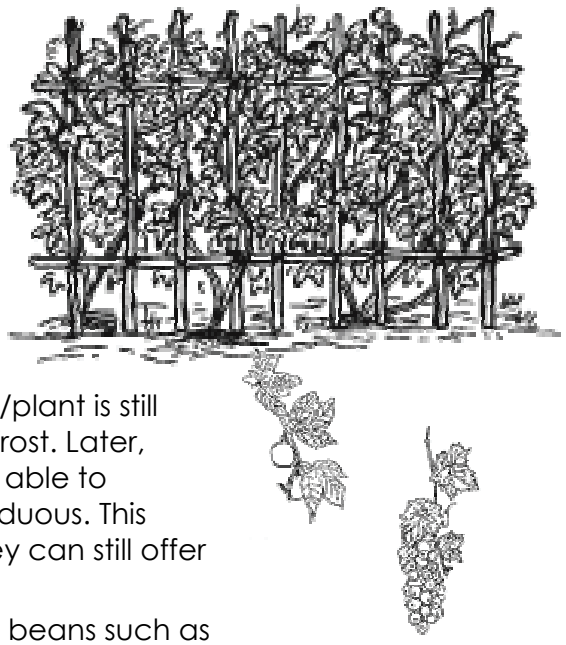
These are very hardy, fast growing, very thorny trees. They are frost and drought resistant. They fix nitrogen into the soil. The tree provides good firewood. Leaves, flowers and pods are good animal fodder.

It may be difficult to find some of the plants described above. They will also need some water when they are young and some protection against frost. Below are some examples of how you can protect individual trees and plants in your windbreak.

From: Introduction to Permaculture



You can also use other materials as small windbreaks around your garden:



- A fence made of many thin sticks can help. You can use old maize stalks or even black jack stalks.
- It is also possible to grow vines or creepers on a fence to give more protection. It may be difficult to find vines that are highly resistant to frost. Passion fruit or granadilla can take some frost. This is called frost tolerant. It means that if you are expecting very heavy frost and your vine/plant is still young it will need some protection from the frost. Later, when the plant is older and stronger it will be able to tolerate the frost better. Other vines are deciduous. This means they will lose their leaves in winter. They can still offer some protection.

  Examples are: Grapes, Kiwi fruit and climbing beans such as

lima beans, seven year beans and red runner beans.

- Bundles of thatch grass or maize stalks can be tied to the fence, across the path of the main winds.
- Animal feed sacks or plastic orange pockets can be sown together and sown onto the fence to provide a screen.

Experimentation



You need to decide how much you need a windbreak and what it should be made from. Growing rows of plants and trees will take a few years, but it is the best kind of windbreak. It can also provide fruit, food for animals and firewood.

But perhaps you only need a windbreak for your seedlings or a small part of your garden.

You may want to experiment by using a temporary windbreak, like animal feed sacks sown onto a fence. If you do this, it will be hard to have a control for your experiment, because there will be nothing that you can compare your experiment with. But you may be able to see some differences between having a windbreak and not having one.

Questions to think about:

- Do your plants seem healthier because they have not been bent and damaged by wind?
- Do you have to water less because the wind has not taken so much moisture from the soil?
- Do you think you have put your windbreak in the right place? Is it in the path of the wind? Should it be closer or further away from your garden?
- What have been the advantages and disadvantages of a windbreak? You may want to make a list. But remember, some advantages might be hard to see at first. Maybe you are watering your plants less, or there is less soil erosion. (Mulching is also a good way of stopping soil erosion.) Other advantages of growing a windbreak are wood for stakes or firewood, fruit and natural pest repellents that you get from them.
- What will you make your windbreak from? If you are going to use plants and trees, which ones will be best? Which ones can you get hold of easily? When they are fully grown, will they give rows of protection to stop the wind getting through, like in the picture on page 1? Think about how tall each will grow and whether it will loose its leaves in winter or not. Will the wind be able to get through? You need to plan your windbreak carefully.

Frost protection

Frost is like cold water, as it flows downhill and collects in the lowest points. This freezing air is usually less than 1m (the length of a spade) deep. It is coldest closest to the ground.

Early frosts are usually only ground frosts. That means that the temperature only goes below freezing at ground level, but not at, say, 30 cm (the width of a spade) above ground, so only tiny seedlings will be damaged. Fully grown plants like peas, especially if staked, will survive. But later frosts will be air frosts, which means that the temperature drops below freezing at even 1,5 metres above the ground, thus affecting all crops. These are the killer frosts and are usually seen as coating everything with a crust of ice instead of dew.

Crops damaged or killed by frost	Crops affected by frost	Crops that can withstand Frost	
tomatoes green beans peppers sweet potatoes chillies pumpkins	leaves of potatoes (but not the plant, which can re-grow) young peas (the flowers and pods)	spinach swiss chard some mustards carrots beetroot lettuce onions	broad beans cabbage kale turnips garlic leeks

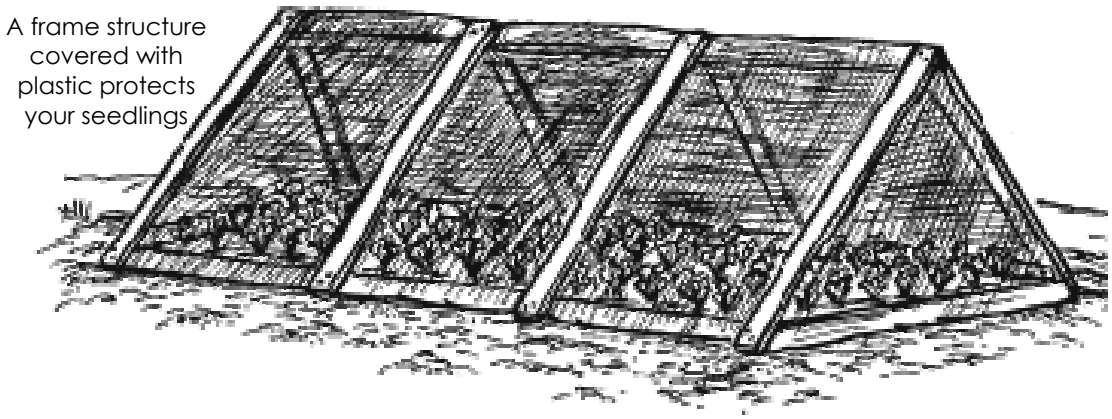
Dealing with frost

The only real way to deal with both kinds of frost is to protect your plants. There are a number of ways you can do this. All of them will need you to plan in advance. Some may even need you to design your garden in a different way.

1. Covering your sensitive crops

For the early frosts, you can cover your sensitive young plants with anything you can find which will act like a thin blanket. You can use grass, newspaper weighed down with stones, or old onion and orange pockets tied together. You can also use old livestock feed bags. It is possible to buy frost cover from your local nursery or Co-operative. This "cloth" is not very expensive and works very well. It can just be draped over your beds and pegged down using clothes' pegs. Make sure to put this "blanket" over your plants in the late afternoon.

It is also possible to cover your crops with structures made from greenhouse plastic or netting, placed over a wooden frame. This will protect your crops also from the severe winter frosts. One can buy shade cloth or special netting to deter frost from a garden centre or agricultural cooperative. This however is quite expensive.

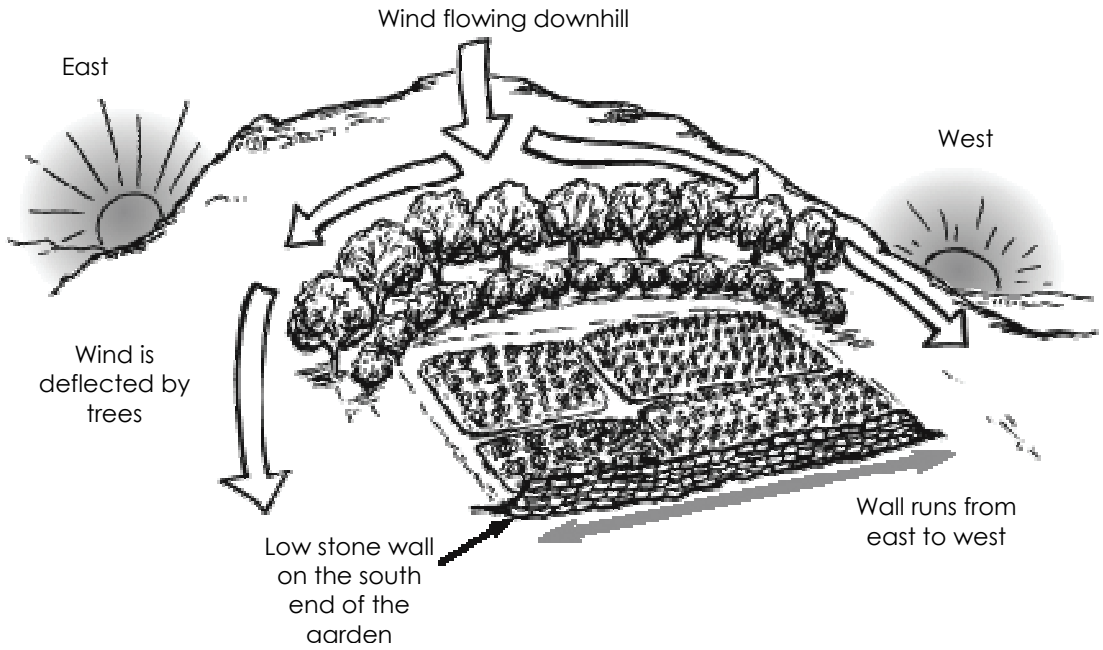


2. Siting/placing your garden

The best place to have a garden is on the top part of a north facing slope. It will get the most sun and will not be so cold at night as land at the bottom of a slope.

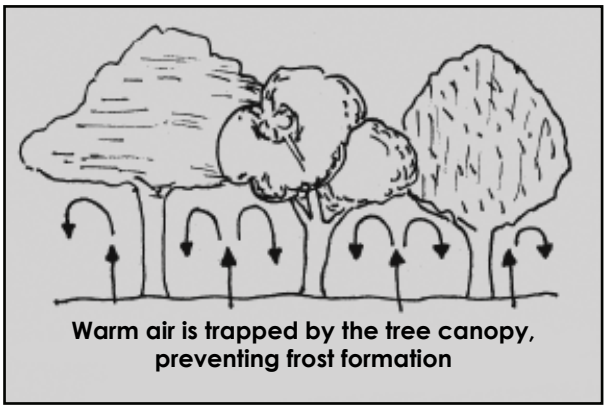
If your land is on a slope, put plants which may be affected by frost at the top of the slope.

A low wall of stones, built roughly east-west across your garden and on its southern edge will catch the sun during the day and warm up. It will then act like a stove at night giving off the day's heat.



3. Hotbeds

These will help in autumn and into winter. Put soil back on top of a trench full of rotting weeds, grass and manure and then plant on top of that, keeping the whole bed well watered.



Warm air is trapped by the tree canopy, preventing frost formation

4. Trees and bushes

Trees and bushes help to prevent frost by trapping the heat as it is lost from the ground. They will also radiate some heat into the air at night.

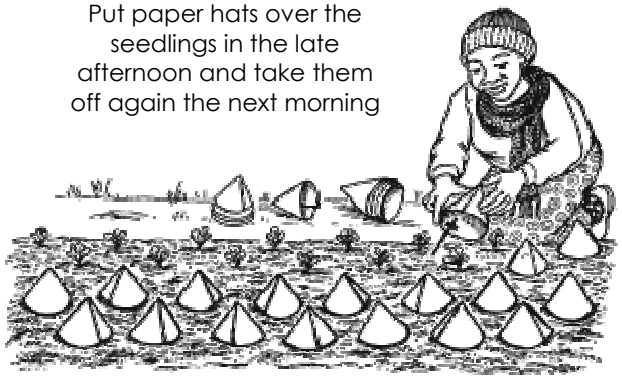
5. Movement of water and air

If there is a lot of water on and around your plants, it is sometimes less likely that frost will form. You can try watering your plants well, late in the afternoon. This will sometimes reduce the amount of frost formed on your beds and plants.

You can also make little conical hats from paper for each seedling. This involves quite a lot of work, but may be worthwhile in protecting sensitive plants and seedlings.

Then, it can also help to water the frozen plants in the morning early, before the sun comes up and heats up the environment. This reduces the damage to plants that have been frosted.

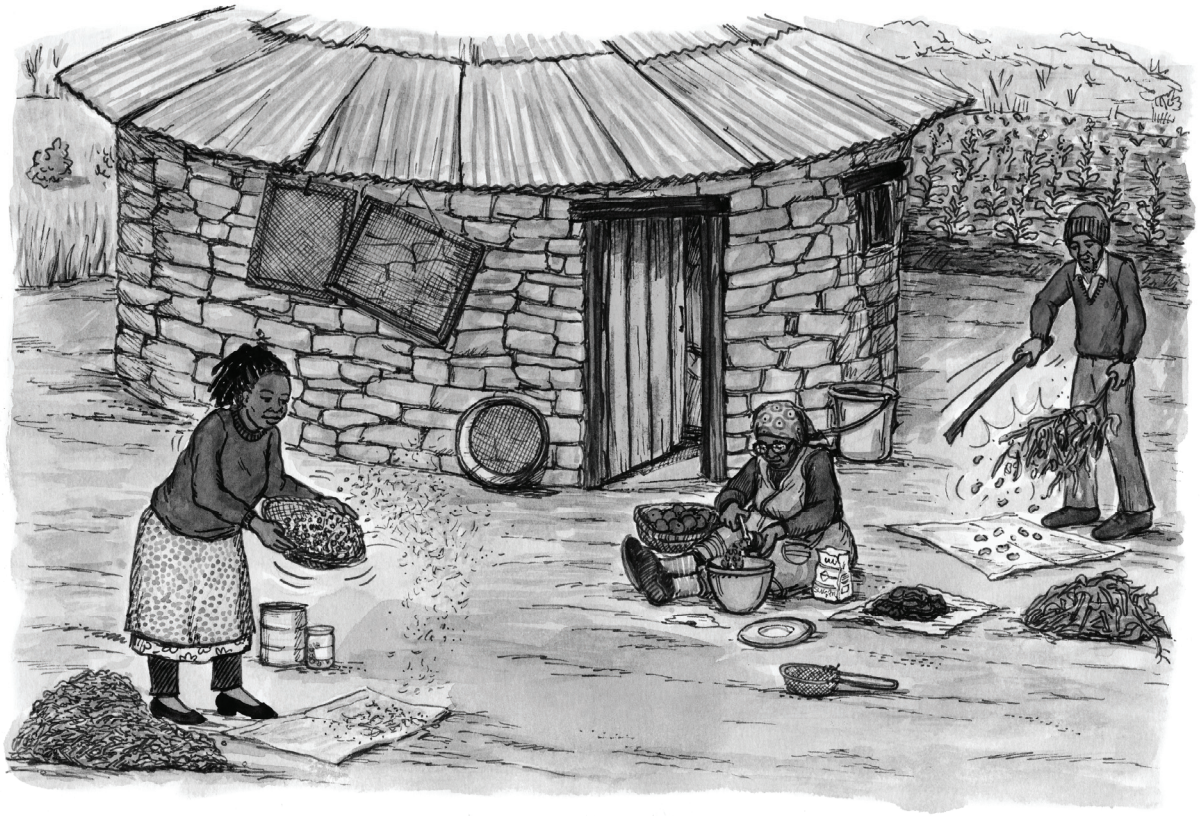
Put paper hats over the seedlings in the late afternoon and take them off again the next morning



Some people make fires in their gardens at night. The movement of the air reduces the settling of frost on plants.

If you have a nice big rock that faces the sun, you can use this as a "heater" for a small seedling bed. Make the small bed in front of the rock. Make a small structure of wattle sticks around your bed. Then drape some clear plastic over your structure. It is easy to get large pieces of plastic from furniture shops in the area. This will create a small "greenhouse" for your seedlings. It will be much warmer inside the structure than outside.

5. Seed saving



Keeping your own seed is central to your independence as a farmer. You can choose which crops you like and which varieties or types of crop. You do not need to go to the shop to buy seed.

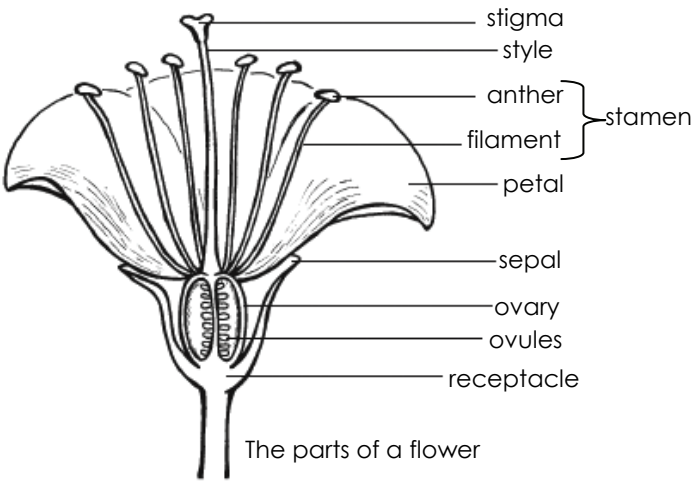
There are still many varieties of seed that farmers keep or that you can buy from a shop that you will be able to keep for yourself once you have grown the crop.

Growing from seed to seed involves germinating seeds, transplanting seedlings and looking after selected healthy plants until they mature, so that their seeds can be collected and stored for the following year.

Plants adapt to the environment they are grown in and produce seeds that carry those adaptations, producing healthier plants better able to cope with the local environment.

Pollination

Pollination occurs in plants when pollen from the male parts of the flower (stamen) is deposited on the female parts (stigma). Fertilisation occurs when the pollen grain reaches the ovum (egg).



The parts of a flower

In some vegetables, herbs and flowers, the male and female part is in the same flower. These are called **complete flowers**.

Exceptions are:

- The cucurbits such as pumpkins, melons, gourds and cucumber and maize. Here the male and female parts are on different flowers, but on the same plant.

- Asparagus and papaya. Here male flowers are on one plant and the female flowers on another.

'Open pollinated' vs 'Hybrid' crops:

Originally all crops were open pollinated. Many plants propagate themselves like humans do. Pollen from the male parts of flowers needs to reach the female parts of the flower. This pollination usually occurs through wind or insects of various kinds: mostly bees.

Hybrid crops have been cross pollinated by humans in a controlled environment. These are crops that will NOT NORMALLY CROSS. This means that you cannot keep seed from a hybrid plant. The seed will either be sterile, or will produce many surprises. The plants grown from hybrid seed will not look like their parents and often are not very strong.

You know that a packet of seed contains hybrid seed when it has a sign on it that says: F

Self Pollination

Here, pollen is transferred from the male to the female part of **the same flower**.

Crops that self-pollinate are: tomatoes, lettuce, capsicum (green pepper) and okra. Beans and peas self-pollinate even before the flower has opened.

Generally, plants that self-pollinate can be grown quite close together without them crossing with each other. It is still a good idea however to separate different varieties of the same plant (e.g. different varieties of lettuce) from each other, as some crossing can still occur.

Self pollinated crops:

Green beans, dry beans, cow peas, peanuts, peas, tomato, lettuce and capsicum (green pepper)



Cross Pollination

Here, pollen is transferred from one flower to another on the same plant, or to the flower of another plant of the same type. Cross pollinated plants produce more varied offspring that are better able to cope with a changing environment.

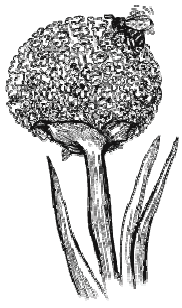
Cross pollination occurs when the pollen is carried between flowers by the wind, bees, other insects, birds and bats. Honey bees are by far the most important pollinators.

Pumpkins are an example. If you have two different types of pumpkin, planted close together. They will cross with each other. The seed that is produced will grow and produce a plant with a fruit that is a mixture of the two types of pumpkin you have grown. This happens with all cross pollinated crops.

Cross pollinated crops:



Brinjal (eggplant), cabbage, carrot, chilli, kale, leeks, maize, mustard greens, onions, spinach (swiss chard)



Pollinators

Bees are the best pollinators of vegetables. As they fly around and

collect the nectar (sweet juice) from the flowers of plants, pollen collects on the sticky hairs on their legs. When they visit the next flower some of this pollen is rubbed of and cross pollination occurs.

Insect pollinated crops:

Brinjal (eggplant), cabbage, carrot, chilli, green pepper, kale, leeks, mustard greens, onions, spinach (swiss chard)



Many grains (such as sorghum and maize), grasses (such as Napier fodder and sweet reed or imfe) and trees are dependent on the wind for pollination. Pollen picked up by the wind can travel vary far (many kilometres) on air currents before coming to a rest.

Wind pollinated crops:

Beetroot, spinach (swiss chard), amaranthus (imbuya)



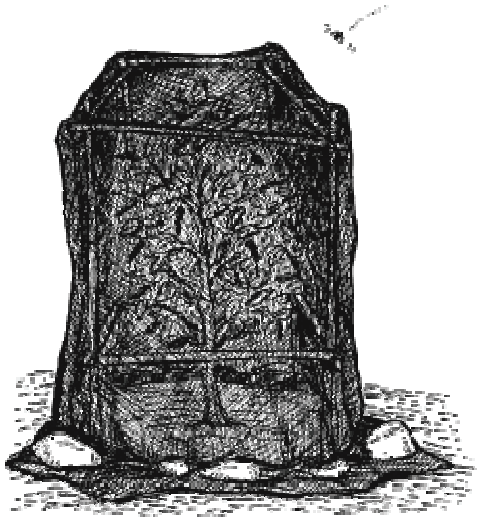
Keeping them pure

Any **insect** or **wind pollinated** plant will need to be isolated from other varieties to stop them from crossing with each other. Below are four techniques you can try to achieve purity:

Grow them apart: Grow two varieties that cross pollinate at least 500 m or more apart. This is how far most insects fly, although bees can fly up to 4 km. Obstacles that deflect wind or insects such as hedges, buildings and ridges can greatly reduce cross pollination.

Isolate them in time: This is possible for crops where all the plants flower at the same time, such as maize and sunflowers. Crossing can be avoided by growing early, mid- and late season varieties that shed their pollen at different times.

Cage them: Caging is needed for species that



Caging of a chilli plant

flower over a long period of time, such as cabbages and chillies. Put cages made of fly or nylon netting over the flower stalks of the different varieties to exclude all insects. Pollinate by hand.

Cage them on alternate days: This can be used instead of hand pollinating varieties that are flowering at the same time. Cage one variety while insects pollinate the second variety. Then cage the second variety while insects pollinate the first one. Once they have been pollinated, both varieties should be caged until flowering has stopped.

Selecting and collecting seed

How long does it take?

You should harvest seed from at least six (6) plants of each variety or type that you want to keep. For some crops, such as onions, you need to keep seed from at least 20 plants and for crops such as sunflower and maize you need seed from 50-100 plants. In multi-coloured maize you may lose some colours and insect resistance if too few plants are used.

Annuals:

These plants produce their crop and seed within one year and then die. This takes 6-9 months. Examples are tomatoes.

Biennials:

These plants grow during the first warm period, slow down through a period of cold weather, and flower and seed during the second warm period. Most biennials originate form the colder European climates where winters are severe and there is not enough time for a plant to produce seed in one warm season. This takes around 18 months. Examples are cabbage, cauliflower, carrots, parsnips, turnips and radishes.

Perennials:

These plants continue to grow, are permanent and survive from year to year. Few vegetables fall within this group. Examples are fruit trees and herbs such as comfrey, rosemary and thyme.

Criteria for selecting seed

- The seeds should possess the same quality as the variety that was planted. If you planted a long, purple brinjal, collect seed from a long purple fruit. If the fruit looks different, the seed will also be different.

- Take out plants with undesirable characteristics before they start flowering. Examples are slow growers, sick/diseased plants or ones that bolt (start seeding) too early.

- Harvest seed only from strong, good looking plants.

- Harvest seeds from plants that perform well under stress such as extreme weather conditions and plants that resist disease or insect attack.

- Harvest seed only from healthy plants; if the leaves or fruit have rotten spots or a mottled appearance, do not use seeds from these plants. These diseases are carried in the seed and will appear next time.

- Do not harvest seed from plants that have bolted. Bolting is when the plant goes to seed much quicker than it normally should. It could be due to stress, such as hot and dry conditions, but is also in-built. So if you take seed from plants that have bolted you are selecting for a plant that bolts, or goes to seed very easily. This is important for crops such as mustard spinach and lettuce where you are looking for a prolonged leaf stage.

- Harvest the seed when it is ready. Immature seed will usually not germinate as it has not fully formed. Over-mature seed tend to go rotten before you plant them.

- Do not harvest seed that has been damaged by insects or in any other way. They can only germinate if they are whole.

- Do not harvest seed that have diseases, such as brown blotches or mould growing on them.

How to know where to find the seed?

Seed heads

Some plants carry pods which contain the seed, like beans and peas. These are called **legumes**. They are mostly self pollinating, so you do not need to be too careful in separating different varieties.



Beans

Leafy crops like lettuce and swiss chard will send out stalks from the middle of the plant. The flowers and seeds will be produced on these stalks.



Cabbage

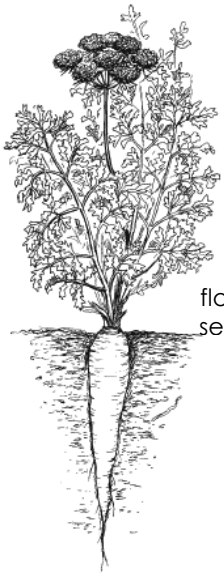


Brassicas (the cabbage family) will first make a head, or compact leaves. Examples are cabbage, cauliflower, broccoli, kholrabi, kale, chinese cabbage and mustard spinach. Then, in the next warm season, a flower stalk will grow out and seed pods will be produced on these. This can take up to 18 months.

Lettuce

The cabbage family requires bees or other insects to carry pollen between plants. You need as many plants as possible to collect seed from (at least 6, but up to 20). One plant on its own will produce hardly any seed. Brassicas can cross with any member of the family. A cabbage can cross with a cauliflower or a broccoli or chinese cabbage!!! It is important to isolate different members of the cabbage family to obtain seed.

Root crops like carrots: With this type of root crop, the bulb will start to go woody and harder and send out a long stem on which flowers and seed will develop. This will take about 9 months. Wasps and flies carry pollen from one "umbel" to another or from one plant to another. Other crops in the **Umbelifferae** family (umbrella shaped flowers), behave in a similar way. Examples are celery, parsley, fennel and parsnips.



Carrot plant – flower and seed head



Onion plant and seed head

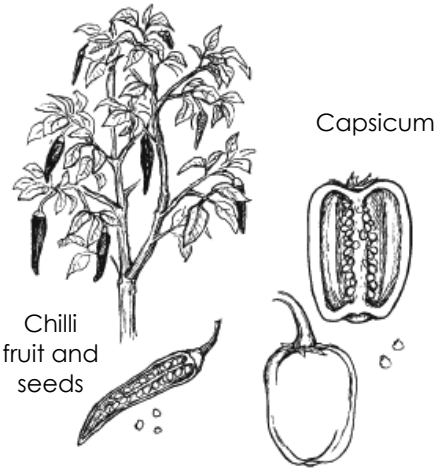
Root crops like onions: With this type of root crop, the flowering stalk develops in the second warm season, as the crop is biennial. This stalk is leafless, hard and hollow, and can grow very tall.

Other plants in this family (**Amaryllidaceae**) are leeks, shallots, garlic, spring onions, chives and garlic chives. These plants are pollinated mostly by bees. Pollination occurs between the little flowers on the same flower ball and between flowers from one plant to another. Seed from at least 20 plants needs to be kept to keep the variety strong. Seeds don't all ripen at the same time and they need to be harvested as they become ready, as they tend to shatter and are blown away by the wind.

Leave these seeds on the plant to dry. For those plants where the seed heads shatter and scatter seeds, you will need to collect them as they dry, rather than waiting until all the seeds are ready. Examples are lettuce, carrots, parsnips and onions.

Seeds in fruit

Fruit is produced only after the fertilisation of the ovules has taken place. These ovules develop to produce the seeds inside the fruit.



Capsicum

Chilli fruit and seeds

- **Fruit** is picked when it is slightly over-ripe.

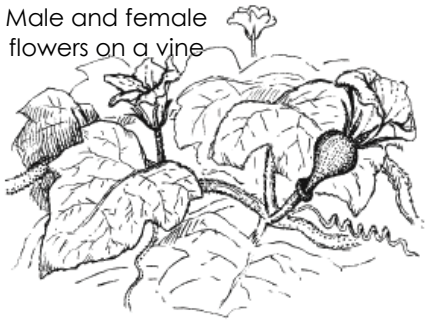
Examples are tomatoes, chillies, capsicums (green peppers), gooseberries and brinjals.

Tomatoes and capsicums are self pollinating. The other plants in the Solanaceae family like chillies and brinjals are cross pollinating. If you are growing more than one variety of chilli, they need to be isolated from each other. Otherwise you may get some HOT surprises!

Pumpkins, melons, gourds and squashes are picked when over-ripe and then left for a few more weeks for the seed to mature further. There are many different kinds of pumpkin and melons. All different kinds of pumpkins will cross with each other, but they will not cross with melons, cucumbers or marrows which are all in the same family (Cucurbitaceae). In this family there is crossing in each species, but not between them. A cucumber for example will not cross with a pumpkin.



Male and female flowers on a vine



In this family, plants have both male and female flowers. The male flowers grow on long thin stems and open before the female flowers, which grow on a short stem and have a small swelling at the base.

- Cucumbers and marrows are left on the plants until they are fully mature; cucumbers will go brown and marrows will go yellow (and VERY big!).

Seeds that are eaten

Examples here are maize, beans, peas and sunflowers. These are left on the plants until they are mature and dry.

How to know when your seed is ready?

- The fruit has a **hollow sound** and/or is **disconnected** from the branch. *Examples:* pumpkins, cucumbers. For these fruits it also helps to leave the seed inside the fruit for several weeks after picking.
- **Colour, size and shape** of fruit. *Examples:* tomato and chillis (red), aubergines (purple or yellow). Green peppers need to be left until they go red. They are immature when green!!!
- **Shattering** of pods. *Examples:* beans, peas, cowpeas.
- **Dryness**. *Examples:* carrots, coriander, lettuce, swiss chard, cabbage (seed head goes brown and dry).

Cleaning seed

Winnowing

Chaff and stems need to be removed from seed, as they can hide insects that can attack your stored seeds.



- Seeds and chaff are tossed into the air and the chaff is wafted away with a gentle breeze. Elongated flat baskets work well.
- Or put the seeds in a bowl and shake them until the debris floats to the top. Gently blow the chaff away.
- Large quantities of podded seeds (peas, beans) can be placed in a sack and the seeds separated by stomping on the sack or beating it with a stick. The dried empty pods can then be winnowed out.

Wet cleaning

This is used for plants that **carry their seeds in moist flesh or fruit** such as tomatoes, melons, pumpkin and cucumbers.

- Scoop the seeds out into a large container of water and rub vigorously. Pour off the water and place seeds on a flat surface to dry.
- Ferment the seeds of tomatoes and cucumbers. These seeds are encased in the flesh of the fruit and have a slippery jelly around them. This jelly needs to be removed before the seed will germinate. It also rids the seeds of unwanted seed-borne diseases.

Method:

Place the seed in a container. Cover with water. Add one to two tablespoons of sugar and stir until it is dissolved.

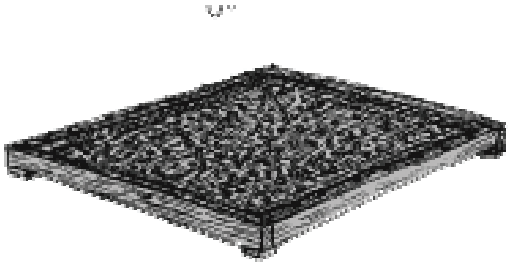


Now leave this mixture for 3-5 days (NOT LONGER!!!). A foam or crust will form showing that the fermentation has occurred and the jelly has dissolved.



Rinse the seeds with large amounts of water.

Spread them out to dry in a cool place and store in an airtight container like a glass jar.





Drying seed

Large seeds need longer to dry than smaller seeds. A simple test for large seeds (such as beans) is to try to bite one of the seeds. If no impression is made on the seed (tooth marks) it is ready.

- You need to dry seeds away from the sun in a dry and breezy, airy place.
- In wet or cold weather, place seed on screens for fly netting and place them high up on racks in a warm room, such as the kitchen.
- Hang up small quantities in paper bags in a breezy spot.
- Lay larger quantities on screens or hang them up in hessian sacks. Do not use plastic bags.



Storing seed

The length of time that seed can be stored depends on:

- The seed type;
- The quality of the seed; and
- The storage conditions.

Storage conditions

Most seed can be stored for a period of 3-5 years and remain viable. **Viability** is the ability of the seed to germinate. Your seed may look perfect, but if it is not viable, it will not grow!

Darkness

Find a way to keep the seeds in darkness. Use paper bags, dark coloured plastic and galls jars and place them in cupboards. DO NOT place the seeds on a shelf in clear glass jars.

Moisture

Even if the seeds are dry, if you store them in a damp environment they will absorb that moisture/water. This seriously affects how long your seeds will be viable. Mostly we can only dry our seeds in the air. Do not dry them in the sun, but in a shady place where the air can move (ventilated). When the weather is very wet with a lot of rain and mist, it will be difficult to dry seeds, especially the larger ones, like beans and peas.

The life of seed doubles when the moisture content is lowered by 1%.

If you store your seed in hot, light (sunny) and wet conditions they will lose their viability very quickly. You may even not be able to plant them in the following season. They like cool, dark and dry conditions to germinate.

Temperature

Seeds last longer in cold, but not freezing conditions. Choose a cold place such as near a river, under trees, under the ground or inside a clay jar.

The life of a seed doubles when the storage temperature is lowered by 5°C.

Pests

Store your seeds in dry, clean, airtight glass jars or other airtight containers. AND LABEL THEM – Give them names!! By next year you will not remember what it was.

Storage weevils, fungi and bacteria shorten the life of seeds.



- Weevils begin to multiply when the moisture content gets high enough (10% or more). The eggs are laid inside the seed, under the seed coat, and the insects hatch from there.
- Storage fungi/ moulds begin to grow when the moisture content is high enough (around 13% or more) and bacteria start growing around (20% moisture). Mostly we cannot measure the moisture content of our seed. All we can do is keep our seed as dry as possible.

Materials that stop the growth of pests can be used:

- **Dry ash:** this absorbs moisture inside the container and also prevents the growth and increase of weevils. Add ½ kilogram ash to 1 kilogram seed.

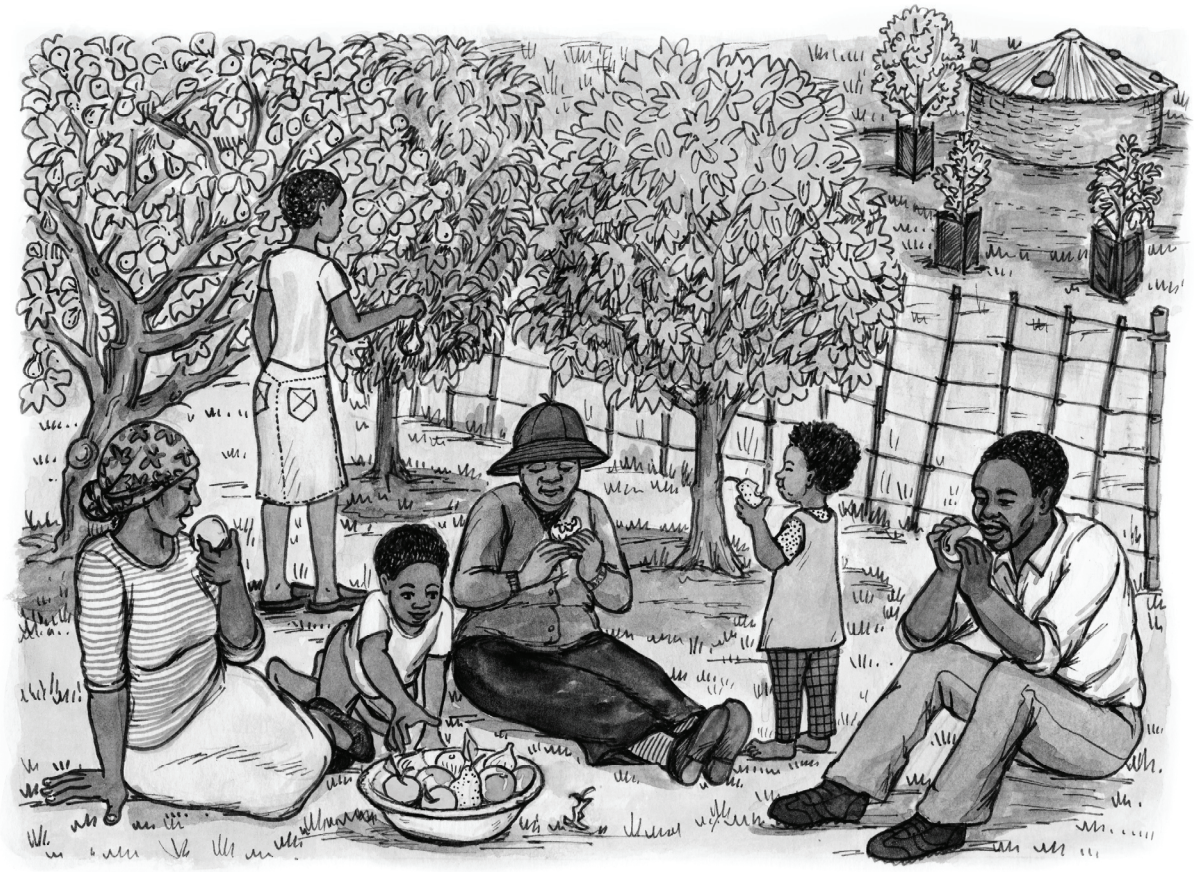
- **Lime:** can be used in the same way as dry ash. Mix 15 teaspoons (50 grams) with every kilogram of seed.

- **Cooking oil:** mix cooking oil with your seeds to prevent increase of weevils. Use only 1 teaspoon of oil for every kilogram of seeds.

- **Dried and powdered leaves of different aromatic plants:** weevils are sensitive to aromatic or strong smelling plants. Try the following:

  - CHILLI: mix 4-6 teaspoons of chilli powder with 1 kilogram of seed.
  - WORMWOOD (MHLONYANE): Dry and crush the leaves and mix with seed. Use 4-6 teaspoons for every kilogram of seed.
  - ALOE: As above.

6. Growing fruit trees



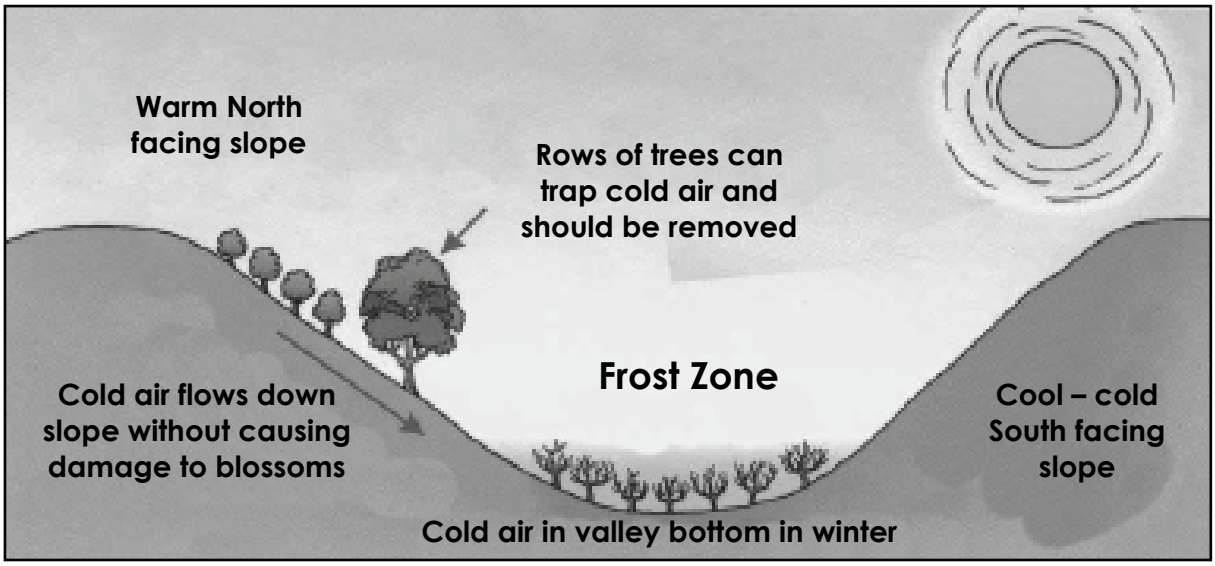
It is possible to grow many different types of fruit trees around your homestead. You can acquire your trees by growing them from seeds or cuttings or buying grafted trees from nurseries.

Choosing a site

Different trees grow better in different climates. The table below will give you some ideas of which trees will grow in your area.

VERY COLD AREAS: Has frost often in winter and sometimes snow	**NOT SO COLD AREAS:** Has frost sometimes in winter and rarely snow
Apples, pears, peaches, nectarines, plums, almonds, grapes, cherries, apricots, pecan nuts and walnuts	Apples, pears, peaches, nectarines, plums, almonds, grapes, cherries, apricots, pecan nuts and walnuts Also: figs, granadillas and citrus fruit (lemons, oranges, naartjies and grapefruit)

Your trees will grow for a long time; so it is important to choose the right place.



You need an area with:

- well drained and deep soil
- that has enough sun (preferably a north facing slope)
- where fruit trees can be protected from wind.



As it becomes colder in Autumn deciduous trees and vines shed their leaves and go into a state of rest. They all need a certain period of cold weather to break this rest. The degree of coldness needed varies for different varieties of trees. In some cases when the temperatures in June/July are not low enough the rest periods are insufficiently broken, which results in a state called "delayed foliation". In spring some buds and leaf blossoms drop of and some branches remain dormant and die back.

The trees do not grow or produce well. It is thus important in warmer areas to choose varieties that do not need very cold winters.

It is also important to know when a tree flowers. Late frost will kill early blossoms on a tree and badly damage the fruit production for that tree. You will need to choose a tree that flowers after the threat of frost has passed.

Choosing a variety

Each type of tree has many different varieties and you will need to choose a variety that is suited to your area and climate.

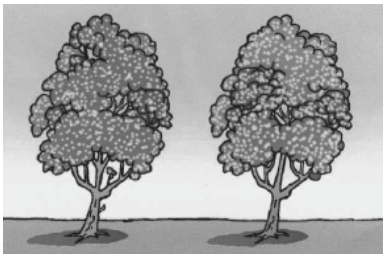
Some varieties grow better in very cold areas and others in warmer areas.

Another consideration for choosing a variety: Pollinators

Here you will need two different varieties of the same type of tree (and two specific ones!) For example; you will need to plant both Granny Smith and Golden Delicious varieties of apples.

- They will help each other bear fruit, as they pollinate each other. The blossom of the one cultivar/variety will need to be fertilized by the pollen of the other cultivar/variety. They need to flower/blossom at the same time and they need to be compatible, so that both types can bear fruit.
- These trees must not be planted more than 30metres apart, so that the pollen can be transported from tree to tree with the help of bees and the wind.
- You can plant 1 tree of one type (cultivar/variety) and 4-5 of the other; depending on which variety you prefer. This means that you can have more of one variety of trees, than another.

Which trees need pollinators?

YES		**NO**
APPLES		CITRUS
PEARS		MANGOES
PECANS		GRAPES
SOME PLUMS		
PAWPAWS		

Different varieties/cultivars you can choose from

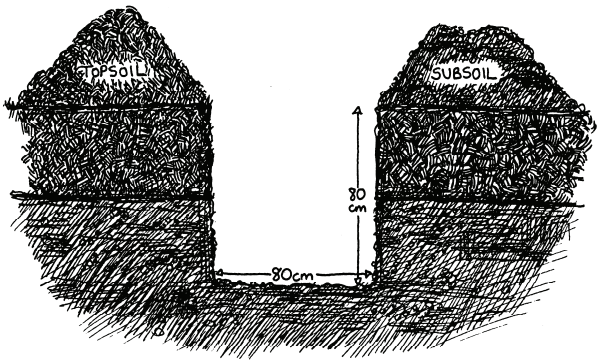
There are many, many varieties and cultivars and new ones are always being produced. It may help to ask the nurseries in your area which varieties are suitable. In the table below some varieties are mentioned to give you an idea.

CULTIVARS FOR VERY COLD AREAS			CULTIVARS FOR NOT SO COLD AREA		
NAME	**POLLINATOR**	**FRUIT RIPENS**	**NAME**	**POLLINATOR**	**FRUIT RIPENS**
APPLES					
Granny Smith; green apple	Yes: Golden Delicious or Starking /Top Red	April	**Granny Smith; green apple**	Yes: Golden Delicious or Starking /Top Red	April
Golden Delicious; yellow	Yes: Granny Smith or Starking /Top Red	15 February	**Golden Delicious; yellow**	Yes: Granny Smith or Starking /Top Red	15 February
Starking/Top Red: Red	Yes; Golden Delicious or Granny Smith	March	**Starking/Top Red: Red**	Yes; Golden Delicious or Granny Smith	March
PEARS					
Packhams; Light green	Bon Chretion and Forelle	Mid February	**Packhams; Light green**	Clapp's Favourite	Mid February
Bon Chretion; Yellow	Self pollinator	March			
Forelle; yellow with red blush	Packhams and Bon Chretion	Early April			
PLUMS					
Santa Rosa: red skin and flesh	Self pollinating	15 December – Begin January	**Pioneer; red skin and flesh**	Self pollinating	20 November
Songold: yellow skin and flesh	Santa Rosa, Laetitia	15 February	**Songold: yellow skin and flesh**	Santa Rosa, Laetitia	15 February
Laetitia; red skin and flesh	Songold	30 January	**Laetitia; red skin and flesh**	Songold	30 January
PEACHES					
Elberta; yellow freestone	Self Pollinating	25 August 1 February	**De Wet; yellow freestone**	Self pollinating	25 July 25 October
Kakamas; yellow clingstone	Self Pollinating	15 August 15 January	**Oom Sarel: yellow cling**	Self pollinating	5 August 15 December
Early Dawn: white freestone	Self Pollinating	15 August 20 November	**Boland; White Freestone**	Self pollinating	15 August 15 December
NECTARINES					
Flavortop; dark red kin, yellow flesh	Self pollinating	20 August 5 January	**Sunlite; dark red skin, yellow flesh**	Self pollinating	5 August 5 December
APRICOTS					
Peeka; Dark orange	Self pollinating	15 September 25 December	**Palsteyn; dark orange**	Self pollinating	30 August 30 November

Planting fruit trees

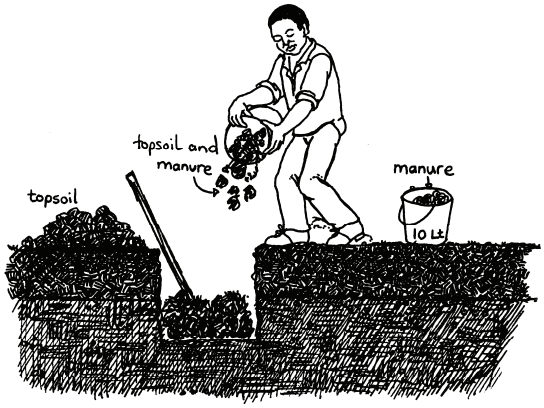
It is a good idea to prepare the planting site/hole a few weeks before you want to plant the tree. The soil will settle in the hole that you dug and the manure will not be too strong for the roots.

Preparing the hole



1. Dig a square hole that is at least 80 cm wide and 80 cm deep. A big hole means a good tree. Put the top soil in one pile and the subsoil in a separate pile.

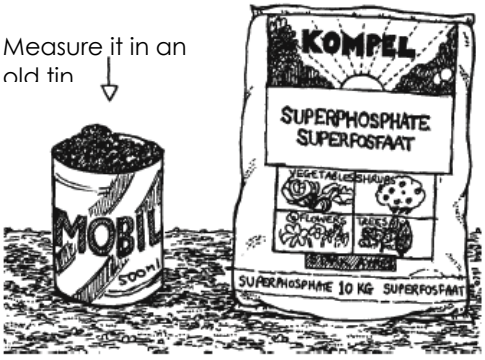
2. Now put 1 bucket (10 litres) of manure in the hole. Mix it with a few buckets of subsoil.



3. Mix in 500 g of superphosphate or 1kg of crushed bone.

4. Next, put in two more buckets of manure and some topsoil and mix them together.

5. Now fill up the rest of the hole with topsoil. You may need to dig up some topsoil from somewhere else.



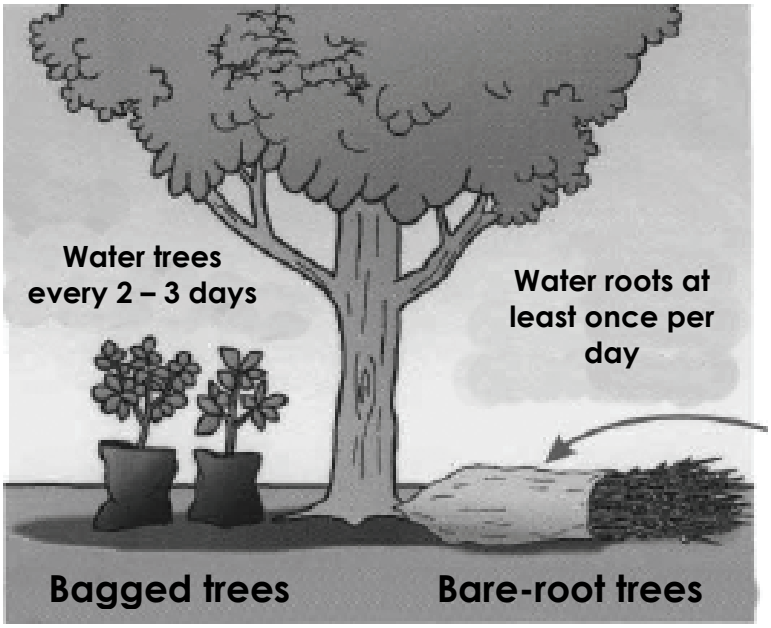
Planting the tree

Caring for the little tree before you plant it

- If it is in a plastic bag, water it every few days.
- If it has bare roots, put moist sandy soil over the roots and wrap it in a wet sack until you are ready to plant it. You can place the trees in a bucket of water for 2-3 hours before planting them.



Place bare-rooted trees in a bucket for two hours before planting



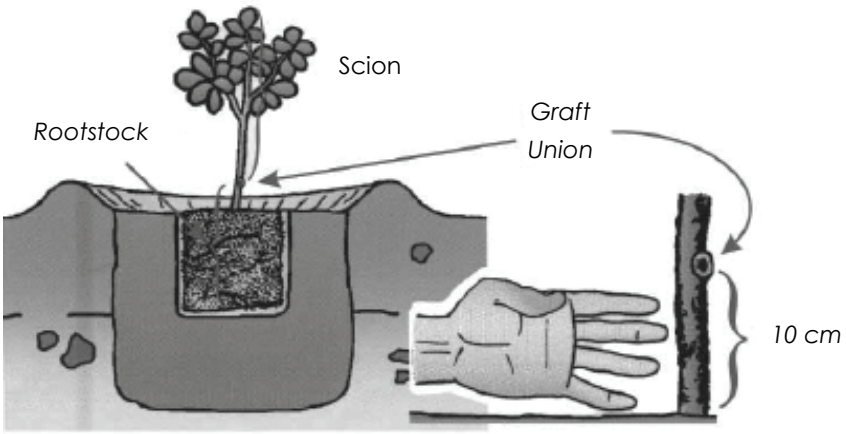
Keep trees in a shady place before planting

Cover the roots with grass, sawdust, or moist sandy soil

Planting a tree that is in a plastic bag

These trees are usually planted in spring and will have leaves on the trees when you plant them. (September-November)

1. Water the tree in the bag without breaking the soil bundle
2. Make a hole in your planting hole (which you prepared earlier) the same size as the plastic bag
3. Take the tree out of the plastic bag
4. Plant the tree and make sure the roots are covered with soil. The planted tree should be the same depth as it was in the bag.
5. The join or graft/union on your tree must be 10cm above the soil level



- Dig the hole the same size as the bag.
- Carefully cut the bag and remove it without disturbing the soil around the roots.

NOTE: Graft union must be 10 cm (hand width) above the soil level

Graft unions:

Wild fruit trees grow in many different soils and climates and have very strong roots. But the fruits from these trees are not very big or tasty. Other trees that are not so strong may bear good, tasty fruit. To obtain a tree with both strong roots and good fruit the roots of the wild tree are joined to the branches of the tree with tasty fruit. The process is called grafting; this is done by cutting the stem just above the roots of a wild tree and binding a branch that has been cut from a good fruit bearing tree. The two trees grow together to form a single tree.

The graft union can be seen as a large lump just above the roots. It should always be above the ground when the tree is planted.

Planting a tree with bare roots

These trees are usually planted in the middle of or towards the end of winter (July-August).

1. Make a hole in the soil you have prepared for planting. It should be a bit bigger than the roots of the tree.

2. Cut cleanly any *broken roots to avoid disease.*

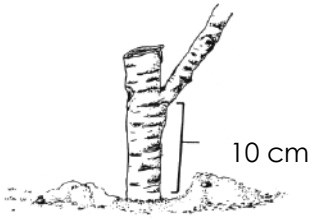


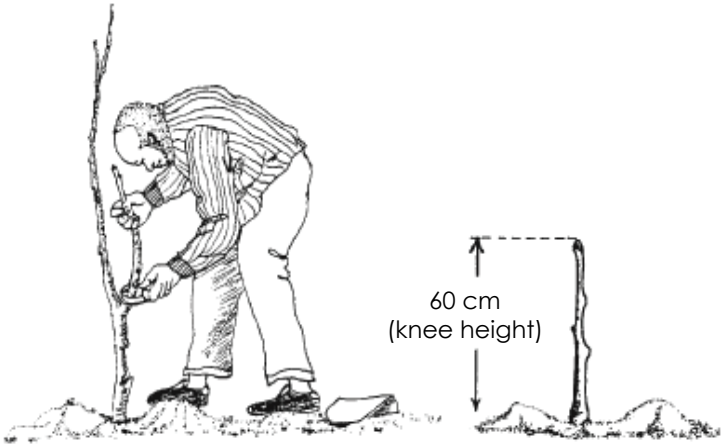
3. Hold the tree in the hole so that it is a little bit higher out of the ground than it was before.

4. Carefully place the soil around the roots. Make sure the soil gets right in between the roots so that there are no air spaces left. The planted tree should be the same depth it was before in the soil.

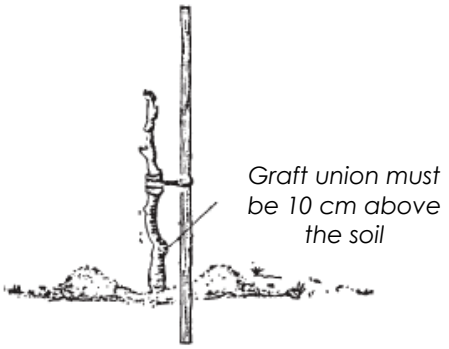


5. The join (bud union) must be at least 10 cm above the soil.





6. Once the tree is planted (bagged or bare rooted), you should prune it. Trees are weak after you plant them, because their roots take time to get used to the new place. It helps the roots to grow strong if you prune the tree after planting. You need to cut off the top and all the side branches.



7. To help the tree grow straight, tie it to a strong stick pushed into the ground.

As the trees grow, they will take up more and more space.

It is important to plant them far enough apart.

Peaches, plums and apricots should be planted 3 paces (metres) apart in the rows and rows should be 5 paces (metres) apart.

Pears, apples and citrus trees need to be 5 paces (metres) apart in and between rows.

Watering your newly planted tree

1. Press down on the soil gently all around the young tree.
2. Make a small dam around the tree to hold water.
3. Give the tree 4 buckets (10 L) of water.



4. Mulch around the tree with dry grass or newspaper or rocks, keeping the mulch away from the trunk of the tree. This will save water for the tree. It will also stop weeds from growing.

5. Water that runs off the roofs and bare ground around the houses can be directed by means of small furrows to the trees, so that when it rains the trees will get a good soaking.



6. Use the following guidelines to water your trees.

Year	Spring and Summer	Winter
1	2 Bucket (20 L) every 7 days during dry weather	1 Bucket (10 L) every 14-21 days
2	3 Buckets (30 L) every 7 days	1 Bucket (10 L) every 14-21 days
Year 3 onwards	3-4 Buckets (30-40 L) every 7 days	2 Buckets (20 L) every 14-21 days

Feeding your fruit trees

Using kraal manure

Spread the manure on the ground, as far as the branches reach. Do not let the manure touch the stem of the tree. Then cover the manure with mulch, otherwise it will lose its strength.

Age of tree	September	December
Year 1	1 (10 litre) bucket	1 (10 litre) bucket
Year 2	2 buckets	2 buckets
Year 3	3 buckets	3 buckets
Year 4	4 buckets	4 buckets
Year 5	5 buckets	5 buckets

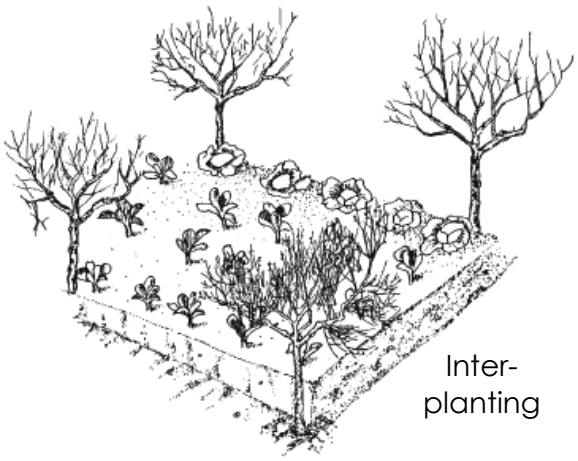
From 5 years onwards, you should apply the same amount of manure each year.



Caring for your trees

Inter planting

It is more natural for trees and other plants to grow together rather than to stand alone. If you only plant one crop, insects will have a feast. Growing vegetables and other crops between your trees encourages "good" insects that control the "bad" ones and a better balance is maintained.



Inter-planting

It is also possible to grow a mixture of other ANNUAL crops such a grasses (oats, annual rye grass) and legumes (vetch, lupins). These grow through winter and die down in early summer to provide mulch and compost.

OR it is possible to grow PERMANENT crops between your rows of trees. Here you would mix grasses (rye grass, fescue), legumes (clover, lucerne) and herbs (comfrey, chicory). These plants can be regularly cut short and the cuttings can be used as mulch, compost or animal feed. A variety of species always attracts a variety of organisms that may help in pest and disease control.

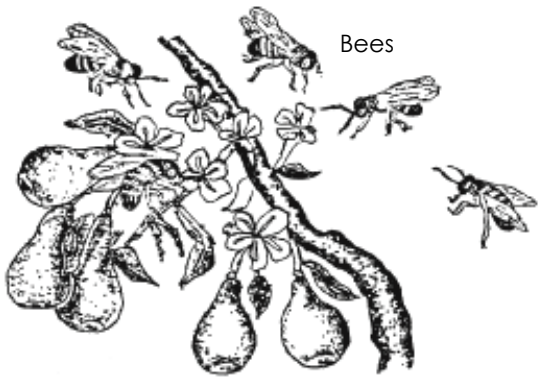
Pest and disease control for fruit trees

Growing healthy trees is a good starting point. They are stronger and more resistant to insects and diseases. Use lots of compost, manure and mulch and weed your trees regularly.

Other ways to grow strong healthy trees include:

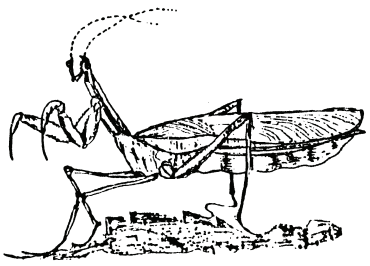


Marigolds



Bees

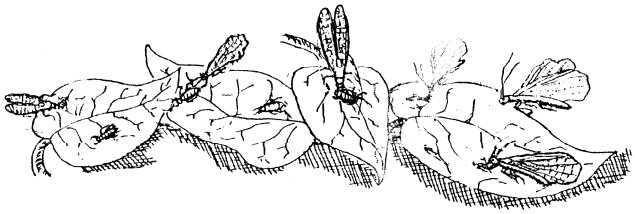
- Growing marigolds, leeks and comfrey nearby deters insects.
- Promote the presence of bees. Bees help to pollinate the flowers of the fruit trees and thus to bear fruit.
- Promote the presence of insect predators (good insects); these insects live off other insects and provide a natural way to control pests (bad insects). These include ladybirds, lacewings, wasps, praying mantis, dragonflies and frogs.



Praying mantis eat many kinds of insects



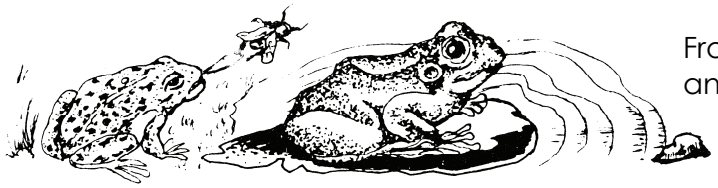
Wasps lay their eggs in living worms and caterpillars. When the young hatch they feed off these worms



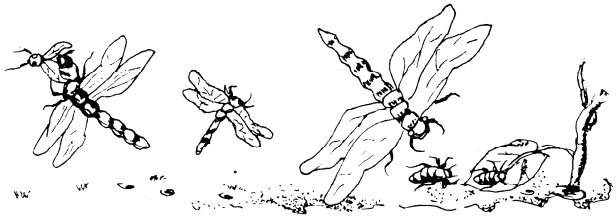
Lacewings eat aphids



Ladybirds eat lots of aphids and other bugs



Frogs eat worms, caterpillars, slugs and even snails



Dragonflies eat flies, aphids and mosquitoes

- Make up simple mixtures or brews that will get rid of insects and diseases

  - **Garlic and onions sprays** (deter most insects): Chop up 1 whole garlic or onion bulb. Soak it for 1 day in two teaspoons of paraffin. Add 0.5 litres of water and strain off the onion or garlic from the liquid. Add a medium bar of green sunlight soap and mix it in until it has completely dissolved. This will help to stick the mixture to the leaves of the trees. Dilute this mixture 1:10 with water and splash or spray on the tree.

  - **Tobacco mixture**: This should be used carefully as it is a strong poison and can kill bees and useful insects as well. Boil up 0.5 cup of cigarette ends or

tobacco in 1 litre of water. Strain off the liquid and mix with 2 litres of water. Splash or spray on the tree.

– **Fruit fly traps**: Fruit flies spoil fruit later in the season by stinging them and laying eggs inside the fruit. Small worms hatch in the fruit and make them rotten. Fruit flies like eating ripe fruit like plums, grapes and oranges. You can fill a trap with some water mixed with fruit (you can use any sweet smelling fruit), water and sugar. The fruit flies will fly into the traps to feed and will not find a way out again.

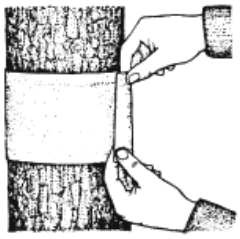




– Another fruit fly trap consists of making up a mixture of Bovril or Marmite and mixing in some poison such as the tobacco mixture above.

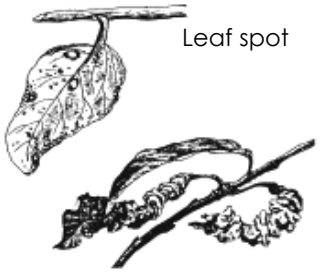
❖ Fruit flies can also be controlled by picking up fallen and rotten fruit beneath the trees EVERY day. The fruit is collected in buckets of water, which will drown the small worms. The fruit can also be fed to chickens and pigs. It is important that the small worms do not make contact with the ground. They burrow out of the fruit into the soil and rest there to start a new cycle of fruit flies.





❖ Wrap a band of paper or cloth covered in grease around the trunk of each tree. The grease should not touch the bark as it is poisonous to the trees. Any pests, ants and other insects walking up the trees will get stuck on the grease and die.

❖ Diseases such as mildew (a white powdery fungus on the leaves, mostly on apples, pears and vines), black spot (little black spots on leaves and fruit) and leaf curl (mostly on peaches and nectarines) can all be controlled by dusting the trees and fruit with sulphur or copper-oxychloride. These chemicals can only be obtained from gardening shops and some hardware stores.



Leaf spot

Peach leaf curl

Storing fruit

Preserving fruit by drying, bottling or making jam is an excellent way of making your fruit useful for longer periods.

Drying fruit

No special equipment is needed for drying fruit, although some simple drying frames might help. Fruit is properly dry when no moisture can be squeezed out of it.

You can dry fruit by preparing it according to the recipes below and then placing it on a flat tray or board. You can dry fruit inside your home or in the sun outside. In both cases, it is better to cover the fruit, so that flies and dust can not settle on your fruit and spoil it.

Recipes for preparing fruit for drying:

- Peaches, plums and apricots: Cut the fruit in half and remove the pips. Place the fruit on a tray with the cut side facing up.
- Apples: Peel apples and remove the core with pips. Slice the apple into rings and hang the rings on a piece of string above a hot stove. Apples need to dry quickly; otherwise the rings turn brown or black and do not look good to eat.
- Pears: Peel pears and remove pips. Make a solution of 1 teaspoon of salt to 2 litres of water. Cut the peeled pears into 4 pieces. Drop each piece into the solution, then remove and dry as normal.

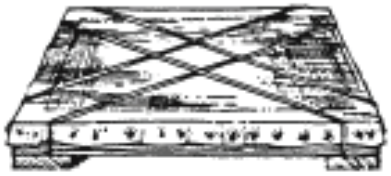
Fruit can be covered with thin cloth, paper, or wire mesh.



Gauze wire frame

Wire mesh drying frame

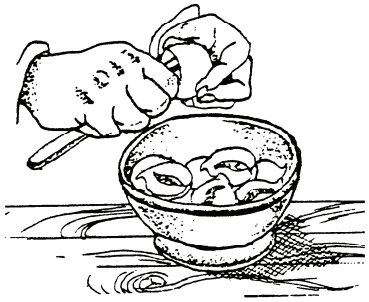




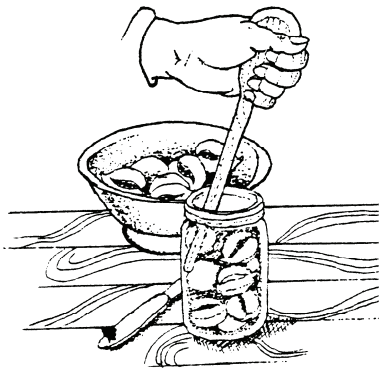
Cheese cloth drying frame

Bottling fruit

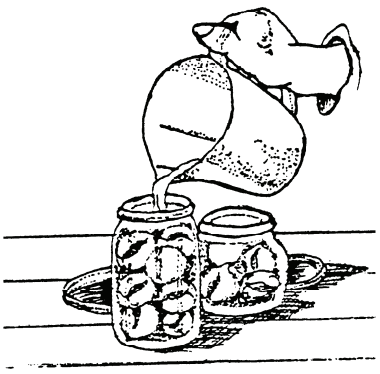
Bottling is a simple way of having sweet and tasty fruit available in your home throughout the year. You will however need to buy some good storage bottles to ensure the fruit does not go rotten. The best bottles are the preserving bottles with metal lids and rubber seals or other bottles with metal screw tops that can make an airtight seal.



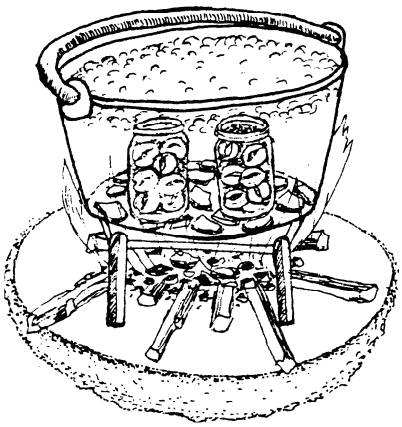
1. Remove the pips



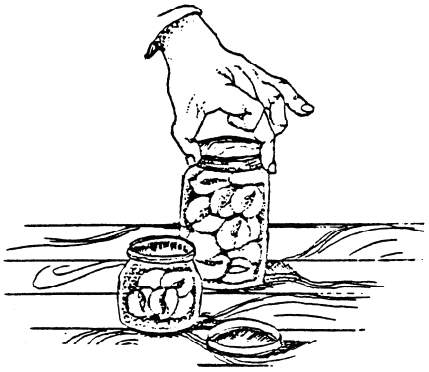
2. Pack the jars with clean fruit



3. Pour in cold syrup



4. Place jars on stones in a pot to avoid cracking



5. Tighten tops after boiling

- You will need to use slightly unripe firm fruit. For peaches, plums and apricots they can be cut in half and the pips removed. For pears and apples, they need to be peeled, the pips removed and cut into pieces.
- The jars need to be sterilised before packing the fruit by boiling them and their lids in water for 10 minutes
- Pack the sterilised jars with clean fruit
- Fill up the jar with syrup; 0.5 cups of sugar dissolved in 2.5 litres of warm water. Tap the jars to make sure there is no air bubbles trapped between the fruit.
- Now boil the fruit in the jars for 1.5 hrs: Place the lids loosely on the jar and place the jars on small stones in a large pot that has water in it. The water should cover your bottles.
- Remove the bottles from the boiling pot after about 10 minutes of cooling. Tighten the lids as much as possible.

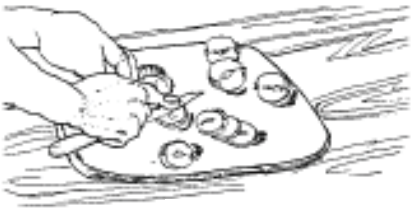
Making jam

Fruit sets when boiled with sugar because of a substance inside the fruit known as pectin, which is released during boiling. Some fruits make jam more easily than others, because they contain more pectin.

Good jam fruits: apples, plums, peaches and apricots

Some fruit will need extra pectin in the form of lemon juice (1 lemon /kg of fruit). These fruits include cherries, figs and grapes.

Recipe:



1. Clean and cut your fruit into small pieces, removing all the bad bits and pips.



2. Place the fruit in a pot and cover with water. Boil until soft.



3. Now add sugar. You will need equal amounts of sugar and fruit. If your fruit weighs 1 kg, you will need 1 kg of sugar.

4. Add also the lemon juice if you are using low pectin fruit.



5. Boil this slowly for 10-60 minutes until the jam is ready to set. To test this, put a little bit of your jam onto a saucer and leave it to cool. If the surface becomes stiff like jelly the jam has set and it is ready for bottling.

6. Sterilise your jars/bottles by boiling them for 10 minutes. Fill these jars to the top with jam, while they are still hot. Screw the lids on tightly and allow cooling.

Seal bottled fruit with wax paper

References:

Robyn Neeson. 1997. AgnoteDPI/190. Organic Fruit Production. NSW Agriculture. Australia

Sheard, Andrew. 2007. Fruit Production in KwaZulu-Natal. Department of Agriculture and Environmental Affairs, KZN, South Africa.

Parker,W., Bolus, R. and Hosack, P. 1985. The Soil is Good for Fruit; A guide to fruit growing in the Transkei. The Transkei Appropriate Technology Unit, Umtata, Eastern Cape, South Africa.

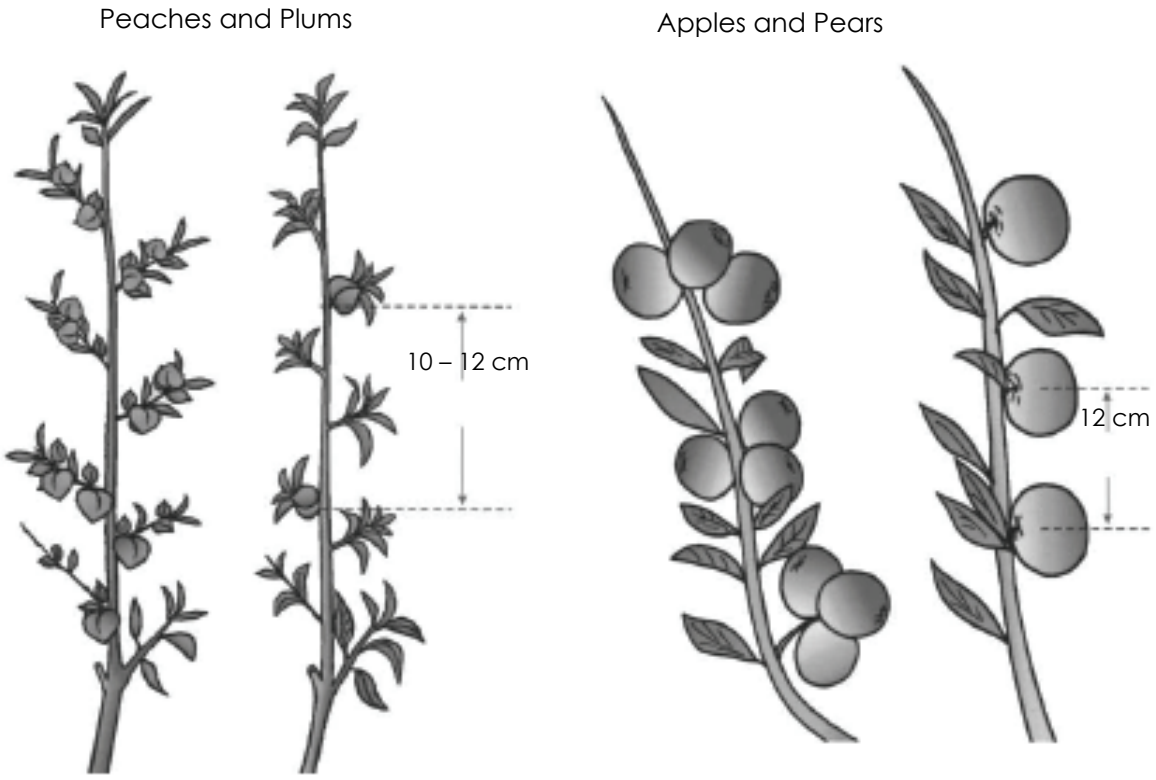
Pruning fruit trees

Introduction

Pruning is the selective removal of parts of plants to promote patterns of growth. It relates mainly to branches, stems and leaves, but can also be roots and fruit. Fruit grows more on new branches than on old ones. A tree with new branches will bear more fruit than a bushy tree that has not been cut at all.

In stone fruits (peaches, plum, apricots), pome fruits (apples and pears) and citrus (oranges, lemons, naartjies) a very heavy crop of fruit in one year can be followed by very few or none the next year. Branches can also become too heavy and break if they bear to many fruit. It is thus a good idea to thin fruit on an over crowded tree. This also ensures fewer, but larger fruit, rather than many small fruit.

Start thinning fruit 6-8 weeks after flowering when the fruit are the size of marbles, or small pebbles



Above: Thinning of fruit. Generally you should leave about 7-8 fruits per metre of branch, or about 4 fruits per arm's length

Why do pruning?

The pruning of branches on fruit trees creates a strong structure that can:

- Withstand wind without breaking
- Carry heavy crops of fruit
- Be harvested from easily, as the tree is not too large.

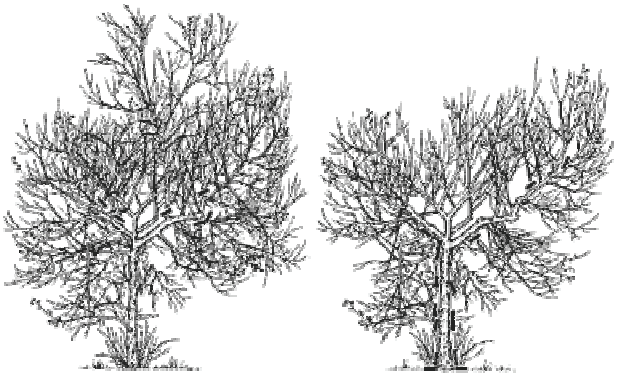
Pruning also increases light and air circulation between the branches of the tree to reduce diseases and help fruit to form and ripen.

Pruning Young Trees

In the first three years of a tree's life, it is important to shape a tree, or give it the basic shape that it will keep. In this way much less pruning will then be required later.

Pruning Older Trees

You may need to prune an old bushy tree quite severely. This means that you may get very few fruits for one season. The second year after the pruning however should see the tree producing a lot of fruit again.



The first year

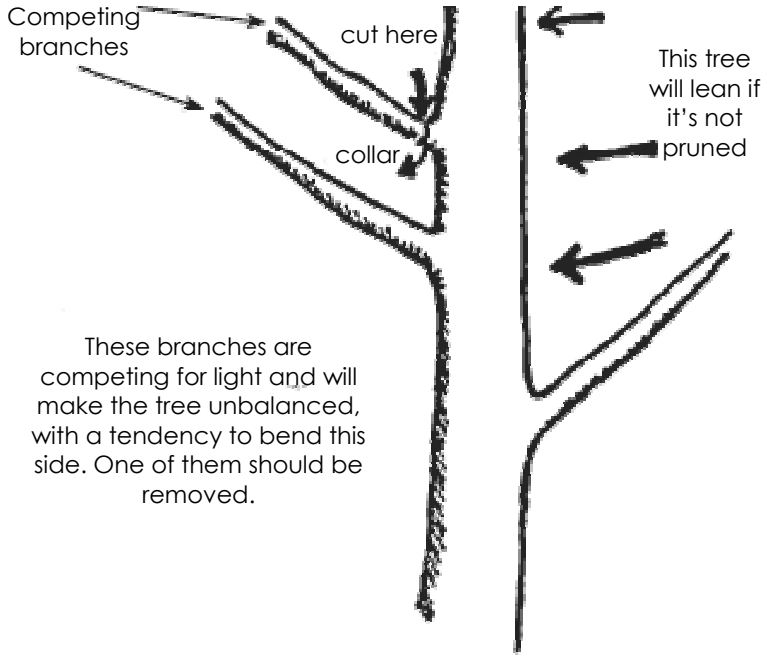
Steps in pruning

Always prune on dry days, to reduce the chance of getting diseases on the open wounds.

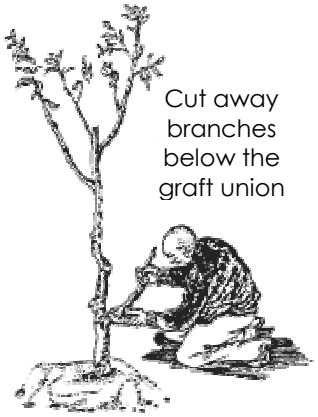


Second and subsequent years

- First; remove all the dead and diseased branches.
- Then remove any unnecessary limbs; those that cross over one another are too close together or rub against each other. Make the cut just above the collar as shown on the picture on the next page.



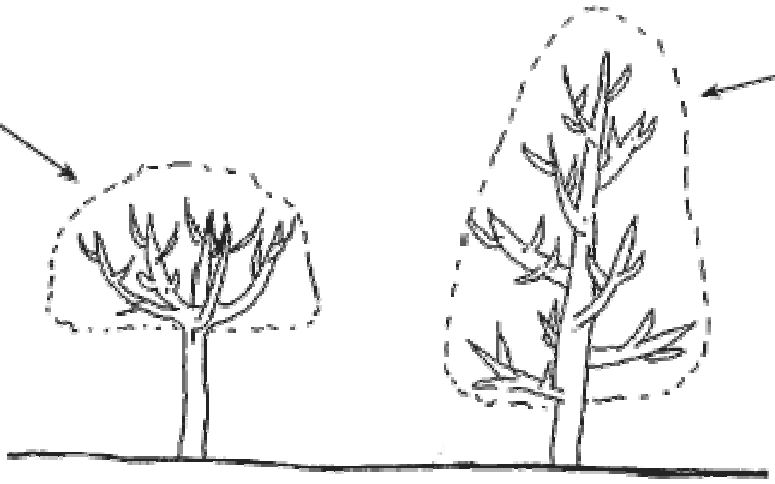
- Always cut away any branches growing below the union of grafted trees. This is the root stock growing through and it will compete with the fruit growing part of the tree. The picture on the right shows a man cutting a shoot from below the graft union.



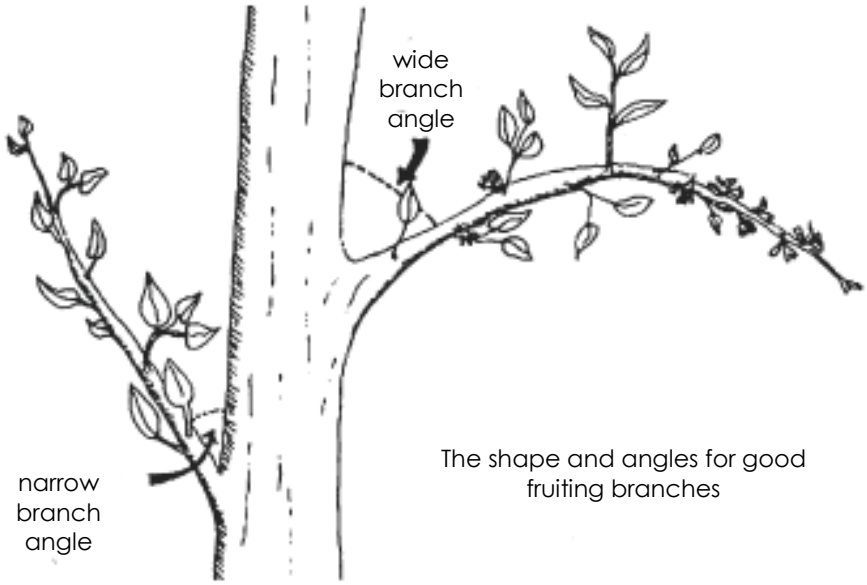
- Fruit trees are generally pruned to either have open centres or to have central leaders.

Open centre:
Spreading tree that allows light into the centre for fruiting. It is generally used for stone fruit (peaches, plums ...)

Central leader:
Takes up less space. It is generally used for pome fruits (apples, pears ...)

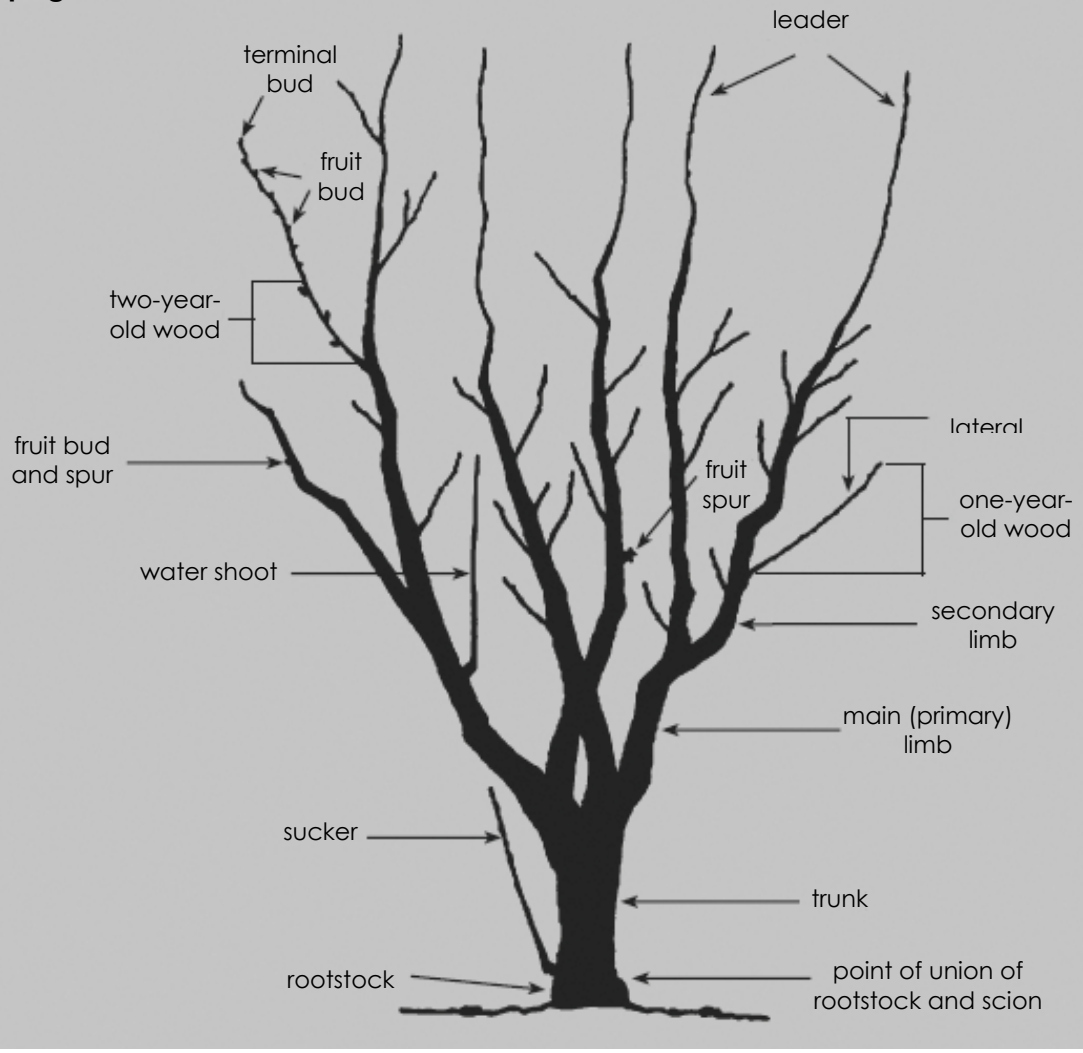


- Generally branches that are good for fruiting are at angles of 45-65 degrees off the main branches. Branches with smaller angles tend to break in high wind. Only keeping one main vertical branch on a tree, together with promoting angled branches, stimulates production of fruit rather than more growth; the tree spends more energy producing fruit than trying to grow taller.



The shape and angles for good fruiting branches

Parts of the tree referred to in the descriptions on pruning on the following pages:



Pruning stone fruits

To prune, it is also important to know HOW a tree fruits:



Fruiting wood on peaches showing laterals and fruiting spurs

PEACHES:

Fruit forms only on shoots from last year's growth on both laterals and fruiting shoots.

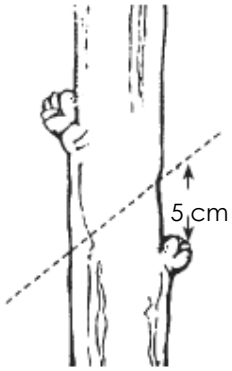
PLUMS:

Fruit forms on laterals or spurs that are two years or older. On young trees the spurs look more like a group of short laterals and on older trees like multiple buds



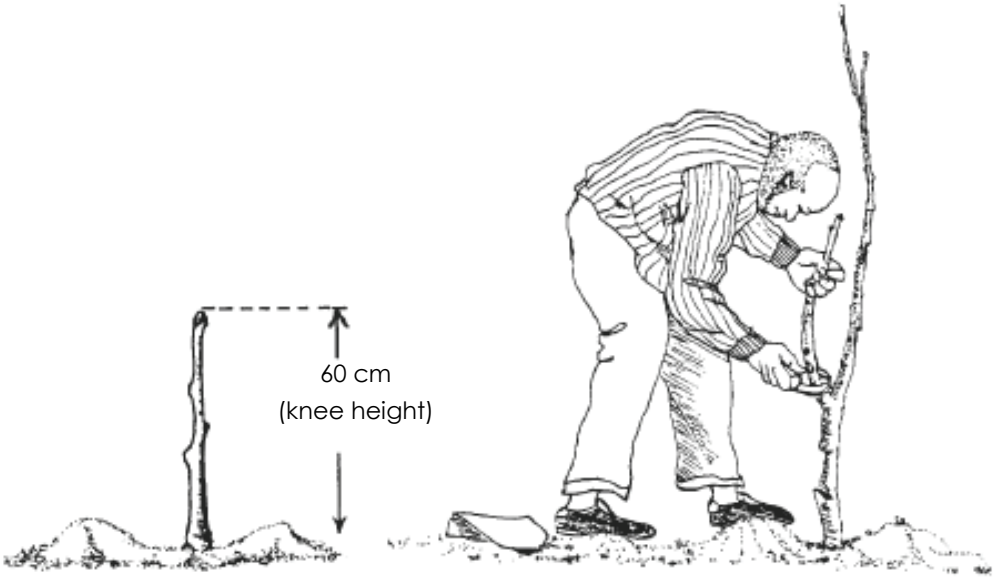
Fruit spur on older wood of plum trees.

When cutting back a branch; make the cut just above an outward pointing bud or shoot, to encourage new growth as shown in the picture. Prune strong branches at an angle of about 45° so that the highest point of the cut is directly above the bud.



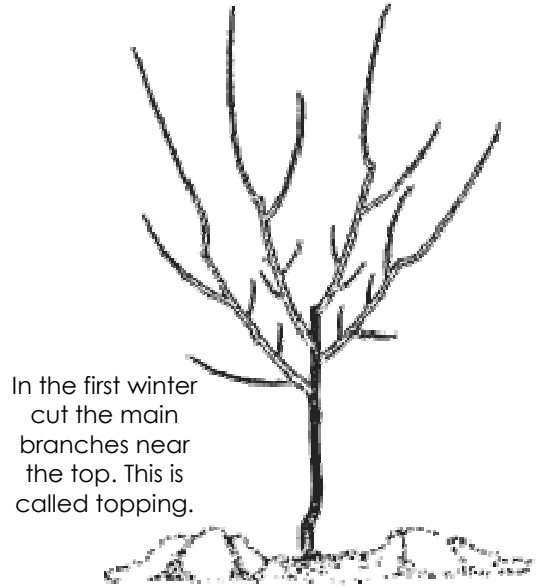
1. AT PLANTING:

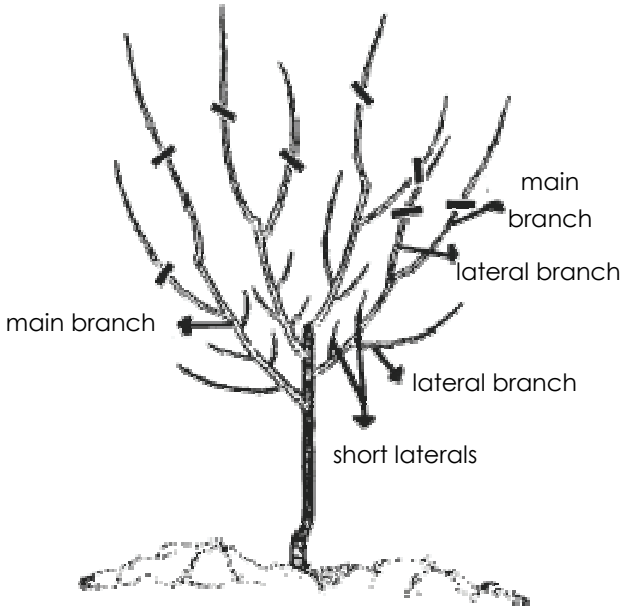
Prune the tree's roots and also prune the tree itself to about knee height (60 centimetres). This will force the tree to branch out rather than grow straight up.



2. IN THE FIRST WINTER:

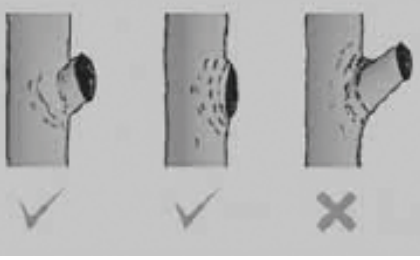
- Cut the main branches at the top.





- Some laterals will have grown on the main branches. Leave 2-3 laterals on each branch; the first lateral should be about 40 cm from the main branch and the second further along.

Pruning lateral branches:



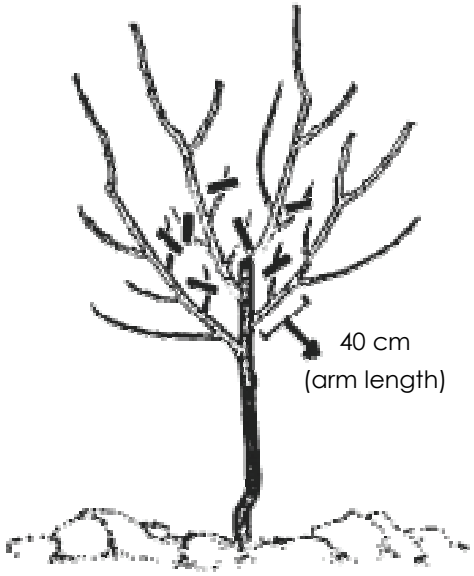
3. IN THE 2nd and 3rd WINTERS:

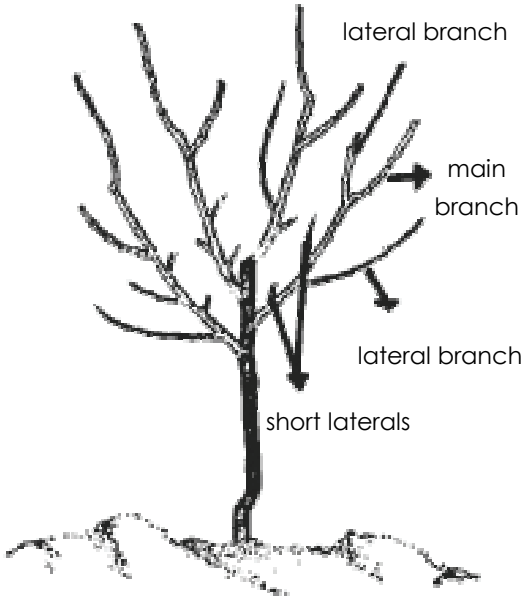
- Trim the tops of the main branches. If you cut them further back than the previous year's growth, it will delay fruiting.

- Shorten the laterals. Cut them 1cm above a flowering bud or cut them back to the join between the old and new wood.

- Shorten the side branches coming off the laterals. Again leave 2-3 side branches on each lateral.

In the 3rd year fruit will be carried on the pruned back lateral. Once established, prune lightly each winter.





Pruning pome fruits

These trees start fruiting around their fifth season in the ground. Fruit is picked green and ripens off the tree.

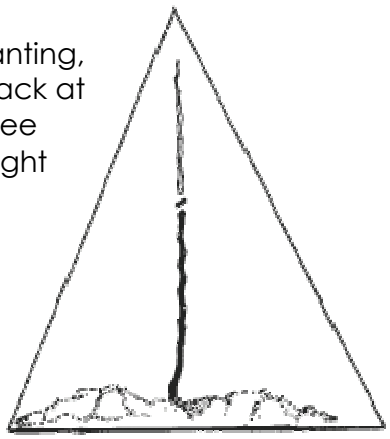
Generally a leader system of pruning has been preferred. Fruit grows on small side branches coming off the laterals and these side branches will bear fruit for many years.

Initial Pruning

- Cut the planted tree back to knee height.
- In the first winter trim the main branches, leaving one central branch. Leave 2-3 laterals on each main branch.
- In the 2nd and 3rd winters trim the main branches and laterals and leave 2-3 side branches coming off each lateral.

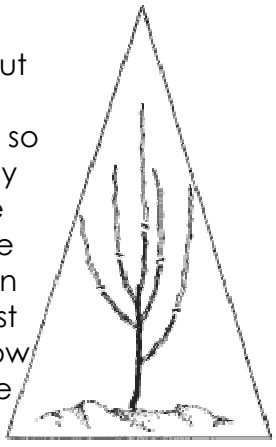
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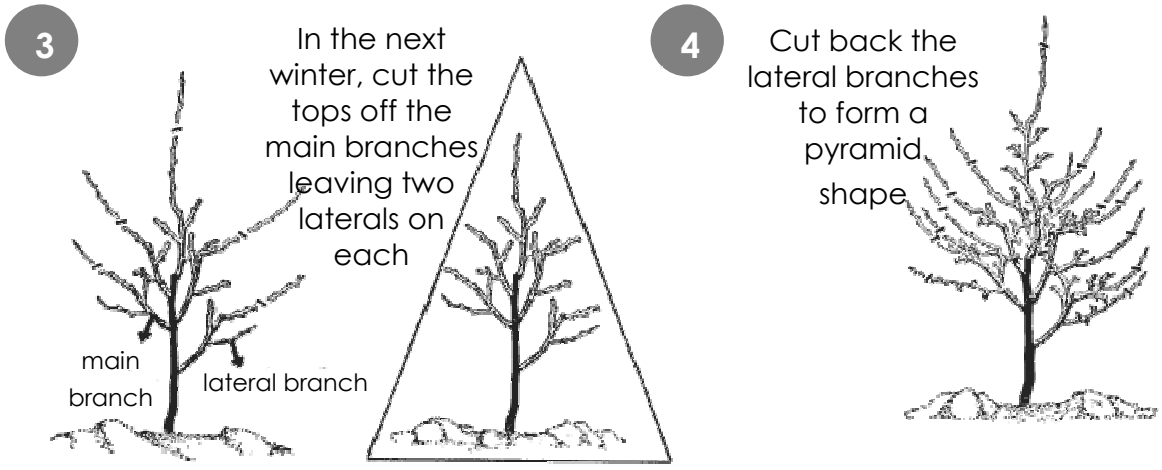
At planting, cut back at knee height



2

In the winter, cut all the branches so that they are the distance between your wrist and elbow from the stem





Pruning grapes

Grapes form fruit on one year old canes (the present year's growth) that are growing off two year old canes. If they are growing off older wood they will not always bear a lot of fruit.

- In the first winter, cut the vine to about 30 cm high.
- In the 2nd winter, prune the vine hard to leave 3-4 main branches that are about 30-40 cm long.
- Retain well positioned shoots for the development of the secondary limbs/canes.
- In the 3rd and subsequent years, remove about 2/3 of the annual growth.

7. Tower Gardens

What are tower gardens?

Tower gardens are small upright gardens that can be watered using grey water. These gardens are good for older people or people who are ill, as you do not need to bend down a lot and they can be made anywhere close to a home.

What is grey water?

Grey water refers to the water that has already been used for domestic purposes; such as washing of dishes and clothes. Because of the normal shortage of water, it is essential to save water. This water can be re-used for gardening purposes.

Making the most of grey water

In many cases, water has to be carried from the nearest stand-pipe in plastic containers not for the purpose of gardening, but for cooking and washing. This water can be re-used for growing vegetables successfully. Tower gardens offer a way of saving water, because you can use your grey water for gardening.

Vegetables are grown in a column of soil that fills a bag. They are planted in holes cut in the sides of the bag itself and, each day, the available grey water is poured into the bag.

Vegetables can grow successfully with soapy water! You can clear the soapy water out of the system by pouring two buckets of clean water into the column once a week.

This is lazy gardening

One of the main attractions of tower gardens is that little labour or attention is required and this appeals to all busy gardeners. Once people have become familiar with the towers, they prefer to position them right at the back door so that it is easy to pour the wastewater into the tower.

It is difficult to predict how much water is required, only time can tell. If water forms a puddle around the bottom of the tower, it is an indication that too much water is being applied and the obvious answer is to make a second tower!

Making up the tower

The way in which the tower works is simple:

- The **upright poles** can be made from branches or fencing standards. Where crops such as tomatoes are planted in the top layer of soil, extensions can be wired on to provide trellising.

- The selection **of the cloth** that forms the sides of the tower is critical.

  - Nylon gunny bags can last about two years;
  - Sacking, *as shown in the photograph on the right can only* ***last the season***;
  - Black plastic sheets deteriorate rapidly in the sunlight;
  - Shade netting is much more durable; but it is important to use nylon string or fishing line to join up the ends of the shade netting to form cylinder, as shown in the diagram at the bottom.



A picture of a tower garden being constructed. Poles here are made from branches, and the tower is made from shade cloth.



- The **soil** is contained by the shade cloth "skin" and surrounds a central stone packed drain/ column.

  The **soil mix** provides fertility and retains water:

  - Mixtures of six parts of soil, four parts of manure and two parts of wood ash are satisfactory.
  - The soil should be damp but not too wet when you are packing the tower.
  - The water must be distributed evenly throughout the soil mass and will not

penetrate any compacted areas.

The **stone column** in the middle of the tower controls the flow of **water** so that the soil in the tower is kept moist.

- Carefully pack flat stones, or building rubble.

- If it is possible, use smallish round stones, provided they are evenly packed, so that even water distribution is achieved.





Participants in Potshini are busy filling up the stone column in the middle. Note the small white bucket (bottomless) that help to provide a rigid structure for the placing of the stones.

What vegetables can be grown?

- Leafy crops:
  The towers are ideal for leafy crops, typically various varieties of *spinach* are

planted through the holes in the side of the shade net cylinder. Ideally the holes should not be one above the other but should be staggered diagonally, providing more space for root development.

- Tomatoes and onions:

  Tomatoes and *onions* can be planted in the top layer and, if crops require trellising, this can be provided by extending the vertical uprights and joining them with wire or string. Where possible, companion crops should be grown to facilitate biological control of disease and pests. *Garlic* and *onions* are useful in this regard.

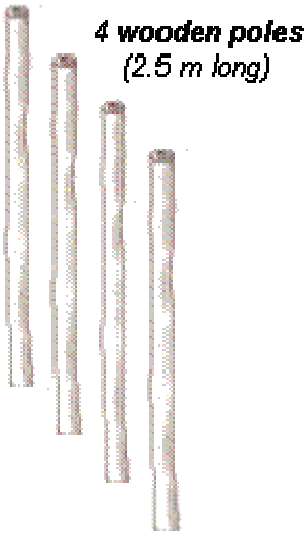
An unexpected benefit is the way in which the vegetables **thrive in severe heat wave conditions** which have proven to be too much for conventionally planted gardens. The reason for this is not quite clear. It may be the free air circulation, lower soil temperature or the better moisture status of the soil.

It is not claimed that towers will be able to provide all the food a family needs but the contribution made to nutrition and eating pleasure is very considerable.



Participants in Potshini are planting spinach into the sides of the newly prepared tower garden. Tomatoes and onions will be planted in the top

Materials needed

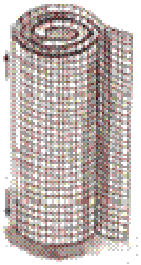


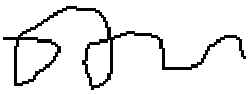
4 wooden poles
(2.5 m long)



bucket, *with the bottom cut out*
(10 liter, with vertical sides,
about 300 mm diameter)

shade cloth
(3.0m x 1,3m)



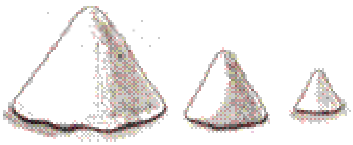


fishing line or
nylon string
(1,5m)

flat stones

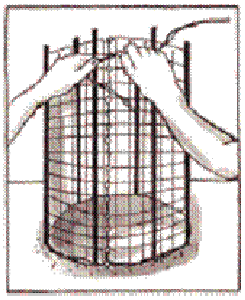


soil mixture:
6 *wheelbarrows* **soil**
4 *wheelbarrows* **manure**
2 *wheelbarrows* **wood ash**



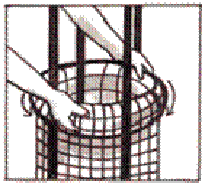
Instructions

Step 1:
Choose a flat piece of ground (1m x 1m), as close to the kitchen as possible, but make sure that goats and chickens won't be able to get to your Tower Garden.



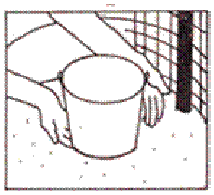
Step 2:
Plant the 4 wooden poles to form the four corners of the Tower.

Step 3:
Wrap the cloth around the poles and sew the ends together with fishing line or nylon string (something that won't rot away, letting the Tower collapse).



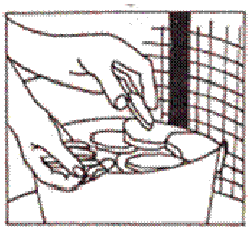
Step 4:
Roll the top edge of the cloth down and out of the way before filling the Tower.

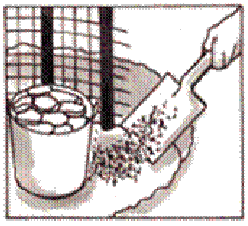
Step 5:
Using a spade, mix the soil, manure and ash very well, then mix in some water to make it slightly damp (not too wet!), so that you can place the soil mixture without compacting it.

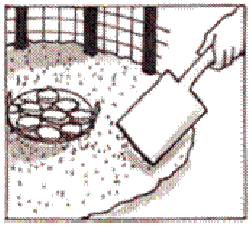


Step 6:
Fill the first 30cm (one ruler height) of the Tower with the soil mixture.

Step 7:
Place the bottomless bucket in the centre of the Tower, on top of the first layer of soil.

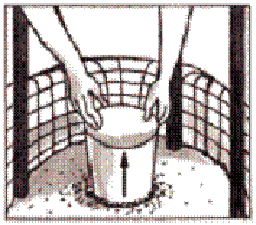






Step 8:
Pack flat stones carefully in the bucket, in such a way that water poured into the top would run through nice and slowly. This gives water time to seep sideways into the soil to the plant roots.

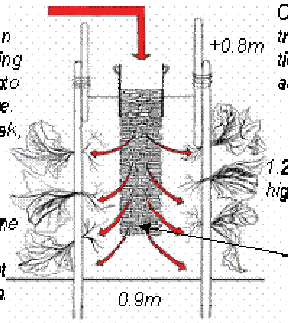
Step 9:
Fill the next layer of soil in the Tower around the bucket and up to its rim. Take care not to compact the soil while placing it.



Step 10:
-Pull the bucket out partially, leaving the stones in position.
-Pack the next layer of stones into the bucket and then the next layer of soil, again to the rim of the bucket.

Repeat until the Tower is at waist height (about 1.2m high). Plant seedlings into small holes made in the cloth, staggered around the sides of the Tower, and taller-growing crops on the top surface of the Tower.

. Water the Tower Garden daily by pouring grey water onto the stone core.
. Once a week, pour two buckets of clean water down the stone core to flush soapiness out of the system.



Once the taller crops need trellising, extensions can be tied onto the upright poles, as necessary.

Use you Tower Garden continuously to prevent it drying out and becoming unusable!

The porous core of flat stones starts 30cm above ground level

8. Grafting Fruit Trees

What is grafting?

Wild fruit trees grow in many different soils and climates and have very strong roots, but their fruit is not very big or tasty. Other trees that are not so strong may bear good, tasty fruit. To obtain a tree with both strong roots and good fruit the roots of the wild tree are joined to the branches of the tree with tasty fruit. The process is called **grafting**; this is done by cutting the stem just above the roots of a wild tree and binding a branch that has been cut from a good fruit bearing tree. The two trees grow together to form a single tree.

Fruit trees that you buy from a nursery are usually grafted. Gardeners can graft their own trees at home to create varieties that provide the type of fruit they desire – perhaps even with different kinds of fruit on the same tree!

Guidelines for Successful Grafting

- Use clean sharp tools to make your cuts – sterilize your knife between cuts with a 10% bleach solution (1teaspoon bleach mixed with 9 teaspoons water)
- Once you've made cuts, work quickly so that the wood won't dry out.
- Don't touch the exposed wood.
- Make sure your rootstock and scion are compatible. You can ask a nursery or just experiment. Generally you can graft apples to apples, pears to pears, grapes to grapes, stone fruits to stone fruits (peaches, apricots), and citrus to citrus (orange, lemon).
- Grow rootstock in rich deep soil with full sun and wind protection if necessary. Water regularly.
- Don't get discouraged as you're learning how to graft! Do several different graftings in case some don't take. Practice makes perfect!

Important terms

A **scion** is the branch that you graft on to another tree. You cut scions from a tree with desirable fruit.

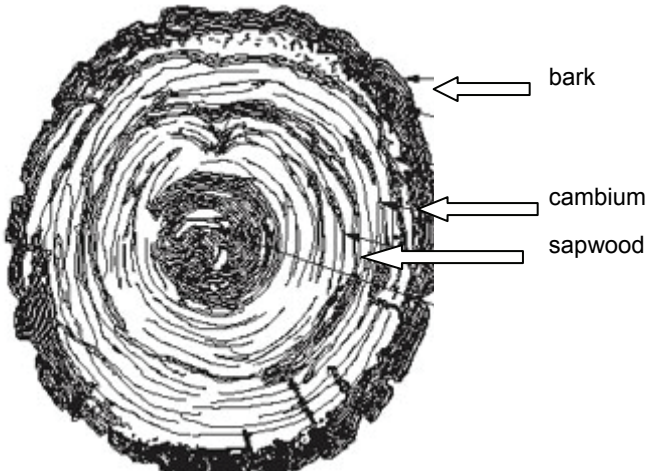
A **rootstock** is the root portion that forms the base of a grafting. To graft a fruit tree you attach a scion to a rootstock. You choose rootstock from healthy trees that grow well in your area.

Benefits of grafting

Some of the benefits grafting can bring to the experimental gardener include:

- You can create trees such as an apple tree with two cultivars that can pollinate each other.
- You can choose a rootstock that gives a nice size tree with good pest and disease resistance and high productivity and graft it with a tree that makes the large, flavorful fruit you desire.

- You get fruit sooner. The top branch (scion) is grafted onto a plant (rootstock) with well-established roots. This means that the roots can feed the scion well, so you have a head start of at least a year.



How to graft

There are many different methods of grafting. The key in all the methods is to make sure the cambium layer in both the scion and rootstock come into contact so that they will grow together. The cambium, a thin layer found just under the bark, is the actively growing part of the stem.

First you must prepare in advance

Two years before you plan to graft (June/July):

Take cuttings *(see box below)* from trees you want to use as rootstock and plant in a container or bed.



One year before you plan to graft (August or September):

Plant the 1-year old rootstock in the ground where you want the tree to grow. Care for it throughout the year, rubbing off buds as they form. Keep watering and adding manure/compost in adequate (but not excessive) amounts. Let rootstock develop until it's approximately 46 cm tall before grafting onto it.

(Alternatively, you can graft directly on to an existing tree. In this case, water and care for the tree in the year preceding grafting.)

The following June/July:

How to do cuttings

- Cut from a good, productive tree
- Use a sharp knife/razor to cut pieces of stem as thick as a pencil.
- Choose stems with buds.
- Cut top section off so you're left with pieces with 4 buds.
- Cut top end at an angle and bottom end straight across.



Take scion cuttings. (Remember, these come from the tree which has the fruit you want your rootstock to produce). When cutting your scion, choose strong straight branches. (Remember, they will form the trunk of your new tree). Cut 23-25 cm (a bit longer than a hand width) pieces about 4cm below a bud. Make sure the width at the

bottom (where you cut) is the same as the width of the rootstock (ideally 1 cm). Cut off any wood at the top that isn't completely hard. Cut several scions. Bundle scions with a tie, wrap in a dry plastic bag, label, and store them in a cool, dark place.

Now you're ready to graft

The following August or September:

1. Just before the buds break in early spring, cut off the top of the rootstock so it stands 15-30 cm (one hand) above the soil line. Prune all branches to be flush with the stem. (If grafting onto an existing tree, just prune back a bit).

2. Cut back the rootstock to where the scion is to be grafted. Make a sloping cut.



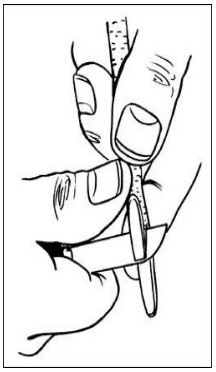
3. Prepare the scion: Make a top cut just above a bud about 4 buds from the base. Make a cut at the base of scion at the same angle as the rootstock cut.



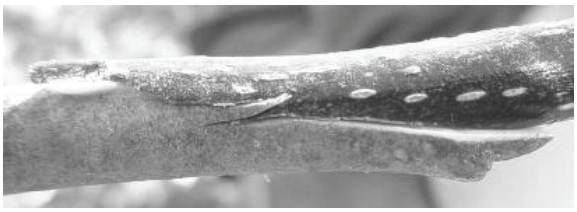
4. Make a shallow cut into the rootstock from 1/3 down the sloping cut.



5. Make a shallow cut into the scion from 1/3 up the sloping cut.



6. Slip the scion into the rootstock so that they interlock.



7. Bind the union with tape. Dab the top of scion with wax and cover tape with wax if possible.

8. After 2 months or so – after a strong callus has formed and buds on the scion are developing, remove the tape. Cut off any rootstock growth – rubbing off any buds and cutting any suckers that arise from the soil.



9. Vegetative Propagation - Cuttings

Plants can be grown from seed or from parts of the parent plant. The advantage of using the parent plant is that the offspring will have the same features as the parent in terms of growth and fruit.

Only some types of plants and trees can be grown directly from the parent plant (vegetative propagation). There are different methods of vegetative propagation – in this handout we will discuss how to grow a tree from a cutting.

Cuttings

Cuttings are plant pieces, usually stems and branches that can grow new roots. Cuttings can be taken from deciduous trees (which lose their leaves in winter) such as peaches, plums, figs and mulberries. They can also be taken from other plants such as herbs and sweet potatoes.

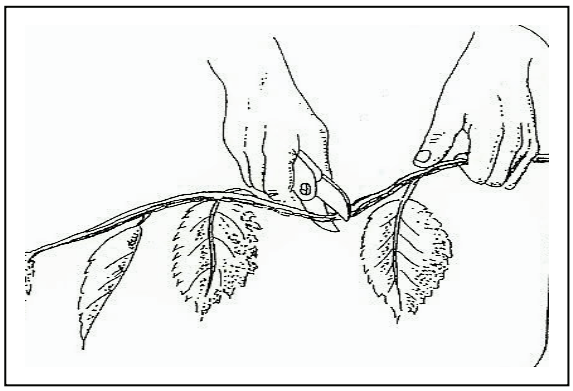
Cuttings should not be taken when plants are stressed for example if they are very hot or cold or during drought. Shoots that are producing flowers or fruit should not be used for cuttings. Generally there are two kinds of cuttings:

Softwood Cuttings	Hardwood Cuttings
These are "green" cuttings taken from new growth during the season.	These are older, woodier shoots from the previous seasons' growth.
Cuttings are usually taken early in spring.	For deciduous trees: cuttings should be taken in the dormant period before buds sprout (winter). For evergreen trees: cuttings should be taken just before a time of rapid growth. (This is difficult to judge so you need to experiment).
Remove all but the top few leaves.	These cuttings have no leaves and usually tips should be removed. In general, use a relatively young shoot with many nodes.

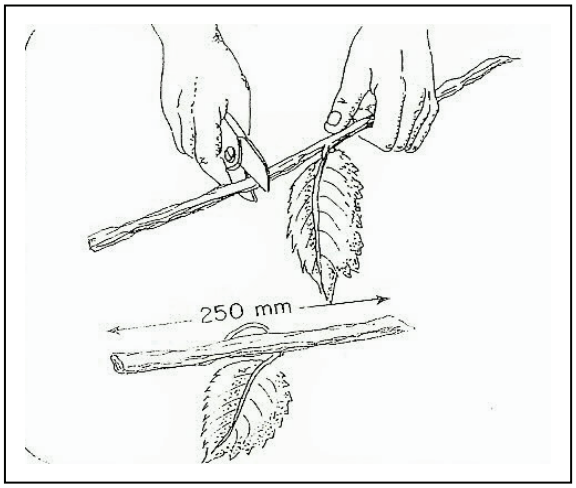
How to take a cutting

- Cut just below a leaf node or bud.
- Make sure that the cutting has at least 5 nodes on it, reasonably close together.

Use lateral and basal branches rather than water sprouts so that the new tree will grow upright with long sections between nodes. The cutting should be about as thick as a pencil.



- Cut the stem to a length of 25-30 cm. The bottom of the cutting is made at an angle just below a node. The top of the cutting is made at an angle just above a node.



- The cutting needs to be placed in well-drained soil (preferably sand) with at least two of the nodes covered. **Make sure your cutting is the right way up!!!** The sand must be kept moist at all times and protected from wind and heat.
- If you can get some hormone rooting powder, dip the bottom of the cutting in this before planting in order to help the stem form roots.



10. Fruit and Vegetable Processing

When you have an abundance of tomatoes, peaches, or any other fruit or vegetable in your garden it's nice to know how to preserve them so that you can use them all before they pass their prime. By learning how to dry your produce or preserve it in a jam or relish, you can ensure that none of your hard work in the garden will be wasted. Also, if you are interested in making an income from your garden, you may find that by processing your produce first you can make even more than if you sell it fresh.

Food Hygiene



It's important to practice good hygiene in food processing to avoid food poisoning. Wash your hands thoroughly before handling food and after using the toilet or handling kitchen waste (especially raw meet). Ensure that cutting boards, knives, jars, and bowls have all been properly cleaned. Make sure the water you are using to clean your kitchen equipment and fruits or vegetables is clean. If not, boil it for 10 minutes or add a bit of bleach (1 : 50 mixture).

Drying Fruits and Vegetables

- Some vegetables need to be blanched before being dried. This means they are dropped into boiling water for a certain amount of time.
- Drying requires a warm temperature, low humidity and a flow of air.
- Drying is a slow process and can take from 6 hours to 5 days. Drying time is influenced by the moisture content of the vegetable or fruit as well as the method of drying used.
- Always use fresh healthy produce to ensure a good quality dried product.

Methods of Drying



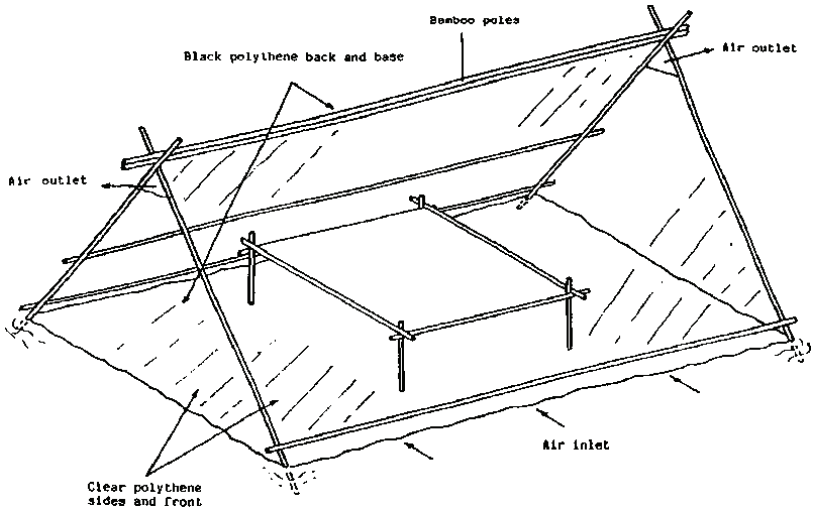
Sun Drying: Produce is placed on drying racks, covered with netting to prevent contamination from insects and dust, and placed in direct sun or shade.

Drying time: 3-5 days

Disadvantages	Advantages
Produce must be removed when weather changes (wind or rain). If produce isn't protected, produce may be contaminated with dirt.	Drying frames are cheap and easy to make.

Tent Drying: Produce is placed in a wooden frame, covered with plastic and placed in direct sunlight.

Drying time: 3-5 days



Disadvantages	Advantages
Requires some supplies and labour to construct.	Protects crops from rain and wind.

Oven Drying: Produce is placed on oven racks and baked at 140° C.

Drying time: 8 hours or more

Disadvantages	Advantages
Very expensive and should therefore only be used as experimentation.	Very fast drying time.

The Drying Process

Cleaning

- Use only good quality, ripe produce
- Clean all working surfaces, containers, and equipment. Use a solution of 1 part bleach to 50 parts water (20L water + 400ml bleach)
- Use fresh cleaning solution every day.
- **Do not break the skin of the produce during this process!!**
- Place produce in a clean container after washing.
- Stops ripening
- Prevents change in flavour
- Enables produce to rehydrate better

Peeling

- Peeling should not take place in the space where raw produce is washed.
- Peel carefully to remove as little flesh as possible.
- Dispose of peels immediately.

Cutting and slicing

- The type of produce determines the thickness of the slice.
- Thick slices take longer to dry.

What does blanching do?

- Destroys enzymes and thus sets the colour
- Shortens the drying time

The following should be blanched before bottling:

- All greens should be blanched about 5 minutes to reduce the bulk.
- In order to prevent loss of the milk, maize should be blanched on the cob until it is firm to the touch and until the milk does not ooze out when it is pricked with a fork.
- Beets, carrots and parsnips should be blanched until the skins will slip off easily.

- Thin slices stick to drying trays.
- If you intend to sell, make sure all slices are the same thickness.

Blanching (necessary for vegetables and recommended for fruits as well)

- Boil just enough water to cover the produce.
- Place cut produce in a steamer basket.
- Immerse in boiling water (required time varies).
- Remove from boiling water and drain with a sieve.

Keeping the colour

- Now place vegetables into a bath of warm water into which the juice of one lemon has been squeezed
- Allow to cool for about 10 minutes, before removing the vegetables and draining them.

- This will ensure that vegetables do not lose their colour or become discoloured during drying.

Loading the tray

- Drying trays must be brushed clean and washed beforehand.
- Load trays while slicing -- produce muse be placed close, but not overlap.
- Trays should be placed on a level area out of the wind either directly in the sun or in the shade.

Drying

- If moisture forms on the inside of your Tent Dryer, open the door slightly.
- If possible, place the tray/dryer inside overnight to protect from dew.

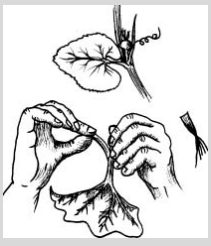
Packaging and Storage

- Proper packaging and storage prevents moisture from re-entering.
- Pack carefully to avoid bruising.
- Packaging needs to be done immediately after totally dry.
- Keep your eye on the container for the first 7 days: stirring daily and removing any mouldy or damaged pieces.
- Store in airtight glass jars, boxes, or metal cans with tight fitting lids or sealed in plastic bags.
- Store in small quantities to avoid major losses due to mould.
- Store only one type of food in each container.
- Glass containers should be kept in a dark environment.
- Containers must be marked with the date.
- Store in a cool, dry, and clean area.
- Product can be stored 1-2 years, depending on the type of food.

A high quality product will be properly dried with no mould. It should have a good colour, but some browning is normal. It should taste like the fresh produce. Dried vegetables must be dry and brittle.

How to dry pumpkin leaves:

Select fresh, tender leaves
Peel off the hairy outer skin
Wash in clean water
Steam blanch for 3 to 5 min
Place on trays ready for drying
Test for dryness: crumble easily



How to dry carrots:

Choose crisp, tender carrots without woodiness
Steam until cooked through but not mushy
Remove whiskers, tails and crowns
Cut into rings (2-3 mm) or shred
Arrange on trays for drying
Test for dryness: slices very tough, but can be bent.



Sauces, Relishes, and Jams

Selection and preparation

- Select firm produce of good quality.
- Do not use mouldy or diseased fruit – the heat will kill potential spoilage organisms, but will not remove the off-flavour that the mould may cause.

Washing

- Wash thoroughly (even if you will remove skin) to remove dust, dirt, and mould spores.
- Wash small quantities at a time under cold running water.



Choosing bottles

- Bottles must not have any cracks.
- Metal lids should not be bent or rusted and should fit securely.
- Clean bottles by washing with soap and rinsing in clean water.

Sterilizing bottles

- Place bottles in a saucepan filled with water.
- Bring to boil and continue boiling for 15 minutes.
- Use tongs to lift the bottles out, pouring out the water.
- Spoons and lids must also be sterilized in boiling water for 10-15 minutes.

Filling bottles

- Fill bottles while food is still sufficiently hot (±80-85°C).
- Ensure you leave 1-2 cm at the top.
- Release bubbles by inserting a knife between the bottle and the food.
- Clean the rim with a clean dampened paper towel.
- Seal bottle, but not too tight.

Warm water bath

- To ensure a longer shelf-life, give bottles a warm water bath for 10-15 minutes.
- Use a large saucepan with a tight-fitting lid, which is deep enough to ensure that the water will be 5cm above bottles during the entire process. Refill water

bath during sterilization if necessary.

- Preheat water to 82°C. Place bottles one at a time on a false bottom (like a flat rock inside the pot) and cover with warm water. Bring water to boil and continue boiling for 10-15 minutes. Start timing only once water is boiling.
- **It is important to leave a 20mm space on top when filling the bottles to prevent content boiling over during sterilization.**

Cooling of bottles

- Remove bottles from the saucepan and place on a rack, towel, or newspapers, allowing a 3cm space between the bottles.
- Allow to cool to room temperature for 12-24 hours.
- Check lids to ensure that they are sealed.

Reprocessing of unsealed bottles

- If lids did not seal, check the lid for tiny cracks or scratches. Replace if necessary. Then repeat warm water bath within 24 hours.

Labelling and storage

- Label with product name and date.
- Store in clean, cool, dark place.

Identifying and handling spoiled bottled food.

- **Do not taste food that is suspect.**
- Check for dried food on rim of bottle, rising bubbles, or unnatural colour.
- When opening the bottle check for unnatural odours and cotton-like mould.
- Discard of all contaminated food and containers.

Recipes

Tomato Relish

1 large onion
1 granny smith apple: cored and chopped
160 g sultanas
¼ teaspoon mixed spices
¼ teaspoon chilli powder
800 g chopped ripe tomatoes
250 ml vinegar
83 ml fresh orange juice
1 whole clove

Place all ingredients in a large saucepan.
Bring to boil.
Turn off heat and simmer for 1 hour, stirring frequently. Remove from heat.
Sterilize bottles for 15 minutes. Pour hot relish into sterilized bottles and seal.

Tomato Chutney

1 kg tomatoes
12.5 ml mustard powder
½ clove garlic
12.5 ml ginger
2 onions
500 ml vinegar
2 ml red pepper
300 ml brown sugar
125 ml sultanas

Dip tomatoes into boiling water and peel. Cut into pieces. Place all the ingredients in a saucepan and boil slowly, stirring occasionally with wooden spoon, until soft and thick. Pour into sterilized bottles and seal.

Piccalilli Relish

2,75 kg prepared vegetables (Enough vegetables to fit into one big pot. You can use cucumber or cabbage, marrow or carrots, small onions, cauliflower, beans)
3 pints (6 cups) white vinegar
6 teaspoons dry mustard powder
250 g sugar (1 cup)
4 teaspoons turmeric
2 teaspoons ginger
37.5 g plain flour (1/3 cup)
Brine (Very salty water. To make add approx. ½ cup salt to 1.5 litres of cold water)

Clean and prepare vegetables (peel, cut into 2 cm cubes, slice onions, break cauliflower into florets, cut beans into 2 cm lengths). Immerse the vegetables in brine and leave overnight.

Spice the vinegar with mustard and ginger and add sugar. Heat slowly until the sugar has melted.

Rinse and drain the vegetables thoroughly. Put them in a pot and add the hot vinegar syrup. Simmer for 20 minutes.

Lift the vegetables out with a slotted spoon and pack into jars. Don't overfill.

Mix the flour and turmeric to form a smooth paste using a bit of vinegar. Stir this into the hot syrup. Boil for two minutes, then pour over the vegetables and seal.

Curry Cabbage Atjar

2 cabbages
500 g white sugar
15 ml curry powder
7 ml salt
4 onions
30 ml corn starch (or flour)
15 ml mustard powder
625 ml white vinegar

Chop cabbage finely. Peel onions and chop finely. Cook cabbage and onions in a little water until soft. Drain well.

Mix sugar, corn starch, curry powder, mustard powder and salt.

Make into a paste with a bit of the vinegar.

Add remaining vinegar, heat until boils. Cook for 5 minutes.
Add cabbage mixture and let it cook through well.
Pack into jars and seal while hot.

Resource Material for Homestead Food Gardeners

Chapter 4: Handouts (seSotho)

Handout 1 Temo ea machobane (Mixed cropping)
Handout 2 Phapanyetsano ea lijalo sebakeng se le seng (Crop rotation)
Handout 3 Taolo ea likokoanyana le mafu lijalong (Pest and disease management)
Handout 4 Tšireletso ea lijalo moeeng le serameng (Wind and frost protection)
Handout 5 Tlhahiso le poloko ea peo ea meroho (Seed saving)
Handout 6 Temo ea lifate tsa litholoana (Growing fruit trees)
Handout 7 Mokgwa wa ho jala sefate sa ditholwana se seng (Grafting)
Handout 8 Tlhophiso la ditholwana le meroho

1. Temo ea machobane (Mixed cropping)

Ona ke mokhoa oo u jalang mefuta e fapakaneng ea lijalo seratsoaneng se le seng ka nako e le 'ngoe selemong. Mefuta ea lijalo eo u ka e lemang 'moho ka mokhoa ona ke eo ho leng bobebe hore e phelisane moho kapa e thusane. Sena se ka etsahala ka hore ebe sejalo se seng se atleha ho bokelletsa letsoai le itseng la bohlokoa ha se seng se sena mokhoa oa ho etsa joalo. Mohlala oo u o tsebang ke ha u jala linaoa le poone seratsoaneng se le seng ka nako e le 'ngoe. Linaoa li tseba ho bokelletsa letsoai le bitsoang "nitrogen" ka mobung ho tsoa moeeng. Linaoa li imona monoana pele ketsong ena ha poone e fumana masokotso (masalla) mobung. Molemo oo linaoa li o fumanang pooneng ke ho itšoarelletsa ka mokhoa oa ho ithatela ka eona.

Mehlala e ea latela:

- Temo ea lierekisi kapa linaoa 'moho le lijalo tse ling,
- Temo ea lijalo tse holang kapele 'moho le tse holang butle,
- Temo ea lijalo tse holang haholo li bile li le tšesanyane 'moho le tse sa holing haholo kapa tse pharallang.

Temo ea machobane e ka phethahatsoa ka mekhoa e mengata e fapakaneng, 'me ke ena e latelang:

- MOTSOAKO: Ka mokhoa ona u jala mefuta e mengata ea lijalo tse kopantsoeng 'moho. Mohlala ke ha u kopanya 'moho peo ea sepaile (mustard), rapa, anyanese le lierekisi ebe u li jala seratsoaneng se le seng. Li tla hlaha li be li hole 'moho.

- TLHATLHAMISO: U jala mefuta e maloa ea lijalo seratsoaneng se le seng ka nako e le 'ngoe ea temo empa u li hlahlamanya ka matsatsi ao u jalang peo ea tsona mobung. U ka qala ka ho jala 'garlic' meleng e arohaneng ka lisenthimethara tse leshome le metso e mehlano ho isa ho mashome a mabeli (15-20 cm). Ka mor'a hore 'garlic' e mele u jala sepaile le lihoete lipakeng ka ho latela hore na u rata ha li hlahlamana joang. Hona ke mohlala feela u ka hlahlamisa mefuta e ratoang ke uena.

- HLAKANTSUTSU: Mokhoa ona o u lumella ho jala mefuta e mengata e fapakaneng ka nako ea temo kapa ho hlahisa mefuta e mengata ea lijalo serapeng sa hau ka ho li hlahlamisa ka har'a nako ea temo, 'me e le e butsoang ka linako tse fapakaneng. U ka jala selae (lettuce) ka nako ea selemo hoba se hola hantle tlas'a maemo a pholileng ebe u se hlahlamisa ka sepinache kapa lihoete. Haele lierekisi tsona u ka li jala ho ea mafelong a hoetla e le hore u tle u li kotule ha selemo sa temo se thoasa.



Hona ke mohlala uena u ka etsa khetho ea hau. Leha ho le joalo u

ka iketsetsa liteko sebakeng seo u leng ho sona hore u tle u tsebe hantle hore na ke li fe lijalo tse lumellanang le maemo a sebaka sa heno. Haeba u etsa liphuputso tse joalo u hlokomelisoa hore u ele lintlha tse latelang hloko:

- ❖ Lijalo li hola bophahamo bo bokae?
- ❖ Lijalo li hola hantle leka potlako e kae?
- ❖ Lijalo li khathatsoa ke likokoanyana li fe le mafu a fe?
- ❖ Lijalo li beha litholoana tse ntle ka bongata le boholo bo lebeletsoeng?

Hore u tsebe ho etsa papiso e ntle u lokela hore u be le seo u tlang ho li bapisa le sona. Ho ka ba bohlokoa ha u ka li bapisa le lijalo tseo u li hlahisitseng sebakeng se le seng li sa kopangoa le tse ling.

Lijalo tse ka lengoang ‘moho ‘me tsa hola hantle ntle le mathata:





Betiruti – Anyanese
Lihoete – Lierekisi, selae, anyanese, tamati
Hanyanese – Betiruti, monokotšoai, tamati, selae
‘Eggplant’ – Linaoa

K’habeche – Litapole, betiruti, anyanese
‘Peppers’ – Meroho ea lirapeng kaofela
Selae – Lihoete, rapa ea likhomo, ‘strawberries’, ‘cucumbers’
Mokopu – Poone
Sepinache – Monokotšoai



Tamati – Anyanese, lihoete
Poone – Makotomane, linaoa, ‘cucumber’, mokopu, litapole
Moora-tsatsi – ‘Cucumbers’
Linaoa – Litapole, lihoete, k’habeche, mefuta e meng ea meroho



Motsoako oa lijalo o sa khothaletsoeng ho lengoa ‘moho:

Leha u sa khothaletsoe ho hlahisa sejalo se ka letsohong le letšehali le se bapileng le sona ka ho le letona moleng o le mong u bolokolohing ba ho iketsetsa liphuputso molemong oa ho ithuta hantle hore na ho etsahala joang.

Betiruti – Linaoa tse itšoarellang
Anyanese – Lierekisi, linaoa
K’habeche – Monokotšoai
Mokopu – Litapole
Tamati – Litapole, k’habeche
Linaoa – Anyanese
Moora-tsatsi – Litapole



2. Phapanyetsano ea lijalo sebakeng se le seng (Crop Rotation)

Leano la mokhoa ona ke hore u se ke ua hlahisa sejalo se le seng habeli kapa ho feta sebakeng se le seng ka ho latellana. U lokela hore u li feto-fetole selemo le selemo kapa ho ea ka linako tsa temo.

Mokhoa ona o na le makhabane a latelang:

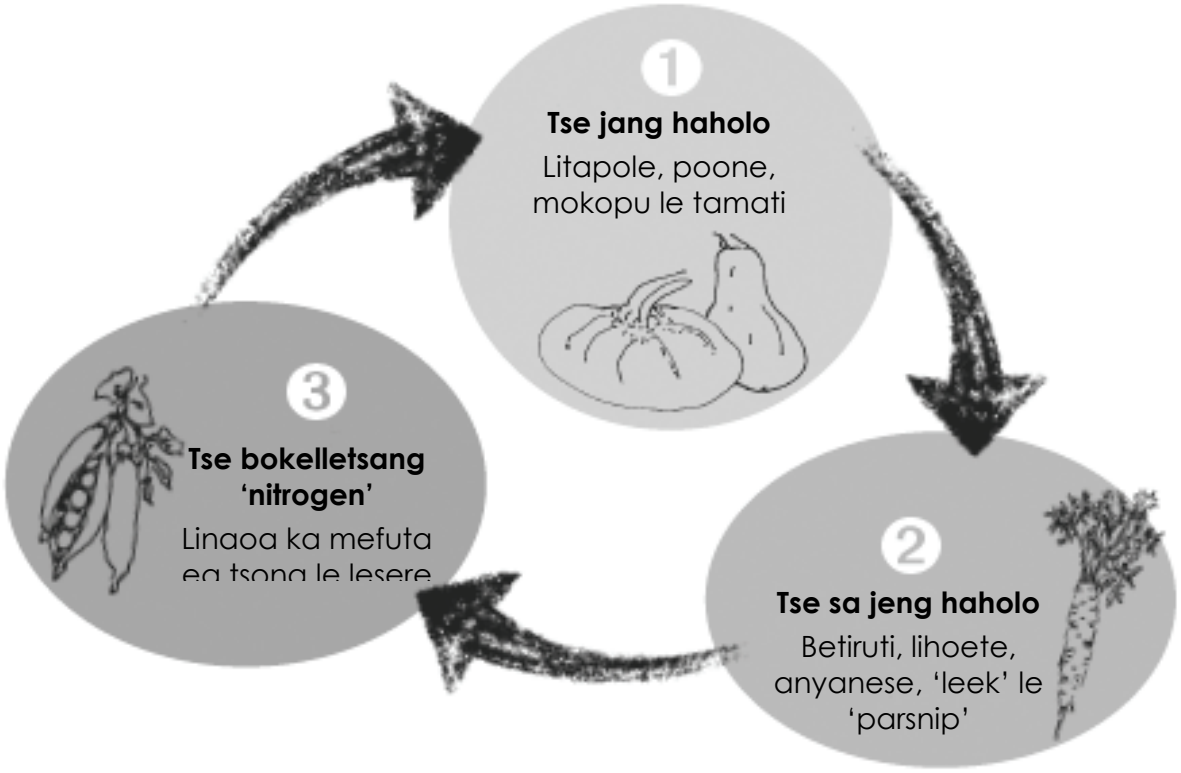
Mekhoa e mengata eo u ka e latelang ho fapanyetsana lijalo sebakeng se le seng. U ka nna ua iketsetsa liteko tsa hau e le hore u tle u tsebe hore ke o fe o khotsofatsang.

- O thusa ho laola ho ngatafala hoa lira tsa lijalo tse kang likokoanyana le mafu.
- Limela li atleha ho sielana matsoai ka mobung kaha lia fapakana ka litlhoko, moho le bongata bo hlokoang ke mofuta ka mong.
- Mobu o lula o ntse o apere selemo kaofela.
- Lijalo tse ling li atleha ho bokelletsa letsoai le bitsoang "nitrogen" joalo ka lierekisi, linaoa ka mefuta ea tsona le ha u li phetholella ka mobung nakong eo li ntseng li le tala.
- Ho thusa hore manyoa (nematodes) a mobung a se ke a fumana mokhoa oa ho ngatafala ka lebaka la khora ha a fumana lijo tseo a li ratang nako eohle.
- Mahola a holang ha bobebe ha lijalo tse itseng li lengoe seratsoaneng ha a fumane monyetla oa ho hola ha u lemme mefuta e meng.

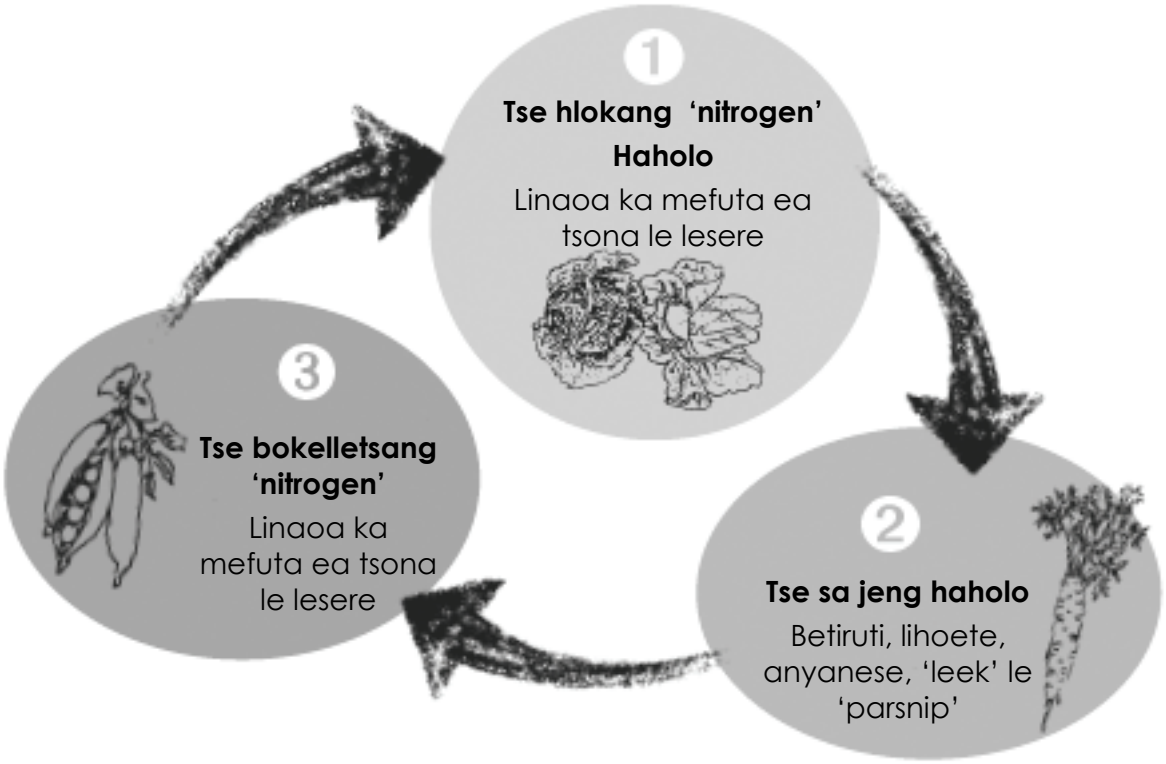
U mothating oa ho ithuta mekhoa e 'meli ea ho hlahlamisa lijalo seratsoaneng sa hau. Ka bobeli ba eona u ka hlahisa litholoana tse hlabosang. A k'u e leke e le 'meli u ntano khetha o le mong o u khotsofatsang haholo.

Mokhoa oa pele:

U ka hlahlamisa lijalo tsa hau ka mokhoa o latelang:



Hoseng joalo u ka li hlahlamisa ka mokhoa o latelang:



Bakeng sa mekhoa e 'meli e bontšitsoeng ka holimo u ka tšela manyolo ka forong ka litekanyetso tse latelang ho latela lijalo tse fapakaneng:

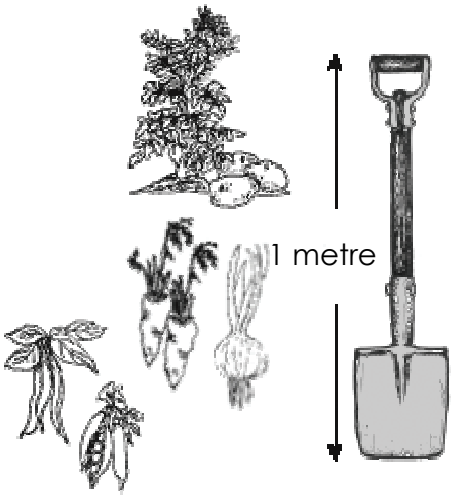
Manyolo a tletseng kharafu (a entse mohlohlo), a boima ba 'kilogram' e le 'ngoe. Bolelele ba mohato o le mong bo lekana le bolelele ba kharafu

Litapole: Kharafu e tletseng manyolo forong e bolelele ba kharafu

Poone: Manyolo a bongata bo etsang halofo ea kharafu forong ea bolelele ba kharafu.

Lihoete le anyanese: Manyolo a bongata ba 0.4 kg sebakeng sa bolelele ba kharafu

Linaoa: Manyolo a bongata ba 0.3 kg sebakeng sa bolelele ba kharafu



Lierekisi: Manyolo a bongata ba 0.2 kg sebakeng sa bolelele ba kharafu

Mokhoa oa bobeli:

Tse behang litholoana



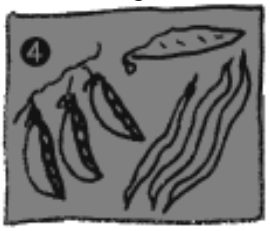
Tse Keoang makhasi/mahaba

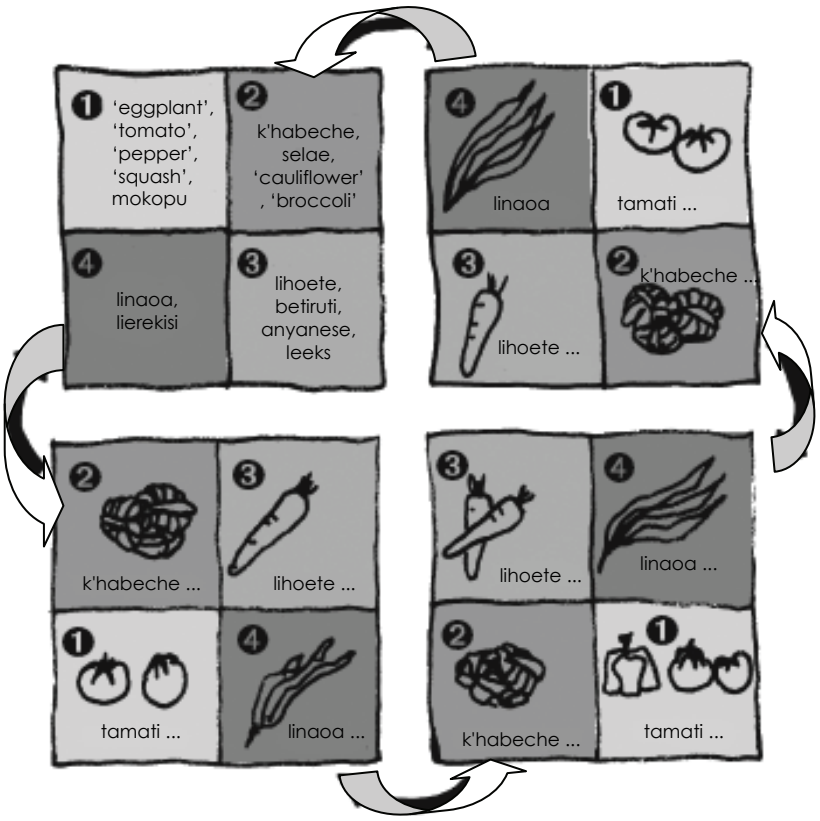


Tse jeoang metso



Lijalo tse behang ka mekotlana





Mokhoa o bobebe oa ho hlahlamisa lijalo serapeng sa hau:

arola serapa sa hau likaroloana tse 'ne tse lekanang ka boholo. ka mor'a kotulo ea lijalo tsa pele u ka jala mofuta o itseng seratsoaneng se sele.

Etsoa: the people's farming workbook, eda, 1995

Lokisa mobu oa lirapa tsa hau hantle pele u jala. Hase moiteli oa bongata ba likharafu tse 'ne tse tletseng sebakeng seo bolelele le bophara li lekanang le bolelele ba kharafu. U ka qala ka ho jala tse behang litholoana joalo ka tamati, mokopu le tse ling. Li hlahlamise ka tse kotuloang makhasi joalo ka sepinache kapa sepaile. Ke tsona tse khothaletsoang hobane litlhoko tsa tsona tsa matsoai a mobung lia fokola ha li bapisoa le tseo u qalileng ka tsona. Tsona u ka li hlahlamisa ka tse jeoang metso (methapo) joalo ka lihoete le betiruti. Haele tsona u ka li hlahlamisa ka lierekisi kapa linaoa ka mefuta ea tsona.

Hopola hore tsona li atleha ho ipokella letsoai le bitsoang 'nitrogen' ho tsoa moeeng.

Ka hona u se ke ua le kenyeletsa matsoaing ao u a eketsang mobung. U lokela ho ela hloko hore lihoete ha li lokele ho jaloa mobung oo u sa tsoa hasa moiteli kapa mosuela o mocha. Lebaka ke hore li tla hlahisa matsoele e leng se sa hlokahaleng bakeng la 'maraka. U ka mpa oa sebelisa monontša oa sekhooa bakeng la ho nontša mobu.

Kamorao hore u hlahise lihlopha tsena tse 'ne seratsoaneng se le seng u ka boela ua lokisa mobu hape joalo ka ha u ile ua etsa sethathong. Boela u li hlahlamise joalo hape.

Tlhatlhamiso ea lijalo

Ka mokhoa ona u ka lema meroho ka mefuta ea eona selemo kaofela. U ka fihlela hona ka ho jala mofuta o itseng oa moroho ka li nako tse fapakaneng empa li hlahlamana. Ka mantsoe a mang linako tsa ho jala li siane ka libeke tse seng kae. Mohlala ke oa tlhatlhamiso ea tamati. Ha e hlongoa e le ngata ka nako e le 'ngoe e tla butsoa kaofela ka nako e le 'ngoe. Ha u etsa hore sethopo se siane ka libeke nakong eo u jalang peo u tla se hloma ka nako tse fapakaneng ka hona u kotule naka e telele.

Tokiso ea seratsoana:

U ka etsa joalo ka ho phetholella mosuoela kapa moiteli ka mobung botebo bo sa feteng lisenthimithara tse mashome a mararo.

Khothaletso ke hore u hase moiteli kapa mosuoela oa bongata ba lithane tse mashome a mararo (30 tones) boholong ba ekere ea sekhooa. Haele seratsoaneng teng u ka sebilisa keribae e tletseng kapa likharafu tse tletseng tse 'ne sebakeng sa bophara le bolelele bo lekanang le bolelele ba kharafu.

Haeba re hlahisa sethopo ka likhaohano re ka sebelisa thepa e botšitsoeng mona. Hlokomela hore li na le masoba ka tlase molemong oa hore metsi a tsebe ho tsoa le teng.

- Lehlabathe: karolo e le 'ngoe.
- Mosouela: karolo e le 'ngoe.
- Mobu: karolo tse peli. Ha u qetetile li kopanye 'moho.



Lebekere le leholo



Moritsoana



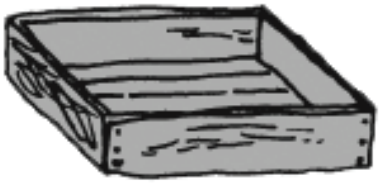
Manki



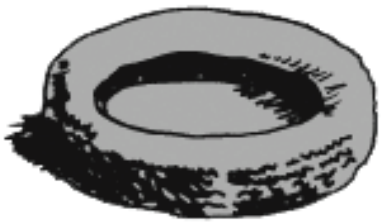
Lipolasitiki



Lehlaka



Lebokose la mapolanka kapa lithupa



Lebili la koloi le sa sebelisoeng

Etsoa: the people's farming workbook, eda, 1995

3. Taolo ea likokoanyana le mafu lijalong

Taolo ea likokoanya na le mafu lijalong

Seroalankhoana
Li ja mefuta eohle ea likokoanyana

Bobile liboko tsa bona
li ja hoaba



Linonyana, linqanqane, mekholutsoane le lempetje
Tsona li ja likokoanyana

Bobi
Bo behela mahe a bona holima liboko

Mesikaphalla
Li ja khofu le mahe a likokoanyana tse senyang, 'me ka tsela ena li nkoa e le metsoalle ea molemi hobane li mo thusa ka ho ja lintho tseo molemi a sa lihlokeng serapeng sa hae

Setšoantšo se bontsang e meng ea melemo eo likokoanyana, lihahabi le linonynana li e etsang serapeng sa hau. kaofela ha tsona li nkoa e le metsoalle eamolemi ka ha li mothusa ho laola likokoanyana

Phapano ke ntho e ntle hobane

- E sebetsa mmoho le thlaho ka ho kopitsa tsela eo limela li holang ka teng. Likokoanyana le lehola ke karolo ea thlaho. Re lokela ho ithuta ho khothaletsa likokoanyana le limela tsena tse kang bo maleshoane, seroalankhoana, 'lace wings', bobi, linqanqane, mekholutsoane le linonyana e le hore li tle li je likokoanyana tsena tse re senyetsang ka lirapeng. Likokoanyana tsena li bitsoa 'predators', 'me ha u ka oa li tlohela ka serapeng sa hau li tla u tsoela molemo.

- Lipampiring tse fetileng joalo ka ea 'tlhahiso ea lijalo', re buile ka ho jala mefuta e fapakaneng ea lijalo le ho jala lijalo tse sa tšoaneng selemo le selemo. Hape, ho a lumeleha hore meroho e ka kopangoa le limela tse ling tse nang le menkho e bohale hore e tebele likokoanyana tse senyang lijalo empa e le limela tse tlang ho hohela li 'predators'.

Setšoantšong se ka holimo, 'nasturtiums' le kuena li jetsoe 'moho le meroho.

Lethathamo le latelang ke la limela tse menkho e bohale tsoe u ka li jalang 'moho le meroho ea hau:



'Pyrethrum' le 'Feverfew'

Limela tsena ke tsa lelapa le le leng le *chrysanthemum*. Li na le lipalesa tse nyenyane tse bileng li khabisitseng ka serapeng, feela li na le chefo e ka bolaeang likokoanyana tse bakang tšenyo ka serapeng. U ka li lema mathuleng a lirapa tsa hau kapa mona le mane ka hare ho serapa sohle sa hau.

Peo ea limela tsena u ka e reka. Ngolla atereseng e latelang:
Mahlathini Organics, PO Box 807, Richmond, 3780, KZN, South Africa.



Mefuta e papakanen g ea li "nematodes"



Marigolds (Tagetes spp)

Le tsona li sebelisoa ka mokhoa o tšoanang le tse ka holimo. Li boetse li na le makhabane a hore li atleha ho tebela li 'nematodes' e leng manyooa a masesanyane a jang metso ea lijalo ka mobung.



'Fennel'

Sena ke semela se setle bakeng sa ho hohela bobi. Bobi bo behela mahe a bona kahare ho seboko 'me ka tsela ena bo atlehe ho bolaea seboko sena ka bongata.



Bobi

Wormwood (Artemisia affra) – Lengana

Limela tsena li hola hore li be li etse morunyana, kahoo, li hloka ho lengoa qetellong ea serapa kapa li fuoe sebaka sa tsona moo li tlang ho holela teng. Tee e entsoeng ka makhasi a tsona e ntle bakeng sa ho phekola sefuba.

'Khakibos' – Monkhane

Ke lehola le thusang ho thibela likokoanyana tse bakang tšenyo lijalong. Etsa bonnete ba hore li teng serapeng sa hau.



Ho jala lijalo tse kang 'cauliflowers' ,'lettuce', 'fennel' le anyanese 'moho ke mokhoa o motle oa ho loantša hoaba le 'diamond back moth'.

Serurubele le liboko sa sona

Lema lijalo tse matlafatseng tse phetseng hantle

Lijalo tse phetseng hantle ha li futuheloe ke likokoanyana le mafu.

- Ha mobu o le manoni o bile o tšeloa mosuela le moiteli selemo le selemo, o tla hlahisa lijalo tse phetseng hantle. Etsa bonnete ba hore lijalo tsa hau li lula li ena le metsi ha ho hlokeha.

- Nakong eo u kotulang, khetha lijalo tse phetseng hantle ho feta tse ling, moo ho tsona u tla iphumanela peo.

- Pele u jala, khetha peo kapa sethopo se phetseng hantle, hobane ha u sa etse joalo, ha lina ho atleha ha li ntse li hola.

- Jala meroho ea hau ka nako e nepahetseng ea selemo sa temo (u khothaletsoa ho bala sehloho sena 'Thlahiso ea lijalo'. Lijalo tse ling li hloka ho jaloa e sa le nako e le ho li sireletsa hore li se ke tsa futuheloa ke likokoanyana le mafu. Mehlala ke seboko sa lehlaka pooneng le 'blight' litapoleng.

- Tšireletso ea mobu letsatsing (u khothaletsoa ho bala sehloho se buang ka 'Ho koahela mobu hore u se lahleheloe ke mongobo').

- Ha u qeta ho hlaola, se sie lehola le tletse-tletse le serapa sa hau hobane menkho ea lona e hohela likokoanyana tse senyang lijalo. Hona le hore li tlale-tlale joalo, u ka li sebelisa ho etsa mokeli-keli (u khothaletsoa ho bala sehloho se buang ka 'Ntlafatso ea mobu'). Ntle ho moo, lehola lena u ka le kopanya le litlama-tlama tse ling ho etsa totoma ea mosuoela.

Haeba u bona hore mekhoa e ka holimo ea ho thibela likokoanyana le mafu lijalong tsa hau e sa sebetse, ho ntse ho ena le mekhoa e meng eo u ka e sebelisang ho phema mathata ana.

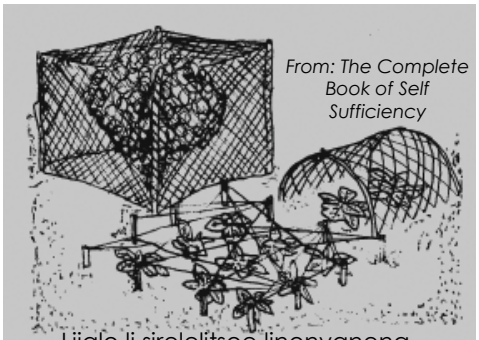
Thibelo ka tšebeliso ea lintho tseo u ka li bonang oa ba oa li tšoara

Linonyana:

U ka qobisa lijalo tsa hau hore li se ke tsa jeoa ke linonyana ka mekhoa e latelang:

- Sebelisa lithupa tse 'ne (4) le nete ho etsa hoko (cage) ea linonyana

- Koahela sethopo sa hau ka nete kapa boseka bo faselelitsoeng terateng e kobehileng halofo



Lijalo li sirelelitsoe linonyaneng ka tšebeliso ea nete kapa ea boseka bo faselelitsoeng 'moho

- Faseletsa terata tse ngata 'moho e be u li tlamella ka li phek'se (pegs).

- Litšosetsi le tsona lia khothaletsoa, feela li lokela hore li se ke tsa lula ng'a e le ngoe nako e telele hobane linonyana li tla qetalletse li se li litloaetse, ebe ha li sa tšoha.

Seseli:

Seseli



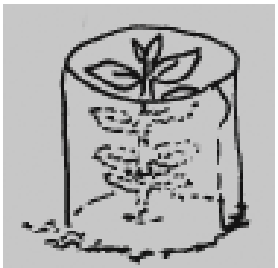
Mofuta ona oa seboko o motenya, o 'mala o mosoothoana. O phela ka tlase ho mobu hanyane, moo teng o senyang ka hoja mahlakana (stems) a lijalo tse nyenyane.



- Mokhoa oa ho tlosa seseli ke hore, hoseng u no cheke ka monoana pela lijalo tse pongoeng, ebe u nka seseli seo u fepe likhoho tsa hau kapa u se bolae.

Setšireletsi se sirelelitseng sethopo ho seseli

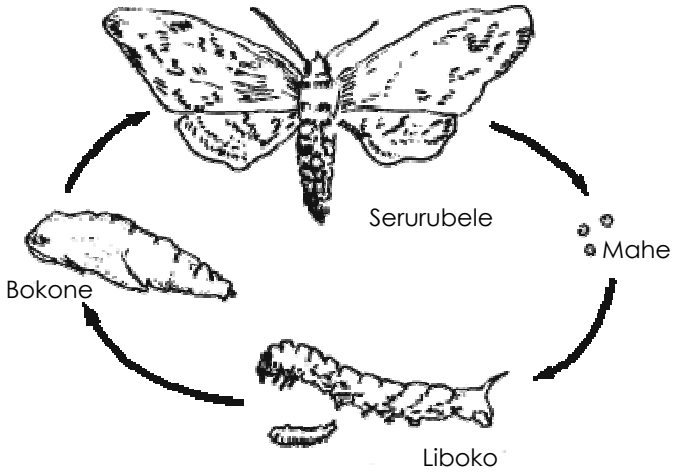
- Litšireletsi li teng tse ka sebelisoang ho sireletsa sethopo sa hau ho seseli. Tsona li pota potisoa sethopo hang ha se qetoa ho hlongoa. Mohlala, u ka sebelisa lebokose la lebese le rekoang la motsilili, lona ebe u le bula ka holimo le ka fatše, u ntano hloma sethopo sa hau ka hare ho lona. U ka boetse oa sebelisa botlolo ea polasitiki, le eona u e khaole joalo ka lebokose la lebese. Khothaletso ke hore litšireletsi tsena li tebisoe ha li kengoa mobung, bonyane botebo ba menoana e 'meli (3cm) ho seng joalo seseli sena se tla phunyeletsa ka tlase ho tsona.



From: Production without Destruction, 1995

Bongata ba liboko bona le thlathlamano (life cycle) e latelang ea bophelo ba tsona:

Ho qala ka serurubele se tla behela mahe, ao oona a tlang ho qhotsoa, ebe ho hlaha liboko. Seboko sena ke sona se jang lijalo. Kamor'a nako seboko sena sea fetoha ebe bokone, boo bona ka lehlohonolo bo sa senyeng lijalo tsa hau. Le ha hole joalo, bokone bona le bona bo tsoala serurubele se tlang ho behela mahe a tla qetelletse a qhotsitsoe, liboko li hlasele lijalo, ebe li ntse li iphetha joalo-joalo.



Thla-thlamano ea bophelo ba tse ling tsa likokoanyana

Leraba la khanya bakeng sa ho tšoasa lirurubele

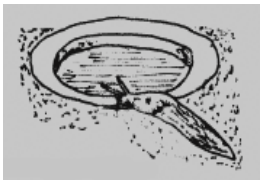


From: Production without Destruction, 1995

Ho bonolo hore u hohele mefuta e fapakaneng ea lirurubele u sebelisa leraba le nang le lebone. Lona le behoa kantle bosiu. Leraba lena la khanya le tla fokotsa sekhahla seo mahe a beheloang ka teng ke mefuta e fapakaneng ea lirurubele.

Likhofu:

From: The Complete Book of Self Sufficiency



Sekotlolo se tsetetsoeng ka serapeng se tšetse joala ho hohela likhofu

- Li ka tlosoa hantle feela ka matsoho. Li tšele ka nkhong e tšetseng metsi kapa li fepe likhoho.

Khofu



- Mokhoa o mong hape ke hore u nke sekotlolo se tletseng joaloa e be u se beha serapeng sa hau. Etsa bonnete bahore se lutse hantle hoo khofu e tlang ho hoheleha ha bobebe e be e qetelletse e kolumetse ka sekotlolong. Ha ese e oetse, e fepe likhoho kapa u e bolae.

Tee ea limatlafatsi

Likokoanyana le mafu a lijalo li ka behoa tlas'a taolo ka tšebeliso ea mefuta e fapakaneng ea metsoako ea lijalo. Tšebeliso ea tsona e etsoe feela haeba mekhoa eohle e se e hlotsoe. Makhabane a ho sebelisa mokhoa ona ke hore ha o theko e phehameng hape o ka etsetsoa lapeng.

Toantšo ea likokoanyana le mafu



Lintlha tsa bohlokoa tsa ho etsa motsoako oa ho tšella lijalo

- Sebelisa sesepa se kang 'sunlight' e seng sa phofo kapa se metsi. Se kopanye le motsoako oa hau ho etsa hore motsoako o tle o mamarele lijalo le likokoanyana.

- Sebelisa lesela ho sefa motsoako. Ha u se u sefile, u ka sebelisa lefielo ho o fafatsa.

- Ka ha motsoako ona o chefo, etsa bonnete ba hore o anela likokoanyana le matšoao a mafu hantle.

- Metsoako e meng e chesa lijalo haeba e loile haholo, kahoo, u lokela hore u etse teko ea motsoako oa hau lijalong tse 'maloa pele u ka e tšela serapeng kaofela.

NTLHA EA BOHLOKOA:

Kaha motsoako oo e le chefo, etsa bonnete ba hore bana ha ba atamele moo u ntseng u o etsa. Haeba u tlo belisa motsoako, sebelisa pitsa ea khale eo u seng u sa e sebelise ho pheha. Roala liatlana ha u ena le tsona.



- Khothaletso ke hore u fafatse likokoanyana tse senyang lijalo motseare oa mantsiboea.

- Ha pula e ena, se ke oa fafatsa hobane motsoako o tla hlatsoeha o batle hore o u tšele hape.

Lethathamo le latelang ke le bontšang tse ling tsa limela, hore na motsoako o riteloa joang le hore na o sebelisoa ho phekola eng:

Lekhala

Mofuta ofe kapa ofe oa lekhala o ka sebelisoa.

- Sila makhasi a lekhala ebe u oa tšela metsing ka karoloana ea 'ngoe ea phofshoana ea lekhala ho tse hlano tsa metsi (1:5). Hona ho bolela hore metsi a be mangata ha hlano ho feta makhasi. Ha u qeta, sefa motsoako ka lesela ebe u fafatsa lijalo tsa hau.
- Mokhoa o mong e ka ba oa ho sila makhasi a ommeng ebe u fafatsa lijalo le peo ea hau.



TOANTŠO:

- Lekhala le loantša likokoanayana ka mefuta ea tsona kaofela, marutle, hoaba le seboko;
- Tšupa;



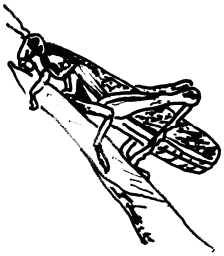
Hoaba



Bohloa



Masetlaoke



Lerutle



Theepe

Nka makhasi a ntseng a le metsi a ka tlalang polasitiki (1Kg) ebe u oa sila. Kopanya lero le tsoang moo makhasing le li lithara tse tharo (3L) tsa metsi a sesepa ebe oa fafatsa.

TOANTŠO:

Motsoako ona oa theepe o loantša mefuta e fapakaneng ea mafu a kang matheba a fumanoang mokhasing (leaf spot) le lefu la makhasi le bitsoang 'blight'.

Lengana

Khabella makhasi ka karoloana e le 'ngoe ho isa ho tse 'ne (1:4) ka metsing, hona ho bolela hore ho seatla se seng le se seng se tletseng makhasi, u tšele li lithara tse 'ne (4) tsa metsi, ebe u li tlohela ka metsing ao matsatsi a mabeli ho isa ho a supileng pele u o sebelisa. Kopanya motsoako oo le sesepa..



TOANTŠO: Motsoako ona o loantša likokoanyana ka kakaretso le likhofu.

Monkhane

Nka peo e ka tlalang lebekere e be u e belisa metsotso e leshome, kapa u e tlohele ka metsing bosiu kaofela. Kopanya motsoako oo le lithara e le 'ngoe ea metsi a sesepa e be oa fafatsa.





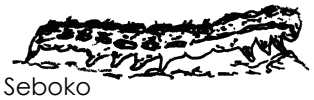


TOANTŠO: Motsoako ona o loantša likokoanyana ka kakaretso, hoaba, bohloa, maleshoane, liboko, seseli, 'mites', le litšintši.

Chilisi

- Khabela lichilisi tse ka tlalang lebekere (hlokomela u seke oa isa matsoho mahlong, u tla fahloa ke chilisi e saletseng moo).
- Kopanya chilisi le lithara tse peli tsa metsi.
- Tlohella chilisi ena ka metsing matsatsi a ka bang mabeli ho isa ho a mararo kapa u li belise metsotso e leshome le metso e mehlano.
- Kopanya lebekere le tletseng la makumane ho fihlela tsohle li qhibilihile .
- Sefa motsoako ho tlosa masalla a chilisi.
- Ha ho chesa haholo, fafatsa motsoako ha 'ngoe ka beke.





TOANTŠO: Chilisi e loantša liboko, hoaba le bohloa.

Hlokomela hore motsoako ona o ka chesa makhasi a lijalo tsa hau ha eba o loile haholo

'Garlic' le Anyanese



Khabela 'garlic' tse tharo tse kholo (kapa anyanese ho isa ho tse peli), ebe u li inela matsatsi a mabeli ka mafureng kapa ka parafining e ka tlalang likhaba tse kholo tse peli. Sefa ebe u kopanya le lithara e le ngoe ea metsi a sesepa. Hlapolla motsoako ona ka karoloana e le 'ngoe ho tse leshome tsa metsi ebe oa fafatsa.

TOANTŠO: Li loantša likokoanyana ka kakaretso, hoaba, 'mites', manyoha le masetlaoke. Hape o boetse o phekola mafu a kang matheba a fumanehang makhasing (leaf spot), 'blight' le 'damping off'.



Masetlaoke



Bohloa



Hoaba

'Marigolds'



Mona teng re sebelisa sejalo kaofela. Sebelisa limela tse peli ho isa ho tse 'ne (2-4), e be u sila makhasi, methapo le lipalesa tsa tsona 'moho. Li tšele ka metsing a belang a etsang lithara ebe u li inela letsatsi le le leng. Letsatsi le hlahlamang, kopanya

motsoako le lithara ea metsi a batang a sesepa ebe u tšella lijalo tsa hau. Sebelisa masalla a makhasi le methapo ho sireletsa mobu khahlanong le lebatama la letsatsi.

TOANTŠO: 'Marigold' e loantša likokoanyana ka kakaretso, bohloa, hoaba, maleshoane, seboko sa lehlaka, hammoho le mefuta e mengata ea mafu joalo ka matheba a fumanoang makhasing (leaf spot) le lefu le bitsoang 'blight'.

Koae



THLOKOMELISO: Koae e kotsi haholo kaha e le chefo bathong le likokoanyaneng. Joale, etsa motsoako o latelang ka hlokolosi.

- Sebelisa liatla tse peli tsa makhasi a omeletseng a koae kapa li tompi tsa koae.
- Tšela lithara tse hlano tsa metsi ebe u belisa tsohle metsotso e ka bang mashome a mararo. Sefa motsoako e be u kopanya le sesepa. Emela motsoako o fole. Tšella ka oona ha 'ngoe ka beke.




Seseli

TOANTŠO:

E loantša seseli, seboko, hoaba, litšintši le tšupa.


Tšupa

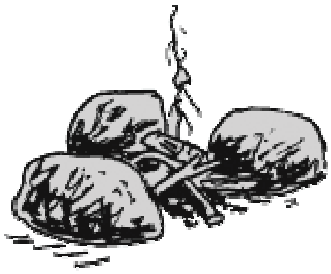
Liboko


Hoaba

Phekolo u sa sebelise limela

Lethathamo le latelang ke la ho phekola likokoanyana le mafu lijalong u sa sebelise limela.

Molora oa patsi



Kopanya khaba e kholo e tletseng molora oa patsi le lithara e le 'ngoe ea metsi a sesepa. Tlohela motsoako bosiu kaofela. U sebelise ho fafatsa likokoanyana ka kakaretso.

Hlobo



Matheba a masehla le likaroloana tse bopang lekhasi le ha feela li se li shoele



Ke phofshoana e tšoeu e fumanehang haholo ka holima lekhasi

Kopanya khaba e kholo e tletseng molora oa patsi le lithara e le 'ngoe ea metsi a sesepa, kopanya hape le lebekere le tletseng la mafi ebe u boetse u tšela li lithara tse tharo tsa metsi..

TOANTŠO: Molara oa patsi o phekola 'mildew' lijalong le mefuta e mengata ea likokoanyana.

- Ala molora oa patsi u pota potisa sejalo sa hau, ebe u tšella hanyane ka hanyane.

TOANTŠO: Likhofu, seseli

Phofo

Kopanya khaba e kholo ea phofo metsing a lithara e le 'ngoe. Tlotsa bo ka fatše ba makhasi e leng moo li 'mites' le hoaba li ratang ho ipata teng. E sebelise hoseng mohlang ho chesang.

TOANTŠO: 'Spider mites', liboko le hoaba.



Hoaba Seboko 'Mites'

Lebese

Kopanya lithara ea lesebe le li lithara tse leshome tsa metsi, ebe u tšella lijalo tsa hau e le ho loantša 'spider mites' le ho phekola mafu a kang 'mildew' mokopung, 'blight' tamating le litapoleng le 'mosaic virus' lipepereng. Tšella ka mor'a matsatsi a mang le a mang a leshome.

Mokeli-keli /Tee ea Mosuoela

Bala sehloho se buang ka 'Ntlafatso ea mobu' moo teng ho hlalositsoeng ka botebo ho etsa mokeli-keli.

- Kopanya kharafu e le 'ngoe e tletseng ea mosuoela kapa moiteli kahar'a metsi a li lithara tse leshome.
- Tlohela motsoako ona matsatsi a leshome ho isa ho a leshome le metso e mene.
- Moiteli oa liphoofolo o tlameha ho hlapolloa ka karoloana e le 'ngoe ea mokeli-keli ho tse 'ne tsa metsi (1:4). Tee ea mosuoela eona e sebelise e le joalo.
- Fafatsa motsoako ona lijalong tsa hau hangoe ka mor'a matsatsi a supileng ho isa ho a leshome.

TOANTŠO: Ka kakaretso e sireletsa lijalo khahlanong le ho futuheloa ke likokoanyana le mafu. Liboetse li na le matla a ho tebela hoaba, liboko, marutle, maleshoane, 'mites' le seseli.



Seseli Lerutle

4. Tšireletso ea lijalo moeeng le serameng



Mela ea lijalo le lifate tse fapaneng tse lengoeng ‘moho li ka tšireletsa serapa sa hau moeeng le serameng (frost). Se tšireletsi sa moea ke ntho efe kapa efe e ka sebelisoang ho tšireletsa lijalo tsa hau moeeng. E kaba lijalo tse ling kapa lifate. Se behoa moo moea o hlahang teng. Se thusa ka ho fokotsa matla a moea, o fihle lijalong tsa hau o se o fokotsehile. Ka holimo ke mohlala oa tšireletso e joalo e bileng e nang le mefuta ea furu bakeng sa liphoofolo. Lijalo tsena tse sebelisitsoeng ka holimo li ka boela tsa sebelisoa e le lijo tsa lipoli, likhomo, linku le likhooho!! Setšoantšo sena se ka holimo se bontša ‘li cow peas’ tse imamaretseng sefateng, hammoho le mefuta e latelang ea limela:’napier fodder’, ‘pigeon pea’ le cheche. Li mela tsena li ntle bakeng sa ho ntlafatsa mobu, ha makhasi a tsona oona a ka sebelisoa ho tšireletsa mobu ho le batama la letsatsi. Makhasi ana a ka boela a sebelisoa serapeng se bopehileng joalo ka lesoba la senotlolo. (u khothaletsoa ho bala sehloho ‘ntlafatso ea mobu’).

Ho tšireletsa moea

Ho foka ha moea ke ntho ea bohlokoa lijalong. Moea o thusa ho qobisa lijalo mafu a bakoang ke mangobo o mongata le a mang a mafu a bakoang ke ho ba sio ha oona moea. Moea o boetse o thusa ho qhalakanya peo e fumanoang lipaleseng tsa sejalo.

Moea o ka ama lijalo tsa hau ka tsela e mpe tjena:

- Meea e matla e ka roba lijalo le ho koqola lifate
- Meea e omileng enka mongobo e be lijalo li sala li omile.
- Meea e chesang kapa e batang haholo e ka senya lijalo.
- Lerole le hoholoang ke moea le ka hohla lijalo tsa hau joalo ka ha eka ke sekiripoto.
- Moea o boetse o baka khoholeho ea mobu, haholo li kheoling tseo ho omelletseng. Ha moea o le mongata, o nka mobu o ka holimolimo o nang le matsoai a mangata o sie o seng motle haholo.

Setšireletsi o ka sebeha kae

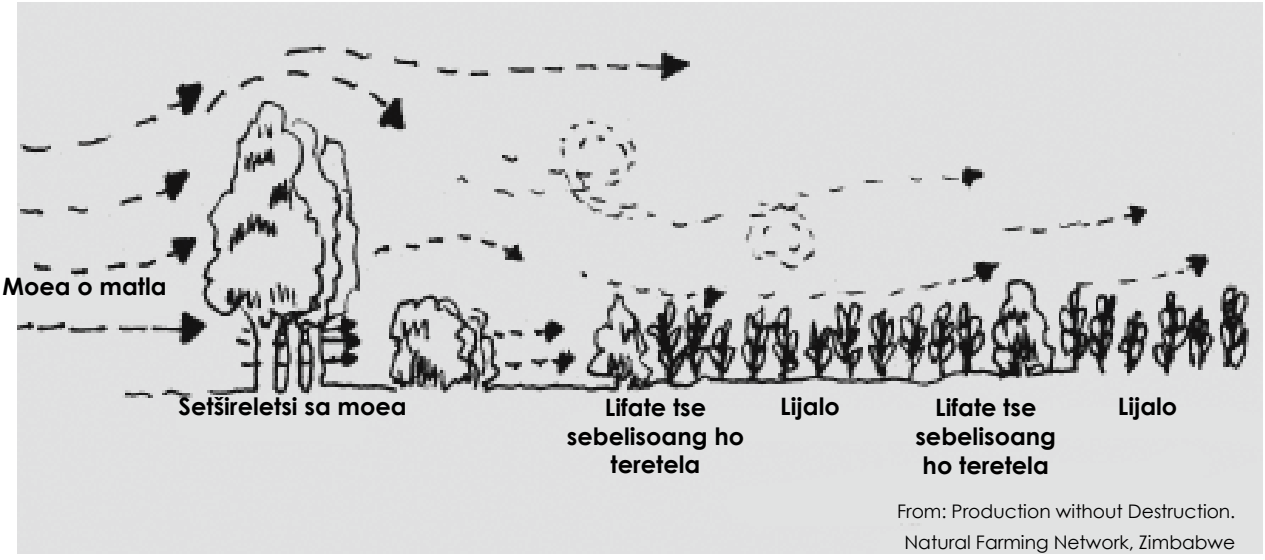
Litšireletsi tsa moea li ka lengoa moo moea o hlahang teng. Li lokile haholo ha li lengoe malapeng. Hape li ka lengoa pela tsela. U ka li sebelisa hape ho teratela jarete kapa tšimo ea hau.

Bohlokoa ba litšireletsi tsa moea

- Li fana ka patsi
- Li fana ka litholoana
- Lia hlaba ho tširelatsa masholung
- Li fana ka lijo tsa liphoofolo
- Li fana ka meriana

Mokhoa oa ho etsa setšireletsi sa moea

Setšireletsi sena se etsoa ka ho lema lifate le lihlahla tsa mefuta le bolelele bo fapakaneng. Li lengoa li teteane hanyenyane hore moea o tsebe ho feta lipakeng empa o se ose matla hakaalo. Li tšireletsi tse matla haholo ke tse entsoeng ka bonyane mela e meraro ea lihlahla le lifate tsa bolelele bo fapakaneng.

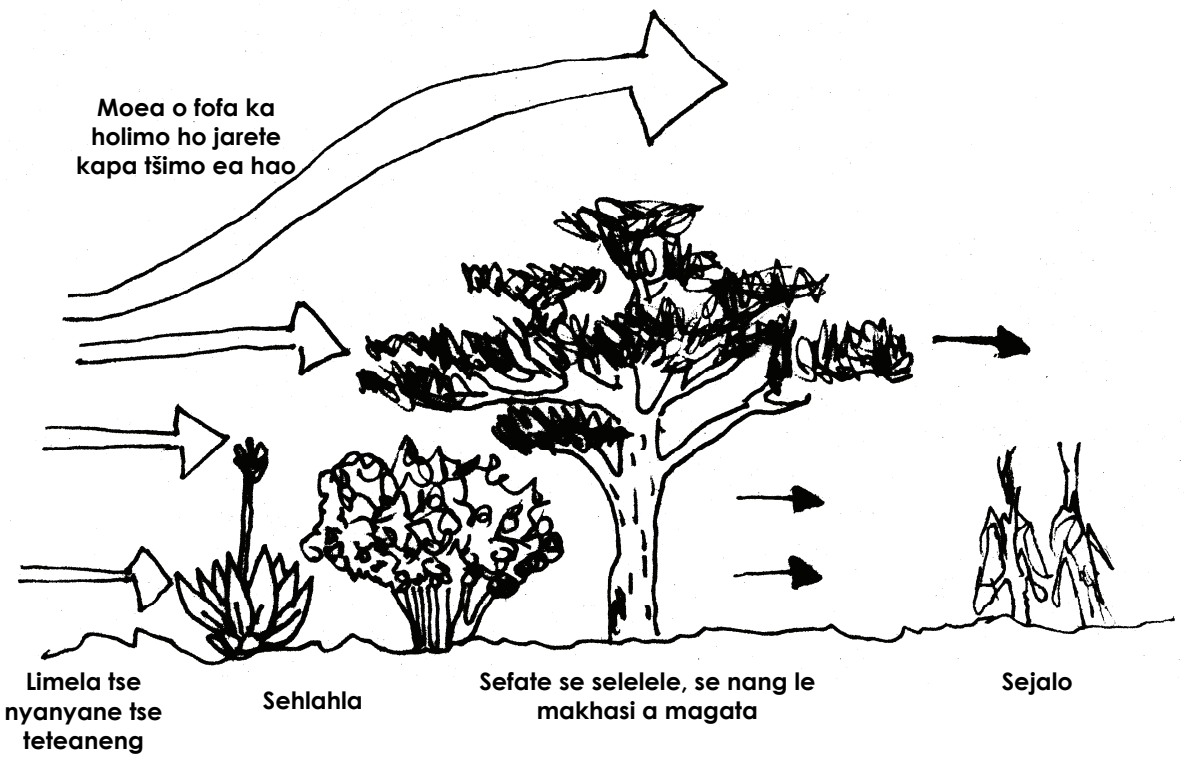


From: Production without Destruction. Natural Farming Network, Zimbabwe

Lifate kapa li hlahla li kanna tsa lengoa moleng o le mong kapa ho e 'meli ha feela u ka oa etsa bonnete ba hore makhasi le makala a tsona a tla fihla fatse. Ha ele lifate tse telele feela tseo u tšireletsang ka tsona, makala a tlaase a shoa ka mora nako e be a sia lifate lepalapaleng, moea o ntano iphethela feela o le matla o le joalo e be o lo senya lijalo tsa hau.

Lifate tse khutsoanyane le lihlahla li ka lengoa ka lehlakoreng leo moea o hlahang ka lona.

Tse latelang ke mehlala ea limela, lihlahla le lifate tseo u ka lisebelisang!



From: The People's Farming Workbook, EDA, 1995

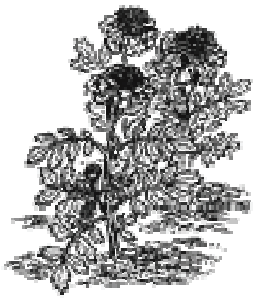
Limela tse nyeyane	Lihlahla	Lifate
❖ Lekhala ❖ Comfrey ❖ Wormwood ❖ Herbs such as rosemary, thyme, lavender ❖ Marigolds ❖ Fennel ❖ Runner Bean ❖ Lifate tsa morara ka mefuta	❖ Napier Fodder ❖ Pigeon pea ❖ Buddleja or Sagewood ❖ Halleria or Tree Fuchsia ❖ Dovyalis or Kei-Apple ❖ Carrissa or Num-Num ❖ Euclea or Blue Guarri	❖ Casuarina or Beefwood ❖ Cheche ❖ Mulberry

Linthla tse ling mabapi le limela, lihlahla le lifate tse khothalelisoeng

Lekhala

Le letle haholo bakeng sa ho tšireletsa kaha e bile le a hlaba, hape le fana ka tšireletso mollong hobane makhasi a lona a na le metsi a mangata. Le ka boela la sebelisoa e le moriana. Mofuta o motle oo u ka u sebelisang oa lekhala ke o bitsoang 'aloe maculate'. Lena ke lekhala le sa holeng hore le be le lelele haholo, le na le mathebatheba a masoeu makhasing. Lero le fumanoang makhasing a lona le letle haholo e le moriana oa ho sokela. Lekhala lena le boetse le na le letsoai le bitsoang 'selenium', le o lona e leng tlatsetso ea bohlokoa masoleng a 'mele oa hau.

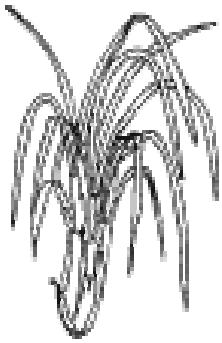
Haele lekhala leo batho ba tloaetseng ho itemela lona malapeng a bona le bitsoa 'aloe striatula', lona le hola haholo, le tlala sebaka.



Marigolds and Fennel

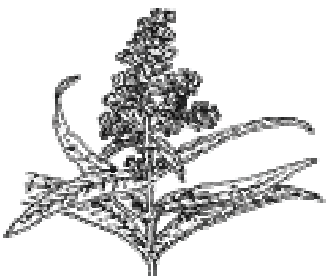
Tsena ke limela tse nyenyane tsenang le monko o bohale. Lithusa hore jarete ea hau e se futuheloe ke likokoanyana. Lipalesa tsa fennel tse bopehileng joalo ka sekhela, li thusa ka ho bitsa likokoanyana tse tlo ja tsena tse bakang tsenyo jareteng, tse kang hoaba le liboko. Marigolds tsona li ka sebelisoa e le chefo e tla bolaea liboko ka mobung.

Napier fodder



Sena ke semela se matla sa mofuta oa furu. Se boetse se se tle bakeng sa ho tšireletsa mobu (mulching). Se hola kapele. Se nyalisoa ka ho nka lehlomela le lenyenyane ho tsoa sefateng seo re ka sebitsang ka hore ke 'ma sona. Hape, se kanna sa hlahisoa ka tsela ea hore mahlaka a sona a aloe ka hara foro e sa tebang haholo, moo se tlang ho hola ka lebaka la linoko tse fumanoang moo lehlakeng (stem). Sebakeng seo ho batang, semela sena se tla robala mariha (empa makhasi a omeletseng oona a tla sala a tširelelitse). Se tla boela se hloma hape ka selemo (spring).

Lelothoane

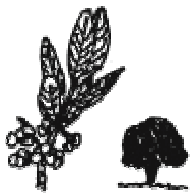


Tsena ke lihlahla tse holang kapele, tse lulang li le tala selemo ho pota. Hona ho bolela hore ha li hlohlorehe makhasi mariha. Hape, ha li bolaoe ke serame (frost). Ha li sale nyenyane li hloka tšireletso e matla empa hang kamorao ho moo li ikholela hantle ho se mathata. Lipalesa tsa tsona li bitsa/likhahla linonyana le linotsi. Makhasi a tsoana a ka sebelisoa e le moriana oa mahlo kapa e le tee.



Lebetsa

Sena ke sehlahla feela se ka hola ho fihlela e kaba sefate se senyenyane. Se hola ho fihlela se eba bolelele ba limithara tse tharo hoisa ho tse leshome (3-10 m high). Sena le mahlaka a mangata a ka holang hore a etse patsi, lithupa tsa jareteng (joalo ka ho phahamisa tamati) kapa ho teratela. Sena le lipalesa tse fubelu kapa tse mobala ekang oa lamunu tse khahlang linonyana le linotsi. Litholoana tsa teng lia jeoa.



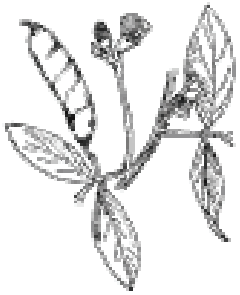
Mohlakolo, Motsoetla

Ke sehlahla kapa sefate se lulang se le setala ho pota. Se hola ho fihlela se eba bolelele ba mithara ho isa ho tse hlano (1-5 m). Sena le litholoana tse nyenyane tse ntšo tse bopehileng joalo ka erekisi, tse jeoang. Se atile haholo Lesotho.



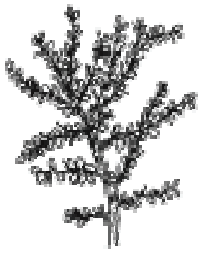
Carissa bispinosa; Num-num

Ke sehlahla se na le makala a mangata a hlabang. Se setala ho pota. Makhasi a sona a matenya a benya. Litholoana tsa teng li nyenyane, likhubelu, li monate hape li ka sebelisoa ho etsa jeme.



Cajanus cajan; Pigeon Pea

This is a small tree that is native to Africa. It fixes nitrogen in the soil and has deep roots. It can be used for firewood. It is frost tolerant, but needs to be protected when young. The young leaves can be eaten as spinach and the seeds are eaten as beans or 'dahl'. The leaves are also good fodder for animals; especially cattle and goats.



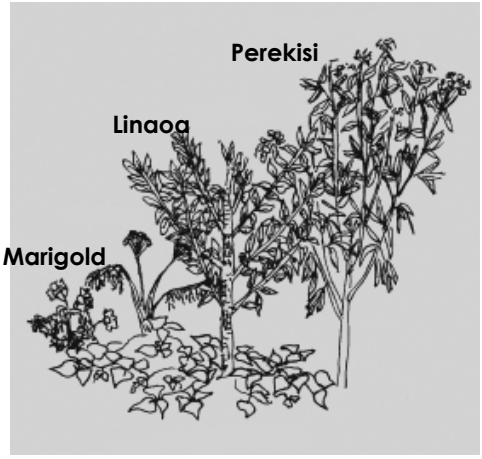
Dovyalis caffra; Kei Apple

Sena ke sefate se senyenyane senang le meutloa le makhasi a nang le boeanyana bo boseou ka holimo. Se sebelisoa haholo ho teratela (hedge). Se batla se lieha ho hola. Se mamella komello le serame. Se hloka ho tšireletsoa serameng ha se sa le senyenyane. Litholoana tsa teng li monate, hape li ka etsoa jeme kapa 'jelly'. Hlatsoa boeanyana bona bo bosoeu peong pele u e jala.

Mulberry



Tsena ke lifate tse kholo, tse hlohlorang makhasi a tsona mariha. Makhasi ana a matle haholo bakeng sa furu. Monokotsoai (berries) oa teng o motšo ka 'mala, o tsoekere hape o ka etsa jeme. Ho bobebe ho hlahisa mulberry ka mokhoa oa nyaliso. Li ka purungoa ea ba makala ao a sebelisoa ho teratela, e le patsi kapa ho tšehetsa lijalo serapeng.



Ho a lumelleha hore u leme lifate tsa litholoana hammoho le tsena tse boletsoeng ka holimo. Ka tsela ena, u tla thusa ho tšireletsa litholoana tsa hau serameng, moeeng le ho hlaseloa ke likokoanyana. Ka lehlakoreng le letšehali ke mohlala oa sefate sa perekisi se lengoeng hammoho le linaoa, 'marigolds', 'fennel' le lierekisi.

Motsoako oa limela tse fapakaneng o ka sebelisoa.



Casuarina Cunningham; Beefwood

Sefate sena se tsoa Asia le Australia. Ke sefate se seholo se fanang ka moriti, senang le makhasi a kang a sefate sa phaena. Se hola kapele ebile se hola hantle mobung o seng motle ha kaalo. Se fana ka patsi le timber (e etsang mapolanka). Se lengoa ha bonolo ka peo. Se mamella serame (frost) hanyenyane feela, se bile se hloka ho tšireletsoa ha se sa le senyenyane.



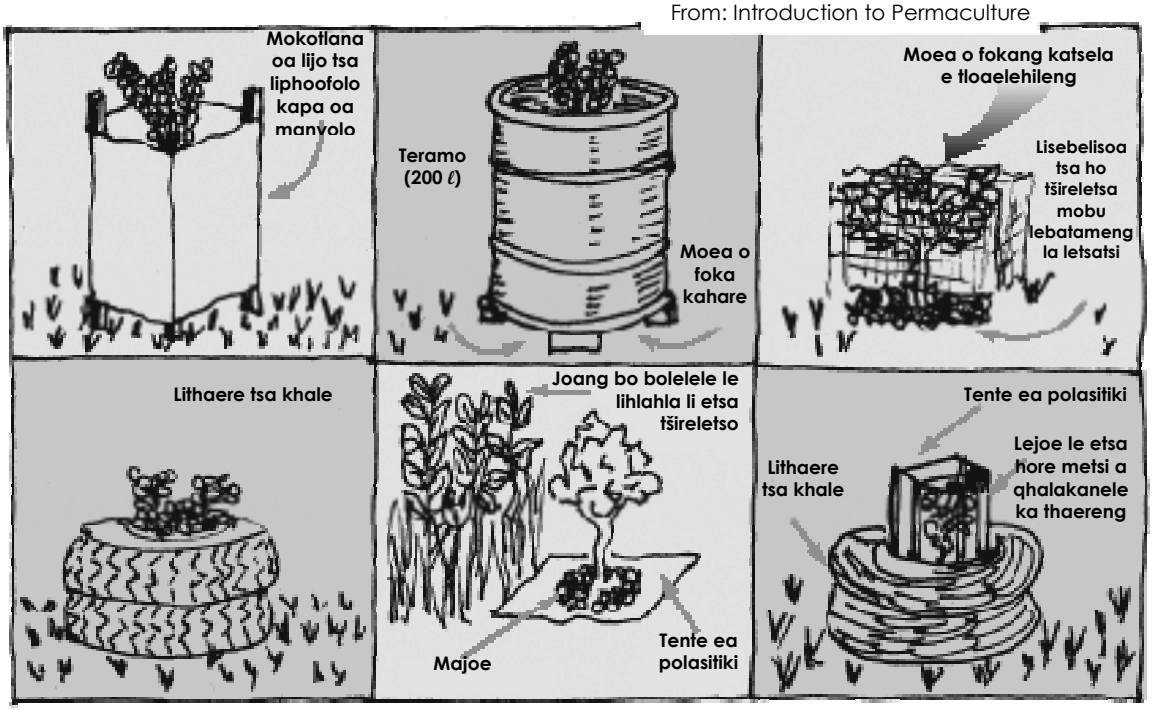


Creche

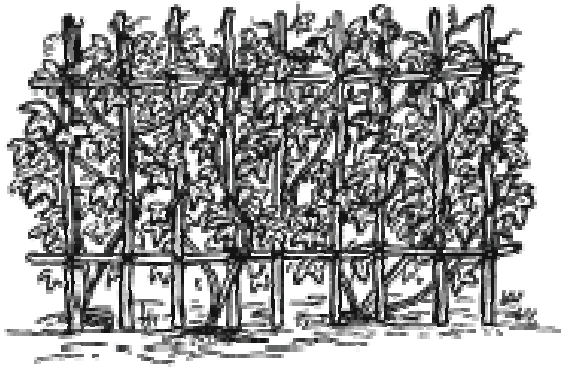
Tsena ke lifate tsenang le mamello, tse holang kapele, ebile li na le meutloa. Li mamela serame le komello. Li sebetsa (fix) letsoai nitrogen ka mobung. Li fana ka patsi. Makhasi, lipalesa le mokotlana (pods) ea tsoan e ka sebelisoa e le furu.

Ho kanna ha se be bonolo ho fumana tse ling tsa limela/lifate/lihlahla tse boletsoeng mona. Ha li sale nyenyane, li hloka ho tšelloa le ho tšireletsoa serameng. Litšoantšo tse latelang ke mehlala e bontša mokhoa oa ho tšireletsa lijalo le lifate tsa hau moeeng le serameng.

From: Introduction to Permaculture

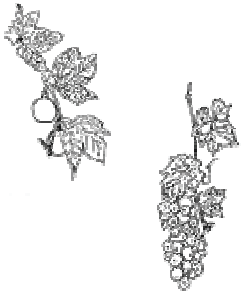


U kannna oa sebelisa lintho tse ling hape bakeng sa ho tšireletsa moea jareteng ea hau. Tsona ke:



- Terata e entsoeng ka lithupa tse sesane. U ka sebelisa lithlaka tsa poone tsa khale kapa tsa semela se bitsoang 'black jack'.
- U ka lema morara kapa lijalo tse ling tse itšoarelletsang terateng, feela ha ho bonolo ho fumana lijalo tse joalo tse sa tšabeng serame. Le ha holejoalo, 'passion fruit' kapa 'granadilla' ha li setšabe hakaalo. Hona ho bitsoa ho mamella serame (frost tolerant). Ho bolela hore haeba u lebeletse hore ho tlaba le serame se sengata, hape le morara oa hau o sa le monyenyene, u tla lokela hore u koahele o se fumane serame. Ha nako e ntse e ya, le morara oa hau o se o holile, u tla atleha ho mamella serame ha bonolonyana. Mefuta e meng ea lijalo tse itšoarellatsang terateng e hlohloreha makhasi mariha. Le ha hole joalo, entse e fana ka tšireletso.

Mehlala ea eona ke; morara, 'kiwi', linaoa tse itšoarelletsang joalo ka 'lima', 'seven year beans', 'red runner beans'.



- Sehlotšoana sa mohlomo kapa lithlaka tsa poone li ka faselletsoa terateng lehlakoreng leo moea o hlahang ka lona.
- Mekotlana ea lijo tsa liphoofolo kapa ea lilamunu e ka rokelloa 'moho ebe e faselletsoa terateng entse ele e ngoe tsela ea ho tšireletsa moea.

Teko/Patlisiso



U lokela ho etsa qeto ea hore na u hloka ho tšireletsa ha kae le hore na setšireletsi seo e be se entsoeng ka eng. Ho lema lifate le lihlahla ho nka nako e telele, empa li etsa litšireletsi tsa šmakhonthe. Hape li fana ka litholoana, lijo bakeng sa liphoofolo le patsi.

Kapa mohlomong u hloka feela ho tširelatsa sethopo sa hau kapa sekhechanayana sa seratsoana.

U kanna oa etsa teko ka ho sebelisa setšireletsi sa nakoana ka mekotlana e tšelang lijo tsa liphoofolo e faselelitsoeng terateng. Ha u etsa teko ka tsela ena, ho ke ke haeba bonolo ho bona hore na e feela teko e atlehile kaha ha hona letho leo u bapisang le lona. Le hahole joalo, u kanna oa bona phapang ea ho tšireletsa le ho se tšireletse.

Lipotso tseo u tšoanelang ho ipotsa tsona:

- Na lijalo tsa hau li shebahala li phetse hobane ha lia rojoa kapa hona ho sengoa ke moea?
- Na ha u sa tšella khafetsa hobane moea ha o sa nka mongobo o mongata mobung?
- Na u nahana hore u behile setšireletsi sa hau sebakeng se nepahetseng? Na ke moo moea o fetang teng? Se lokela hoba haufi kapa hole le jarete ea hau?
- Lintle le limpe tsa setšireletsi e bile life? Etsa lethathamo la tsona. Empa hopola hore lintle tse ling ha li bonahale hang hang. Mohlala, mohlomomg ha u sa tšella lijalo tsa hau khafetsa le khoholeho ea mobu e theohile. (Ho koahela mobu (mulching) ke tsela e ngoe entle ea ho thibela khoholeho ea mobu). Lintle tse ling tsa ho lema lifate kapa lihlahla bakeng sa ho tšireletsa moea ke hore li fana ka patsi, litholoana, lithupa tse sebelisoang jareteng hape ke mokhoa oa thlaho oa ho tebela likokonyana (Pests).
- U tla sebelisa eng ho etsa setšireletsi sa moea? Heaba u tlo sebelisa lifate le limela, ke life tse tlang ho u sebeletsa ho feta tse ling? Ke life tseo u ka lifumanang ha bobebe? Ha li se li holile, na li tla etsa mola oo moea o ke keng oa feta habonolo, joalo ka ha ho bontsitsoe leqhepheng la pele? Ipotse hore na li tla hola ho fihlela li eba telele ha kae, le hore na li tla hlohloreha makhasi mariha kapa che? Na moea o tla khona ho feta? U lokela ho hlophisa setšireletsi sa hau ka hlokolosi.

Tšireletso ea serame

Serame e kare metsi a batang, ka ha se theohela fatše moo se fihlang se ipopa teng. Moea ona o batang hangata o ka tlase ho bolelele ba kharafu ka botebo. Ho bata haholo hoela fatše.

Serame sa pele se fumaneha haholo se koahetse fatše feela. Hona ho bolela hore mohatsela o moholo (freezing point) o feela fatše haholo, ha o fete licentimithara tse mashome a mararo (30 cm), eleng bophara ba kharafu, 'me ka tsela eo, ke lijalo tseng tseng li le nyenyane haholo tse tla bolaoa ke serame. Lijalo tse kholo joalo ka lierekisi, haholo ha liphahamisitsoe li tla phela. Empa ha nako e ntse e ea, serame sena e tlaba serame sa moea. Hona ho bolela hore mohatsela o tla eketseha, feela o se o nyolohela holimo ho ka etsang mithara le halefo (1.5 m above ground), 'me ka tsela ena serame se tla tšoara lijalo kaofela. Ha se se sele tjena se bitsoa lebabo (frost killer),'me hangata le bonahala ka ho koahela lintho tsohle ka 'lekoko' la lehloa le thata, e seng phoka.

Mabalane le mesikomg ea lithaba tsa Lesotho, lebabo la pele le ka lebelloa lipakeng tsa 5-15 Motseanong, ha la ho qetala lona le ba teng 15-25 Phato ka mabalane. Mesikong teng le lieha ho bateng, 15 Loetse.

Lijalo tse ka sengoang le ho bolaoa ke serame	Lijalo tse ka angoang ke serame	Lijalo tse mamellang serame	
tamati green beans pepere sweet potatoes chilisi le mokopu liekerisi	Makhasi a litapole (empa e seng sejalo kaofela, hobane se tla mela) Lierekisi tse sa leng nyenyane (lipalesa le mekotlana ea tsona)	sipinache sepaile lihoete bete lettuce linaoa tse separa	kh'abeche kale turnips konogolo leeks anyanese

Mokhoa oa ho sebetsana le Serame

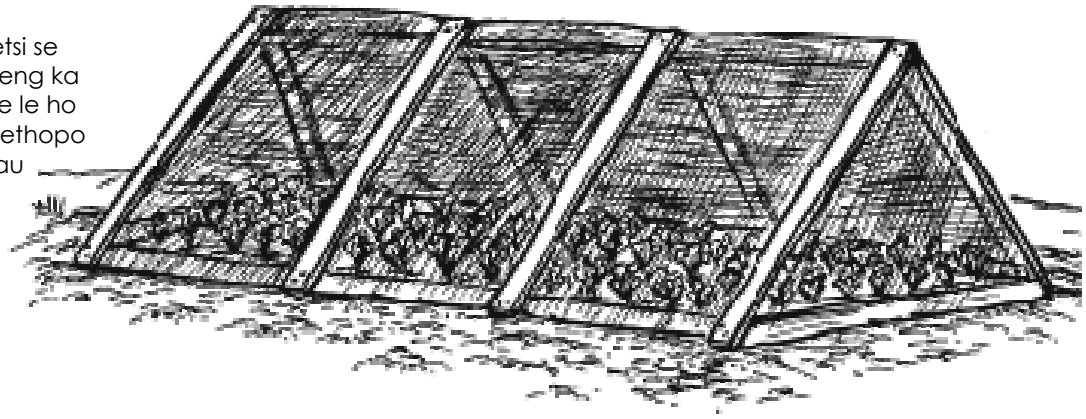
Tsela e le ngoeng feela oa ho sebetsana le mefuta ena e 'meli ea serame, ke ho tšireletsa lijalo tsa hao. Mekhoa e mengata ea ho etsa sena. Emap u tla lokela hore u be u entse lithlophiso pele. E meng eona e tla u hloka hore u be u fetole semelo/sebopeho (design) sa serapa sa hau ka tsela e itseng.

1. Koahela lijalo tse tšabang serame haholo

Bakeng sa serame sa pele, o ka koahela lijalo tse nyenyane tseo o tšabanang le tsona ka eng kapa eng eo u ka e fumanang e tla sebetsa joalo ka kobo. U ka sebelisa joang, koranta-u behe majoe hore e se fefohe, kapa mekotlana ea khale ea anyanese kapa ea lilamunu u e rokelletse 'moho. U ka boela oa sebelisa mekotlana ea khale ea lijo tsa liphoofolo. U ka reka se tšireletsi (lesela) sa serame moo ho rekisoang lifate kapa likoporasing. 'Lesela' lena ha le theko e phahameng ebile le sebetsa ka tsela e khotsofatsang. Koahela leifo la hau e be u tšoara 'lesela' ka li phek'se (pegs) hore le se fefohe. E tsa bonnete ba hore u koahela lijalo tsa hau mantsiboea.

Hape u kanna oa tširelatsa lijalo tsa hau ka ho nka nete kapa polasitiki e kholo oa e beha holima lithupa e be oa koahela. Mokhoa ona o tla tšireletsa lijalo tsa hau lirameng tsa mariha a maholo. U ka reka nete ea ho tšireletsa moea

mabenkeleng moo ho rekisoang lintho tsa temo, feela e theko e phahameng.

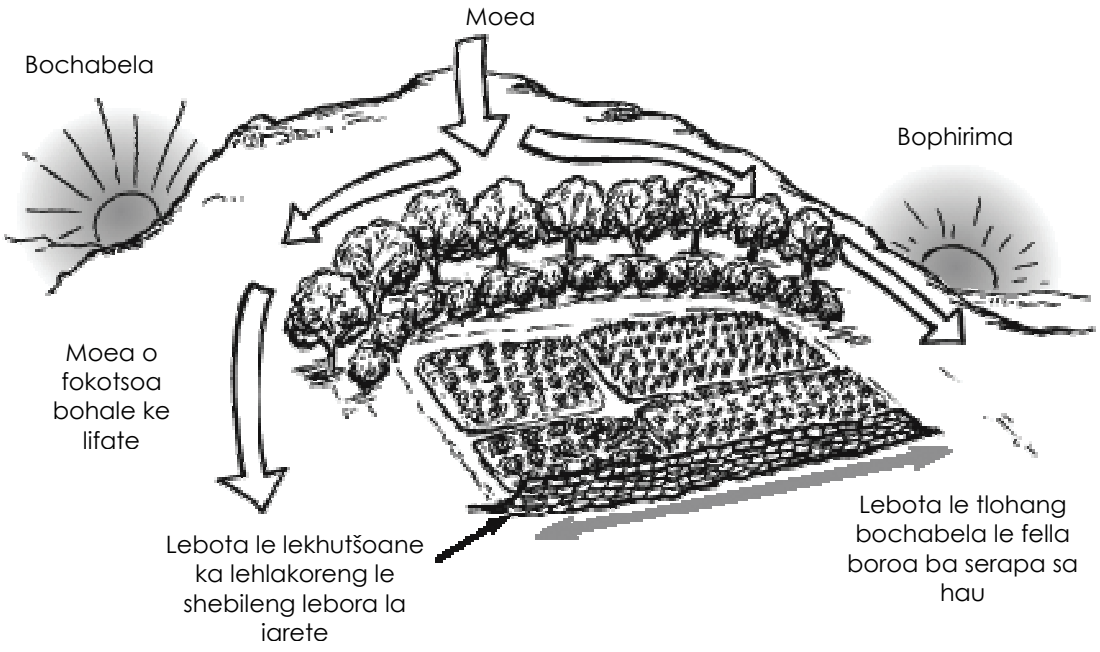


2. Khetho ea sebaka sa seratsoana

Sebaka se nepahetseng sa ho etsa seratsoana ke se shebileng bochabela, ebile se batla se phaha-phahame. Lebaka ke hobane seratsoana sa hau se tla chabeloa ke letsatsi haholo, ebile se ke ke sa bata hakaalo le bosiu ha ho bapisoa le tse ling.

Haeba jarete ea hau e le motheong, lema lijalo tseo u tšabanang le tsona kapa tse tšabang serame haholo ka holimo.

Haha lerako le lekhutsoanyane ka majoe. Le hahelle ho elella ka boroa le leboea la jarete ea hau, hore ka lehlakoreng le bochabela le tle le tsebe ho fumana letsatsi, 'me le futhumale. Ka tsela ena le tla sebetsa joalo ka setofo e be bosiu le ntša mocheso o le oa motšeare.



3. Seratsoana se futhumetseng

Tsena li tla thusa hoetla (autumn) le mariha. Cheka sekoti, se tlatse litlama-tlama, lehola, moiteli, joang ebe u khutlisetsa mobu. Jala ka holima sekoti sena, u ntse u lula u tšella.

4. Lifate

Lifate li tšireletsa lijalo serameng ka ho tšoara mocheso ha o ntse o nyoloha fatše, ebe bosiu lia o lokolla.



Moea o futhumetseng o tšoaseha lipakeng tsa lifate ho thibela serame ho lala

5. Ho foka ha moea le ho phalla ha metsi

Haeba metsi a le mangata ho pota-pota le sejalo sa hau, ha se hangata serame se lalang. Ka tsela ena, leka ho tšella lijalo tsa hau mantsiboea.

Mokhoa ona o leka ho fokotsa serame se tla lala holima seratsoana le lijalong. U ka boela oa etsa lipampiri tse bopehileng joalo ka mokorotlo e be u kaohela sethopo se seng le se seng sa hau. Ke nnete ho etsa mekorotlo ena ke mosebetsi o mangata, empa qetellong e tla be e le ntho e molemo thleng ea ho tšireletsa lijalo tsa hau tseo u tšabanang le tsona.

Hape, ho bohlokoa hore u tšelle lijalo tse letseng serame hoseng haholo pele letsatsi le chaba. Ka tsela ena u tla thusa ho fokotsa tšenyo ho lijalo tseo serame seneng se letse ho tsona.

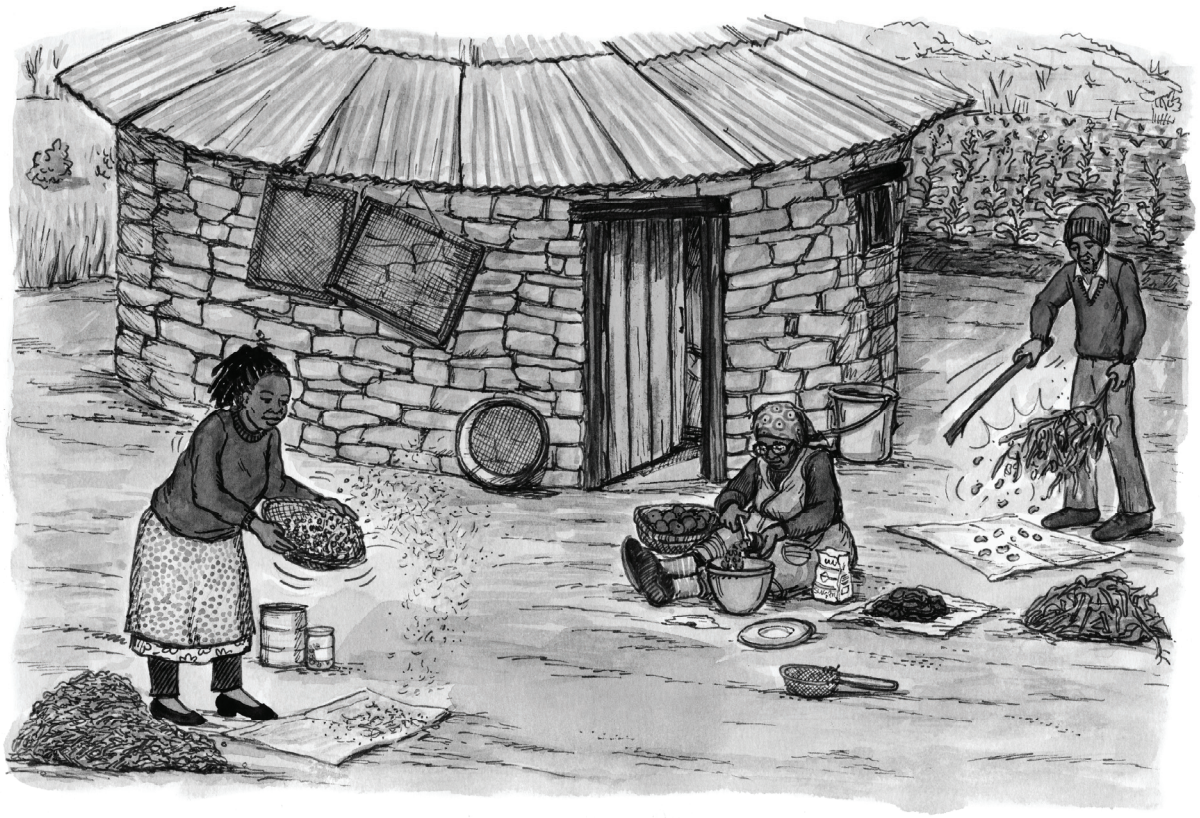
Koahela sethopo sa hau ka lipampiri tse bopiloeng joalo kamokorotlo motšeare oa mantsiboea. feela u li tlose hoseng ka letsatsi le hlahlamang



Batho ba bang ba besa mollo liratsoaneng tsa bona bosiu. Ho foka ha moea ho fokotsa ho lala ha serame.

Ha eba hona le lefika le haufinyane le lapeng ha hau le shebile ka letsatsing, u ka le sebelisa e le 'hithara' ea leifo le lenyenyane. Etsa leifo lena ka pela lerako hantle, ebe u le teratela ka lithupa tsa sefate se bitsoang boloukatlele/ motholo, ebe u koahela ka polasitiki. U ka fumana mapolanka ao u ka a sebelisang mabenkeleng a rekisang litulo le litafole (fanichara). Ho ha ha setšireletsi sena, u tla be u iketsetsa ntlo e bitsoang 'green house' e thusang ho tšireletsa sethopo sa hau ka ha ho mofuthu ka hare ho ntlo ena ho feta kantle.

5. Tlhahiso le poloko ea peo ea meroho



Ho ipolokela peo ea hau ho ka u thusa ho ba sehoai se ikemetseng. Hona ho u fa boikhethelo ba hore mofuta oa sejalo seo u batlang ho se lema u se fumane ha bobebe ntle le ho se reka.

Ho teng mefuta e mengata ea peo ea meroho e ka fumanehang ho Bahlahisi ba bangata le libakeng tsa thekiso eo sehoai ka bomong se ka atlehang ho ipolokela eona kamor'a ho e lema.

Ho lema peo e le ho hlahisa peo e ngoe, ho tlama hore peo e joalo e kene mobung 'me e bole e le hore e tsebe ho hlaha, ho lema le ho baballa sethopo sa limela tse phetseng hantle ho fihlela li holile, hona ho tla thusa hore peo ea tsona e tsebe ho kotuloa 'me e bolokeloe ho sebelisoa selemong se hlahlamang.

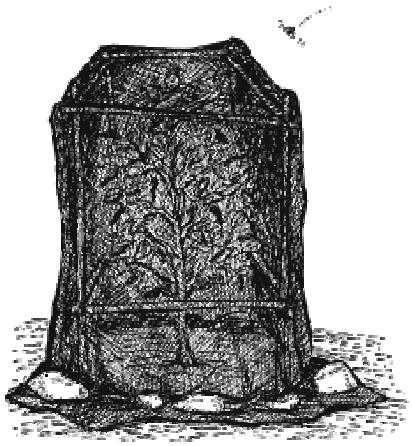
Limela li tseba ho ikamahanaya le maemo a moo li lengoang teng lekhetlo la pele 'me li hlahise peo e nang le makhabane a joalo, e ka tsebang ho hlahisa lijalo tse phetseng hantle tse ka atlehang ho mamella maemo a sebaka se joalo.

Lifate tsa litholoana li nka lilemo tse ngata li ntse li hola, 'me ho bohlokoa ho li lema sebakeng se nepahetseng e sa le qalong.

Ho hlahisa/ boloka peo e hloekile

Lijalo tse nyalisoang ke moea kapa ke linotsi li hloka ho arohanngoa le mefuta e meng ea bo tsona e le ho thibela hore li se inyalise. Mekhoa e sebelisoang ho thibela sena ke e latelang:

Lema libakeng tse fapakaneng: Lema mefuta e 'meli ea lijalo e ka inyalisang e arohane bonyane ka sebaka se ka etsang halefo ea lebala la bolo ea maoto kapa ho feta (50 m). Likokoanyana tse ngata tse ka fetisang peo ha li tsebe ho fofa ho feta sebaka se sekaalo, ka ntle ho linots'i tseo tsona li ka fofang likilometara tse 'ne. Litsitiso tse ling tse ka etsoang ho thibela peo ho fetisoa ke moea kapa likokoanyana ke ho lema lifate, ho etsa makhoakhoa kapa marako a ka thibelang phetisetso e joalo.



HO KHUKHUMETSA SEJALO SA CHILISI

Lema ka linako tse fapakaneng: Mokhoa ona o sebelisoa hangata lijalong tse etsang lithung-thung ka nako e le ngoe joalo ka poone le sonobolomo. Ho inyalisa ho ka qojoa ka ho lema mefuta e behang lithung-thung ka nako tse fapakaneng e le hore phoshoana ea botona e tle e se ke ea fetela bots'ehaling ka nako eo e lebeletsoeng.

Ho khukhumetsa: Sena se etsoa ha ngata lijalong tse behang lithung-thung nako e telele, joalok'a kh'abeche le chilisi. Sireletsa lithungthung ka lesira e le ho thibela likokoanyana ho ka fetisa phoshoana 'me e be ho nyalisoa ka letsoho.

Li khukhumetse ka matsatsi ho fapana: Mokhoa ona o sebelisoa ha ngata ho thibela phoshoana ea sejalo se seng ho ea ho se seng, 'me ho ke ke hoa nyalisoa ka letsoho. Mofuta o mong oa sejalo o oa koaheloa ha o mong o tloheloa hore linotsi li o nyalise. E be se ts'oanang se etsoa mofuteng oa bobeli, ha li se li nyalisitsoe li koaheloa ho fihlela lithung-thung li oele.

Ho khetha le ho kotula peo

Ho ka nka nako e kae?

Tse behang ka selemo:

Tsena ke lijalo tse phelang le ho beha peo ea tsona ka nako e khuts'oane feela e be lia shoa. Sena se nka likhoeli tse ts'eletseng hoisa tse robong. Mohlala ke tamati.

Kotula peo bonyane lijalong tse ts'eletseng tsa mofuta oo u batlang ho o boloka. Lijalong tse ling joalo ka hanyanese kotula peo ea lijalo tse 20, sonobolomo le poone u hloka peo ea tse 50-100. Mefuteng e mebala e fapakaneng ea poone e ka lahla mebala e meng le makhabane a ho loants'a likokoanyana ho ka khethoa lijalo tse 'nyane ka palo.

Tse behabg kamor'a lilemo tse peli:

Lijalo tsena li hlaha Lehlabula la pele li lingoe, li robale Mariha e be ha Lehlabula le thoasa lia thunya 'me li behe peo Hlabuleng la bobeli. Boholo ba tsona li tsoa Europo moo ho batang haholo 'me ho se bobebe hore semela se behe peo ka selemo se le seng. Sena se nka likhoeli tse 18. Mehlala ke kh'abeche, cauliflower, lihoete, parsnips, turnips le rapa.

Tse phelang nako e telele:

Tsena li phela lilemo tse ngata li sa shoe. Boholo ba tsona ke lifate tsa litholoana le lihlahla 'me ha ho meroho e oelang sehlopheng sena.

Mokhoa oa ho khetha peo

- Peo e tlameha ho ba le boleng bo ts'oanang hantle le ba lijalo tseo e tsoang ho tsona. Haeba ho lengoe sejalo se se telele peo e kotuloe sejalong se se telele. Ha tholoana e fapane le ea sejalo se jetsoeng peo e tla fapana.
- Tlos'a lijalo tse bonahalang li fapane le tseo peo e tsoang ho tsona pele li thunya. Mehlala ke tse holag butle, tse kulang kapa tse nang le mafu le tse behang peo pele ho nako.
- Kotula peo lijalong tse phetseng le ho shebahala hantle.
- Kotula peo ho tse sebetsang hantle tlas'a maemo a thata tse sa ts'abeng mafu le likokoanyana.
- Kotula peo ea lijalo tse phetseng hantle feela, haeba makhasi a tsona a bolile kapa tsona litholoana se ke ua nka peo ea tsona ho ba mafu a joalo a ka fetela lilemong tse tlang.
- Se kotule peo ea lijalo tse behang peo pele ho nako ea tsona. Ha u kotula peo ea tse behang pele ho nako u khetha peo ea tse tla beha peo pele ho nako. Sena se bohlokoa merohong e kang spinichi le selae moo nako ea ho beha mahaba e leng telele.
- Kotula peo ha e butsoitse. Peo e sa butsoang e hana ho hlaha ha e jaloa. Peo e butsoitseng haholo e bola pele e jaloa.
- Se kotule peo e lomiloeng ke likokoanyana kapa e maqeba. Peo e mela ha feela e feletse.
- Se kotule peo e nang le mafu kapa hlobo le ha e le mafome.

Mokhoa oa ho tseba ho fumana peo



Lihoohlo tsa peo

Lijalo tse ling li na le mekotlana e ts'etseng peo, jaolo ka linaoa le le lierekisi tse bitsoang "legumes". Li tseba ho inyalisa ka hona ha li hloke ho aroloa.

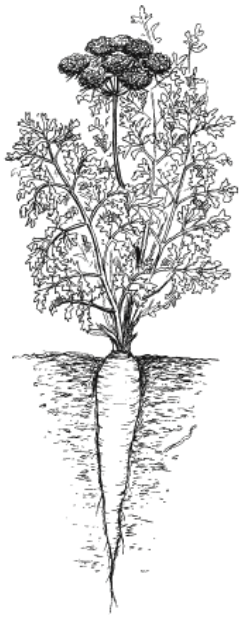
Mefuta ea kh'abeche e qala ka ho etsa hlooho kapa mahaba a thata selemo sa pele sa kh'abeche, cauliflower, broccoli, kholrabi, kale, le sepinichi. Selemong sa bobeli e be lekala le jereng thung-thung le ea hlaha 'me le behe peo. Sena se nka likhoeli tse 18.



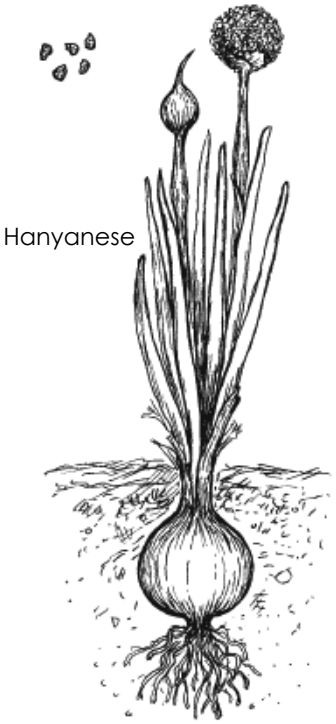
Selae

Lelapa lena la kh'abeche le hloka linotsi le mefuta e meng ea likokoanyana ho fetisa phoshoana e etsang peo. Lijalo tse seng ka tlase ho ts'elela tse seng ka holimo ho 20. Sejalo se le seng se ke ke sa hlahisa peo 'me mefuta e na e ea nyalana lelapeng lena ka hoo ho molemo ho arola mefuta e fapakaneng e le ho fumana peo.

Tse behang ka tlase joalo ka lihoete: Kotola e qala ho ba thata e be e hlahisa lekala leo lithungthung le peo li tla behoa ho lona. Sena se nka likhoeli tse robong 'me likokoanyana li fetisa phoshoana ho tloha karolong engoe ea sejalo ho ea ho engoe. Mefuta e meng e oelang lelapeng lena e its'oarang ka ho ts'oana ke celery, parsely, fennel le liparsnip.



Lihoete



Hanyanese

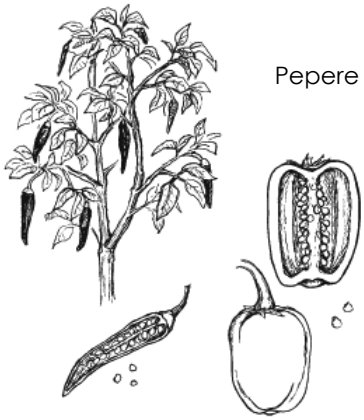
Tse behang ka tlase joalo ka hanyanese: Mothapo o thunyang o loka mokhahlelong oa bobeli ha ho futhumetse.

Tse ling tse oelang lelapeng lena la bo hanyanese ke liki, shallots, konofolo, le eee. Tsena li nyalisoa ke linots'i ha ngata. Phoshoana e ka fetela lithung-thung tsa sejalo se le seng kappa se fapakaneng sa lelapa se le seng. Peo e tlameha ho kotuloa lijalong tse ka bang 20 e le hore mofuta ona o lule o le matla. Peo ha e butsoe ka nako e le ngoe 'me e tlameha ho kotuloa ha e ntse e butsoa sejalong ka ngoe, hobane e tla qhoma e fofe le moea.

Tlohela peo e omele sejalong. Ho tse qhomang ha li omme li kotule pele li oma e le ho qoba hore li tle li qhome li fofe le moea. Mohlala ke selae, lihoete, parsnips le hanyanese.

Litholoana tse behang peo

Tholoana e hlaha ha nyaliso e etsahetse ka katleho kahar'a tholoana 'me peo e hlaha ka hara tholoana.



- Tholoana e kotuloa ha e butsoitse phere. Mohlala ke tamati, chilisi, pepere.

  Tamati le lipepere li ea inyalisa. Tse ling tsa lelapa lena joalo ka chilisi le eggplant tsona li hloka ho nyalisoa ke linotsi kapa moea 'me ka hona li hloka ho aroloa le mefuta e meng e le ho qoba hore li se nyalane tsa hlahisa mehlolo.



Mefuta e fapakaneng ea mekopu

- Mekopu, mahapu, le mehope le tse oelang lelapeng leo li kotuloa ha li se li butsoitse phere 'me li tloheloe hore peo e butsoe ho qeta. Hona le mefuta e mengata ea mekopu le mahapu. 'Me mefuta ena e fapakaneng ea mekopu e ka nyalana empa ha e nyalane le mahapu le licucumber kappa limarrow tse oelang lelapeng le le leng.

Lithung-thung tse tona le hlaha melebong e metelele e mesesanyane 'me li buleha pele ho tse ts'ehali tse hlahang melebong e mekhuts'oane 'me tse nang le kotolanyana ka hare.



Lipalesa tse tona le tse tsehali sefateng

- Li-cucumber le li-marrow li tlohelloa hore li butsoe phere pele li kotuloa, li-cucumber li ba sootho ha li-marrow li ba ts'ehla ha li butsoioe 'me liba tenya.

Peo e jeoang

Mehlala ke poone, linaoa, lierekisi le sonobolomo. Tsena li tlohelloa sejalong ho fihlela li holile li bile li omme.

U ka tseba joang ha peo e lokela ho kotuloa?

- Tholoana e etsa molumo o moholo ha e butsoitse e be e ea kotuloa. Mohlala ke mokopu, le li-cucumber. Ho molemo ho tlohela peo kahar'a litholoana tsena kamor'a ho kotuloa hore e butsoe phere.

- Mebala, boholo le sebopeho sa tholoana; mehlala ke tamati le chilisi. Pepere e tala e tlameha ho tloheloa hore e be khubelu ha e le tala ha eso butsoe.
- Ho qhoma ha mekotla; joalo ka linaoa le lierekisi.
- Ho oma ha lithung-thung le mahaba, mehlala ke lihoete, sepinichi, le kh'abeche.

Tlhoekiso ea peo

Ho olosa

Lithupa le makhapetla li tlameha ho tlosoa hoba li ka pata likokoanyana tse ka jang peo e bolokiloeng.



- Peo le matlakala e olosoa moeeng o seng mongata e hore matlakala a nkuoe ke moea peo e khetheloe ka thoko.
- Mokhoa o mong o ka sebelisoang ke ho hlokola peo e be matlakala a phaphamalang ka holimo a ea khethoa a lahloe.
- Linaoa le lierekisi li ka ts'eloa ka mokotleng 'me tsa poloa li le kahar'a mokotla eaba lia khethoa ka ho hlokola.

Ho hloekisa peo ka metsi

Mokhoa ona o sebelisoa haholo lijalong tse behang peo ea tsona ka hara litholoana tse jeoang joalo ka tamati, mahapu, mokopu, le li-cucumber.

- Khaha peo u e ts'ele ka hara metsi e hlatsoe qhala metsi e be peo e ea omisoa.
- Ts'ela peo ea tamati le cucumber ka metsing nako e telele. Hona ho etsoa ho tlosa lera le potapotileng peo 'me peo e ke ke ea mela ha le ntse le le teng le ho tlosa mafu le likokoanyana.
- Ts'ela peo ka nkhong ea metsi, e be u ts'ela khaba tse peli tsa tsoekere 'me u fulooe hore e qhibilehe. Tlohela matsatsi a mararo ho isa a mahlano. Hlatsoa ka metsi a mangata e be u omisa peo 'me u o ts'ele ka moo ho omeng ha e omme.

Mokhoa:



1. Ts'ela peo ka sets'elong. Koahela ka metsi. Ts'ela khaba ele e ngoe ho isa tse peli tsa tsoekere 'me fuluha ho fihlela e qhebilihile.

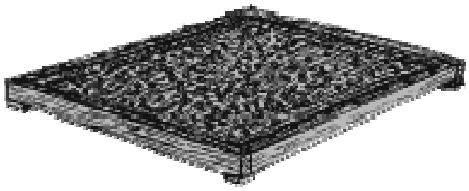




2. Boloka motsoako matsatsi a mararo ho isa bohlanong (eseng ho feta) lekoeba kapa bohoho botla teng ho supa hore ho puta ho bile teng.

3. Hloekisa peo ka metsi a mangata.

4. Ala peo hore e ome sebakeng se pholileng le ho e boloka ka khalaseng e koetsoeng ka thata.





Ho omisa peo

Peo e tenya e nka nako e telele ho oma ho feta e ts'esanyane, peo e ka shejoa hore na e omme ka ho e loma ka meno, haeba meno ao a sa sie mats'oao peong eo, ho bolela hore e lokile.

- Peo e lokela ho omisetsoa moo ho seng letsatsi empa moo ho ommeng ho bile ho le moea.
- Maemong a mongobo a bileng a batang, beha peo kahar'a sets'elo se kenyang moea, 'me se ts'irelelitsoe likokoanyaneng e be e behoa moo ho phahameng.
- Ts'ela peo e seng kae kahar'a mekotlana ea pampiri e leketlisitsoeng holimo.
- Peo e ngata e ka ts'eloa kahar'a 'methe, e seng ka polasetiking.



Ho boloka peo

Nako eo peo e e nkang e ntse e bolokiloe e ipapisa le:

- Mofuta oa peo ka ngoe;
- Boleng ba peo ka ngoe le;
- Maemo a moo e bolokoang.

Maemo a moo peo e bolokeloang

Lefifi

Etsa bo 'nete ba hore peo e behoa moo ho leng lefifi. Sebelisa mekotlana ea lipampiri, mekotla ea lipolasitiki e mets'o le botlolo ea khalase ebe e koalloa ka rakeng. Se ke oa boloka peo sebakeng se bulehileng e le ka botlolong e bonaletsang.

Boholo ba lipeo li ka bolokoa nako ea lilemo tse tharo hoisa bohlanong e phela hantle. Ho phela hantle ke ho bolela hoe peo eka mela. Peo eka shebahala hantle empa esa khone ho mela.

Mongobo

Le ha peo e omme ha e bolokoa sebakeng se mongobo e khona ho nka mongobo o joalo, 'me boemo bona bo ka ama boleng ba peo. Peo e ka omisetsoa feela moo moea o fokang, moo ho leng moriti. Ha ho le maruru, pula e le ngata haho bobebe ho omisa peo haholo ea linaoa le lierekisi.

Bophelo ba peo boa imenahanya ha boemo ba mongobo botheoloa ka karolo ea leshome lekholong.

Maemo a serame le mocheso

Peo e phela nako e telele maemong a pholileng hantle ho sa bate. E ka bolokoa ka lerits'oaneng, moriting oa sefate kapa ea chekeloa fats'e.

Ha peo e behiloe letsatsing le chesang le moo metsi a leng mangata peo lahla boleng ba eona ka potlako. Peo e joalo ekeke ea khona ho lengoa hape. Peo e thabela moo ho pholileng, lefifi le moo mongobo o fokolang.

Bophelo ba peo bo menahana habeli ha maemo a serame le mocheso moo e lulang bo theoha ka bohlano lekholong.

Likokoanyana

Peo e bolokiloeng e ka theoloa boleng ba eona ke likokoanyana tse kang ts'upa le tse ling tse ke keng tsa bonoa ka mahlo a nama.

Boloka peo ka khalaseng kapa nthong e koaehelehang, e ommeng le ho hloeka. E hlalose ka lebitso.



- Ts'upa e khona ho ikatisa ka potlako ha mongobo o eketseha. E behela mahe kahar'a peo kapa ka tlasa letlalo la peo e joalo , e be a sa qhotseha ha mongobo o ba mongata.
- Hlobo le eona e hlaha ha mongobo o le mongata haholo. Ka ha ho kaba thata ho metha mongobo peong ho molemo ho e beha e omme nako tsohle.

Lintho tse ka sebelisoang ho thibela likokoanyana ho ja peo:

- **Molora o ommeng:** oona o monya mongobo kamoo peo e ts'etsoeng e be o thibela ho hola ha ts'upa. Ts'ela halefo ea kilokharama kahar'a kilokharama ea peo.

- **Kalaka:** e sebelisoa joalok'a molora o ommeng. Ts'ela likhaba tse leshome le metso e mehlano kahar'a kilokharama ea peo.

- **Oli e phehang:** kopanya oli le peo ho thibela ts'upa ho ata. Ts'ela khaba e kholo ea oli ka hara kilokharama ea peo.

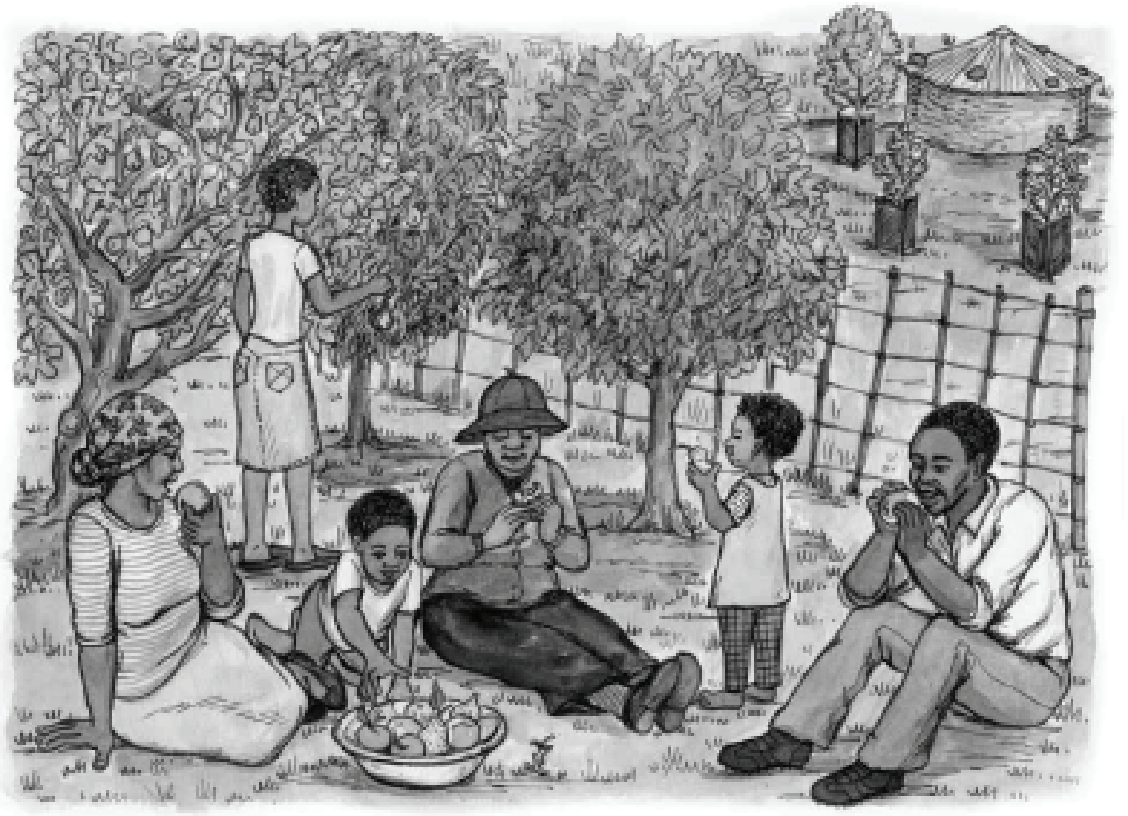
- Makhapetla a sitsoing a litlama tse latelang tseo ts'upa e li ts'abang:

  - CHILISI: kopanya likhabana tse 'ne ho isa tse ts'eletseng kahar'a kilokharama ea peo.

  - MOHLONYANE (WORMWOOD): sila makhasi ebe ua kopanya le peo.

  - LEKHALA: joalok'a e ka holimo.

6. Temo ea lifate tsa litholoana



Selelekela

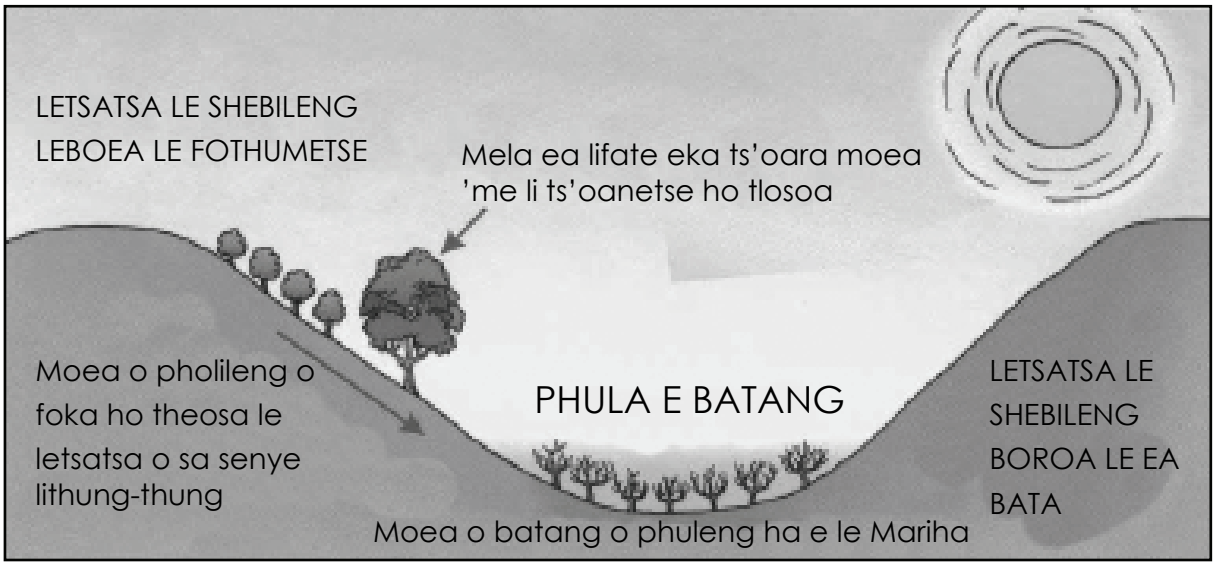
Ho oa lumelleha hore mefuta e mengata ea lifate tsa litholoana e ka lengoa ho pota lelapa. Li ka itlhahisetsoa ka mokhoa oa peo, ka ho khaola makalana ho tsoa ho tse kholo, le ho reka tse nyalisitsoeng ho Bahlahisi ba tsona.

Khetho ea sebaka

Mefuta e fapakaneng ea lifate tsa litholoana e mela hantle maemong a leholimo a fapakaneng. Tlhaloso e latelang e fana ka malebela hore na ke lifate life tse ka melang ka libaka ho fapana.

LIBAKA TSE BATANG HAHOLO: Tseo serame se oelang hangata Mariha le tseo lehloa le khethehang	**LIBAKA TSE SA BATENG HAHOLO:** Tseo serame se sa oeleng hangata, moo lehloa le ts'ohang le khethehile
Liapole, lipere, liperekisi, matebele, lipolamolialmonds, morara, licheri, le mabolilana/apolekose	Liapole, lipere, liperekisi, matebele,lipolamo, lialmonds, morara, licheri, le feekha mabolilana Hape: feiye, granadillas, citrus fruit (dilamunu, diorange, dinartjiesi, grapefruit)

Lifate li ka hola nako e telele 'me ho bohlokoa ho khetha sebaka se nepahetseng ho lilema.



Ho hlokahala sebaka se:

- Mobu o tebileng o sa lumellang metsi hore a eme.
- Letsatsi le lekaneng, se be moathameleng eleng letsoapong le shebileng ka Leboea. Lifate li se ke tsa lengoa phuleng, le matsoapong a shebileng ka Boroa hobane ha ho futhumale joale ka matsoapo a shebileng ka Leboea.
- Moo lifate li ts'ireletsehileng moeeng.



Ho molemo hape ho tseba hore na difate di thunya neng. Serame kappa mohatsela wa morao o ka bolaya ditholwana tsa sefate se thuntseng ka nako eo, ha mpe-mpe hoo sefate se ke keng sa ntsha ditholwana tse ntle kappa tse hlabosehang. O loketso ho kgetha mofuta wa sefate o thunyang kamorao hore serame se fete.

Ha nako e atamela Maria lifate li qala ho hlohloreha makhasi e le mokhoa oa tsona oa tlholeho oa ho phomola. Hore li hlasimolohe phomolong ena ea tsona li hloka mohatsela o khethehileng. Bongata ba mohatsela bo fapana ka mofuta oa sefate ka nngoe, se seng se tla hloka o mongata ha se seng se tla hloka o fokolang. Empa ka nako engoe ho etsahala hore khoeling tsa Phuptjane le Phupu ho se ke ha bata haholo, 'me hoo ho etsa hore lifate li liehe ho lahla makhasi ka hona li

lieha ho phomola. Hona ho etsa hore nako ea selemo ha lifate li boetse li thunya ebe lithunthung lia oela 'me makala a mang a ikhethela ho se hlasimolohe e be a roballa ruri.

Ka hona lifate ha li behe hantle. Ke ka hona ho leng bohlokoa hore ha li lengoa moo ho chesang ho se ke ha khethoa tse hlokang mohatsela o mangata Mariha.

Ho khetha mofuta oa sefate sa litholoana

Sefate ka seng se na le mefuta e fapakaneng ka hona ho hlokahala hore ho khethoe mofuta ka mong o tla lokela sebaka se itseng le maemo a teng a leholimo.

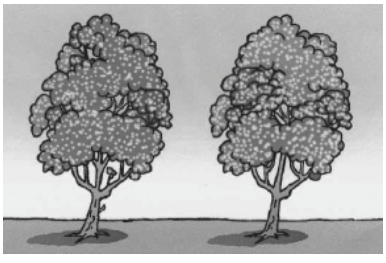
Mefuta e meng e mela hantle libakeng tse batang ha e meng e mela hantle ho tse futhumetseng.

Ntho e lokeloang ho eloa hloko ha ho khethoa mofuta ke phoshoana e fetisetsang botona botsehaling (pollinators)

Mona ho hlokahala hore mefuta e 'meli e fapakaneng ea sefate se ts'oanang e be e khethehileng Mohlala: ho ka lengoa lifate tsa liapole tse bitsoang Granny Smith le Golden Delicious.

- Li tla thusana hore li behe litholoana ka ho romellana phoshoana e nang le botona bots'ehaling. Lithung-thung tsa mofuta o mong o tla hloka ho neheloa ka phoshoana ea mofuta o mong. Li hloka ho beha lithung-thung ka nako e le 'ngoe li be li lumellane e le hore mefuta ena ka bobeli e tle e behe litholoana.
- Lifate tsena li se ke tsa lengoa li arohantsoe ho feta linoko tse 30 e le hore phoshoana e tle e tlohe sefateng se seng ho ea ho se seng ka thuso ea linotsi le moea.
- Ho ka lengoa sefate se le seng sa mofuta o itseng le tse 'ne hoisa bohlanong tsa mofuta o itseng ho ea ka khetho ea motho ka mong. Hona ho bolela hore ho ka lengoa mofuta o itseng oa sefate ho feta o mong.

Lifate tsohle tse lengoang Lesotho li hloka phoshoana ntle le morara

EYA DIAPOLE DIPIERE PECANS DIPOREMA TSE DING PAWPAWS		**TJHE** DIORANGE/DILAMUNU MANGU MORARA

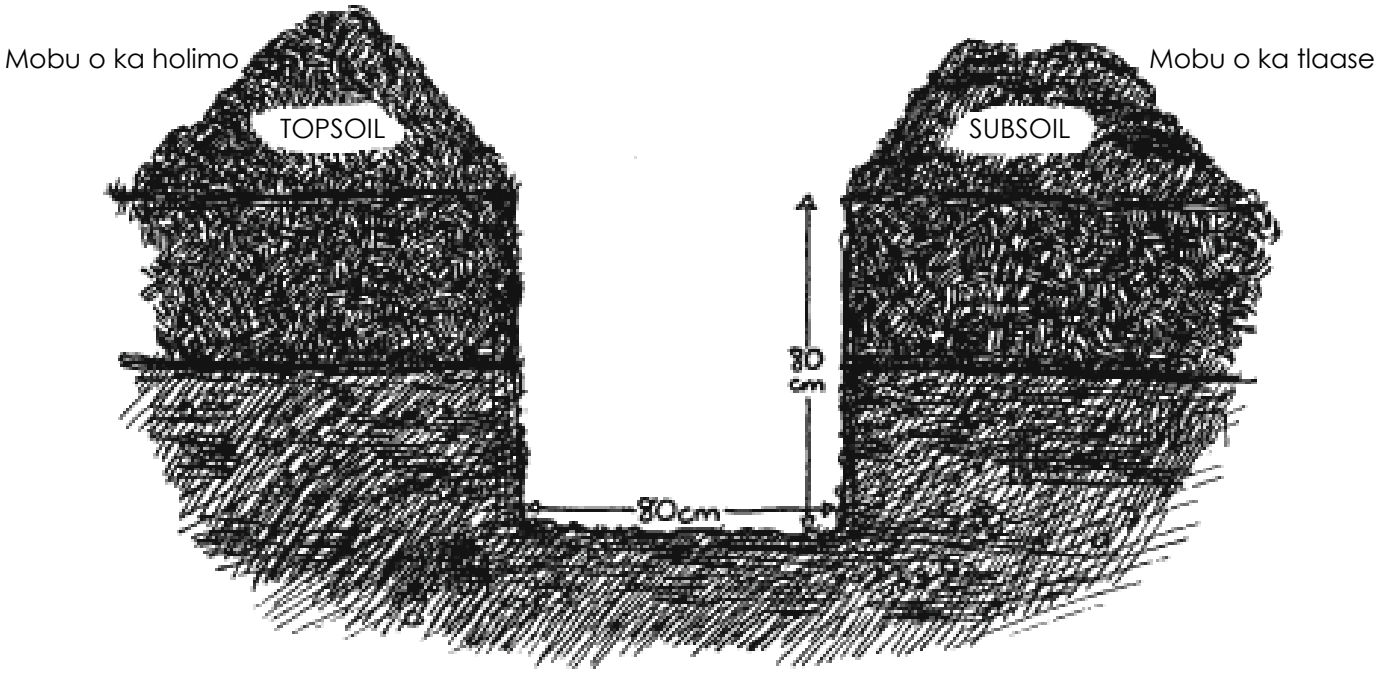
Mefuta eo ho ka khethoang ho eona

Ho na le mefuta e mengata haholo eo ho ka khethoang ho eona, `me e mengata e tsoela-pele ho etsoa. Ka hona ho molemo ho botsa pele litsing tsa tsoaliso ea lifate tsa litholoana hore na ke mefuta e feng e atlehang hantle sebakeng ka seng.

MEFUTA E RATANG SERAME SE SENGATA			MEFUTA E TS`ABANG SERAME SE SENGATA		
LEBITSO	**SE FETISANG PHOSHOANA**	**NAKO EA HO BUTSOA**	**LEBITSO**	**SE FETISANG PHOSHOANA**	**NAKO EA HO BUTSOA**
LIAPOLE					
Granny Smith: apole e tala	Ke: Golden Delicious kapa Starking /Top Red	`Mesa	**Granny Smith; apole e tala**	Ke: Golden Delicious kapa Starking /Top Red	`Mesa
Golden Delicious: apole e ts`hla	Ke: Granny Smith kapa Starking /Top Red	15 Hlakola	**Golden Delicious: apole e ts`hla**	Ke: Granny Smith kapa Starking /Top Red	15 Hlakola
Starking/Top Red: apole e khubelu	Ke: Golden Delicious kapa Granny Smith	Hlakubele	**Starking/Top Red: apole e khubelu**	Ke: Golden Delicious kapa Granny Smith	Hlakubele
LIPERE					
Packhams: e talanyana	Bon Chretion and Forelle	Mahareng a Hlakola	**Packhams; e talanyana**	Clapp's Favourite	Mahareng a Hlakola
Bon Chretion; apole e ts`ehla	E ea inyalisa	Hlakubele			
Forelle; e ts`ehla bo kopaneng le bokhubelu	Packhams and Bon Chretion	Maqalong a `Mesa			
LIURUMU					
Santa Rosa: e khubelu `mele kaofela	E ea inyalisa	15 Ts`itoe – maqalong a Pherekhong	**Pioneer; e khubelu**	E ea inyalisa	20 Pulungoana
Songold: e ts`ehla `mele kaofela	Santa Rosa, Laetitia	15 Hlakola	**Songold: e ts`ehla `mele kaofela**	Santa Rosa, Laetitia	15 Hlakola
Laetitia; e khubelu	Songold	30 Pherekhong	**Laetitia; e khubelu**	Songold	30 Pherekhong
LIPEREKISI					
Elberta; motloha o mosehla	E ea inyalisa	25 Phato 1 Hlakola	**De Wet; motloha o mosehla**	E ea inyalisa	25 Phuptjane 25 Ts`itoe
Kakamas; e ts`ehla	E ea inyalisa	15 Phato 15 Pherekhong	**Oom Sarel: e ts`ehla**	E ea inyalisa	5 Phato 15 Ts`itoe
Early Dawn: motloha o mosoeu	E ea inyalisa	15 Phato 20 November	**Boland; motloha o mosoeu**	E ea inyalisa	15 Phato 15 Ts`itoe
MATEBELE					
Flavortop; e khubelu bo lefifi	E ea inyalisa	20 Phato 5 Pherekhong	**Sunlite; e khubelu ka ntle e ts`ehla ka**	E ea inyalisa	5 Phato 5 Ts`itoe
LIAPOLOKOSO					
Peeka; e ts`ehla	E ea inyalisa	15 Loetse 25 Ts`itoe	**Palsteyn; e ts`ehla**	E ea inyalisa	30 Phato 30 November

Mokhoa oa ho lema lifate tsa litholoana

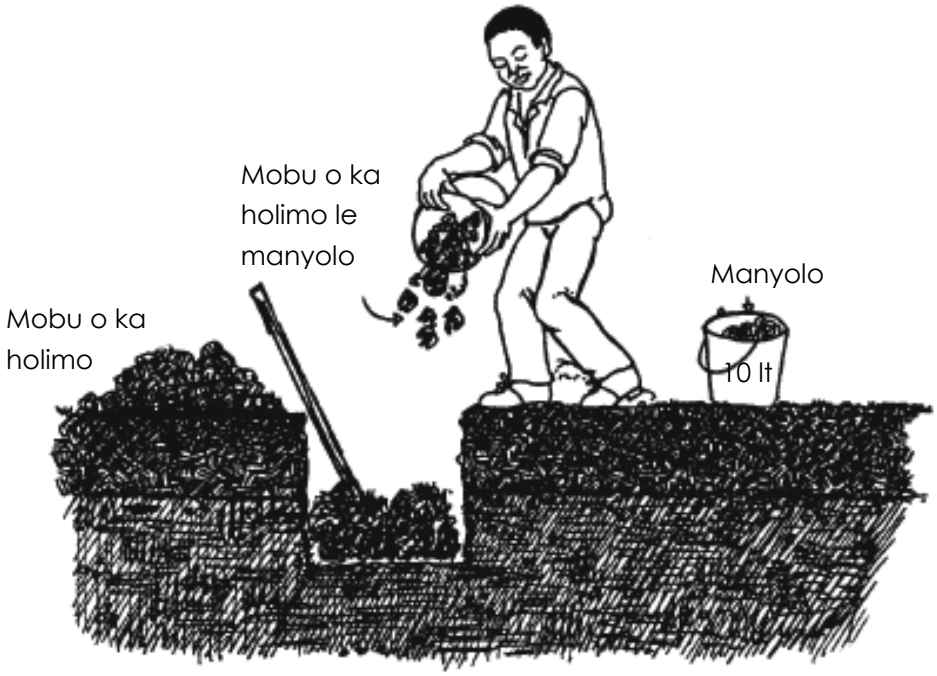
Ho bohlokoa ho lokisa sekoti libeke tse 'maloa pele sefate se hlongoa. Mobu o phomola hantle le hore mosuela o sebe kotsi haholo methapong ea sefate.



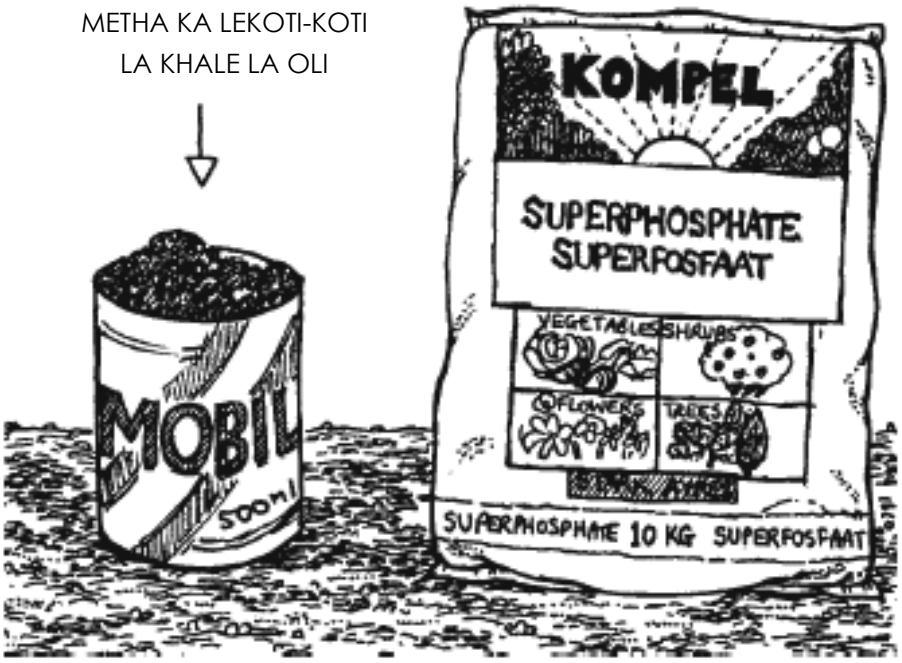
Tokiso ea sekoti

1. Cheka sekoti sa bophara le botebo ba linoko tse 80 mahlakore a mane. Sefate se hloka sekoti se seholo hore se hole hantle. Arola mobu o ka holimo le o ka tlase.

2. Ts'ela emere ea manyolo (10 litres) ka sekoting. E kopanye le mobu o tsoang ka tlase.



3. Tsoaka likharama tse 500 tsa superphosphate kappa kilokharama e le ngoe ea masapo a sitsoeng.



4. Ts`ela liemere tse peli hape tsa manyolo li kopanye le mobu o neng o le ka holimo.

5. Busetsa mobu ka sekoting kaofela. Mobu o mong oa kaholimo o ka nkoa sebakeng se seng.

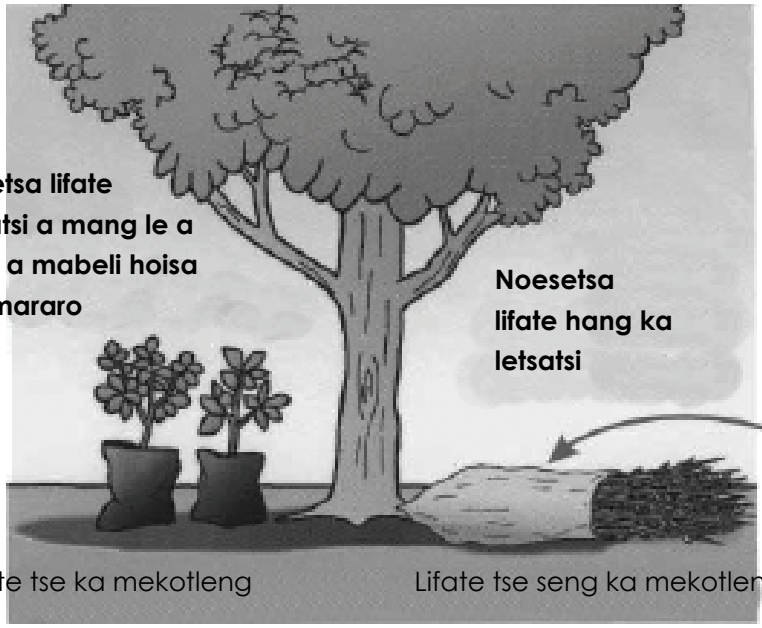
Ho hloma sefate

Tlhokomelo ea sefate se senyane pele se lengoa it

- Ha se ts`etsoe ka mokotleng oa polasetiki se ts'elle khafetsa.
- Ha metloang e sa koaheloa ka letho, e koahele ka lehlabathe `me u koahele ka `methe ho fihlela se hlongoa. Ts`ela methapo ea lifate ka nkhong ea metsi lihora tse peli ho isa tse tharo pele se hlongoa.



Beha lifate ka metso ka emereng lihora tse peli pele li hlongoa



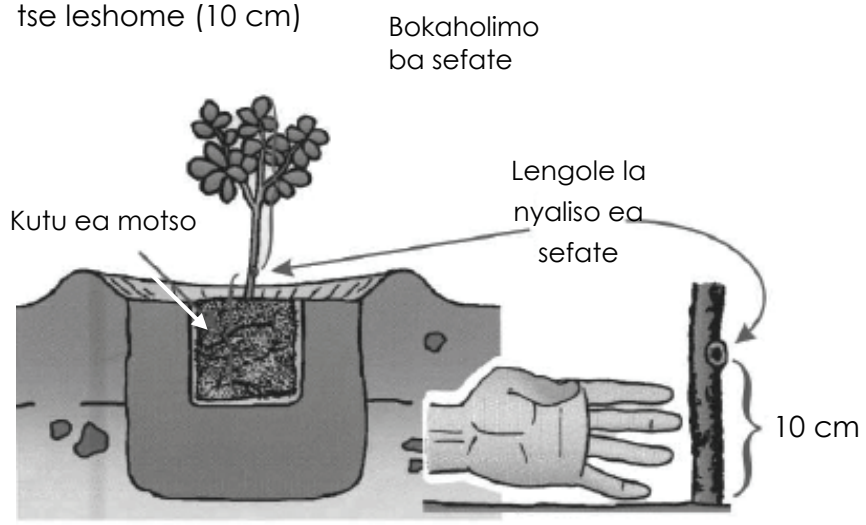
BOLOKA LIFATE MORITING PELE LI LENGOA

KOAHELA METSO KA JOANG, MARATH'A-LILEPE KAPA LEHLABATHE LE MONGOBO

Ho lema sefate se ts`etsoeng ka mokotleng oa polasitiki

Tsena ha ngata li lengoa Lehlabula (Loetse - Pulungoana) 'me li tlabe li hlahisitse makhasi ha li lengoa.

1. Noesetsa sefate se ntse sele ka moo u sa choatle mobu
2. Cheka mokoti o lekanang hantle (mokoti o lengoeng pelenyana) le mokotlana oo seleng ka ho ona
3. Se nts`e ka mokotleng
4. Se kenye ka mokoting, koahela methapo hantle, m`e bophahamo bo lokela ho lekana le ba sona ha se ntse sele ka mo.
5. Karolo ea moo se nyalisitsoeng e tlameha ho hlaha ka holimo ho mobu ka linoko tse leshome (10 cm)



- CHEKA SEKOTI BOHOLO BO LEKANANG LE MOKOTLA.
- TABOLA MOKOTLA KA HLOKO NTLE LE HO SISINYA MOBU O KOAHETSENG METHAPO.

TLHOKOMELISO: LENGOLE LA NYALISO EA SEFATE LE LOKETSE HOBA KA HOLIMO HO MOBU KA LINOKO TSE LESHOME (10 cm).

Lengole la nyaliso ea sefate:

Lifate tse hlaha li mela mebung e fapakaneng le maemong a fapakaneng a leholimo 'me li na le methapo e matla. Litholoana tsa lifate tsena ha li tenya haholo li bile li hloka tatso e monate. Lifate tse ling tse seng matla li ka beha litholoana tse hantle li bile li latsoeha. Ho fumana sefate se methapo e matla le litholoana tse hantle, metso ea lifate tse hlaha e kopangoa le makala a sefate se behang litholoana tse latsoehang. Mokhoa ona o bitsoa ho nyalisa sefate; me sena se etsoa ka ho khaola sefate se hlaha ka holimonyana ho metso e be se kopangoa le makala a sefate se behang litholoana tse monate tse kholo. Likarolo tsena tse peli li hola ha 'moho 'me li fetoha sefate se le seng. Lengole moo tsena tse peli li kopantsoeng le tlameha ho ba ka holimo ho mobu nako eohle ha sefate se lengoa.

Ho lema sefate se sa ts`eloang ka mokotleng

Tsena li lengoa ha ngata Mariha ho isa mafelong (Phupu-Phato).

1. Cheka sekoti se seholo bo fetang metloang ea sefate seo.



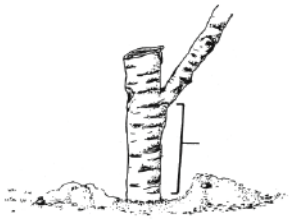
2. Poma ka bohloeki metloang e bonahalang e utloile bohloko e le ho qoba mafu.

3. Ts`oara sefate hore se be holingoana ka sekoting ho feta ka moo se neng se le kateng pele.



4. Koahela methapo kahloko, ts`ela le lipakeng tsa eona e le hore ho sebe sebaka se salang. Sefate se ts'oanetse hore lekane ka botebo bo lekanang le moo se tlohang teng ka mobung.

5. Karolo ea moo se nyalisitsoeng e tlameha ho hlaha ka holimo ho mobu ka linoko tse leshome.



Lengole la nyaliso ea sefate le loketse hoba ka holim'a mobu ka linoko tse leshome (10 cm).



6. Hang ha sefate se qeta ho hlongoa, se faole makhasi, sena se thusa hore se hole ka pele ka ha metloang e satlo tlameha ho fepa makhasi a mangata. Ho kgaola lekala ka tlasa senoko.



7. Hore sefate se hole hantle se otlolohile se ts`ehetse ka ho hloma thupa pela sona `me se tlamelloe ho eona.

Ha sefate se ntse se hola se nka sebaka se se ngata, ka hoo li arohanye hantle ha li lengoa.

Liperekisi, lipurumu le apolokose li arohanngoa ka bolelele ba kharafu tse tharo (3metres) lipakeng tsa lifate, likharu tse hlano (5 metres) lipakeng tsa mela.

Lipere, liapole le lilamuno tsona e be likharu tse hlano (5 metres) lipakeng tsa lifate le mela.

Noesetso ea lifate tse sa tsoa lengoa



1. Hatella ka hloko mobu o pota-potileng sefate.
2. Etsa letangoana le tla ts`oara metsi.
3. Noesetsa sefate ka liemere tse 'ne.



4. Koahela mobu o pela sefate ka joang bo ommeng, kapa ka lipampiri e le ho ts`ireletsa mongobo hore o se lahlahe ha ho chesa, hape le ho thibela hore lehola le se hlahe.

5. Metsi a tlohang marulelong a ntlo le a mathang fat'se a ka lebisoa lifateng ka foro e le hore ha pula e na, lifate li fumane mongobo.

6. Sebelisa mekhoa e latelang ho noesetsa lifate.

Selemo	Hoetla le selemo	Mariha
1	Emere tse peli (20 L) kamor'a matsatsi a mang le amang a supileng ha ho omeletse	Emere e le ngoe (10 L) ka mora libeke tse peli ho isa tse tharo
2	Emere tse tharo (30 L) kamor'a matsatsi a mang le a mang a supileng	Emere e le ngoe (10 L) kamor'a libeke tse peli ho isa tse tharo
3 le tse latelang	Emere tse tharo (30 L - 40 L) ho isa tse nne kamor'a matsatsi a mang le a mang a supileng	Emere tse peli (20 L) ka mora libeke tse peli ho isa tse tharo

Mokhoa oa ho fepa lifate tsa litholoana

Ts'ebeliso ea manyolo

Kamehla ts`ela manyolo pela lifate feela a se thetse kutu ea sefate, koahela manyolo hore a se lahle boleng kapa matla.

Lilemo tsa sefate	Loetse	Ts`etoe
Year 1	Emere e le ngoe (10 L) ea manyolo	Emere e le ngoe (10 L) ea manyolo
Year 2	Emere tse peli (20 L)	Emere tse peli (20 L)
Year 3	Emere tse tharo (30 L)	Emere tse tharo (30 L)
Year 4	Emere tse nne (40 L)	Emere tse nne (40 L)
Year 5	Emere tse hlano (50 L)	Emere tse hlano (50 L)

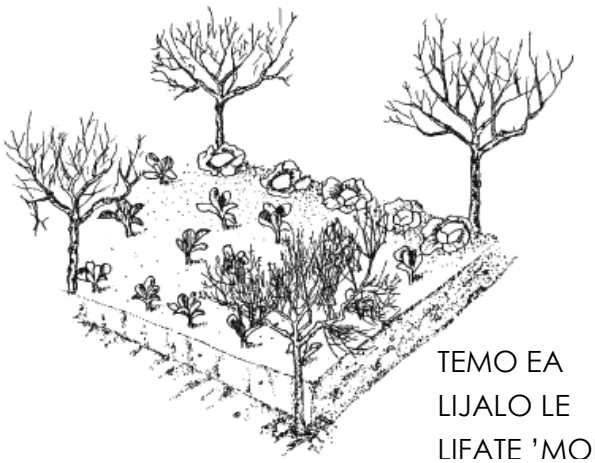
Ho tloha selemong sa bohlano ho ea pele ts'ella ka metsi a lekanang ka selemo.



Tlhokomelo ea lifate

Tlhakants`uts`u

Ho tloaelehile hore lifate ho mela `moho le limela tse ling ka tlhaho, ha li lengoe li le ling li ka hlaseloa ke likokoanyana. Ka hoo ho molemo ho li lema le lijalo tse ling tsa mefuta hore li thusana le ka ho tebela likokoanyana tse ling.



TEMO EA LIJALO LE LIFATE 'MOHO

Ho ka ba bobebe hape ho lema lijalo tse butsoang ka nako e khuts`oane lipakeng joalo ka habore le harese tse e tlare ha li shoa li etse mosuoela bakeng sa lifate.

Empa ho ka lengoa hape le tse nkang nako e telele joalo ka lesere tseo le tsona li tla heloa ho etsa mosuoela kapa eona furu ea liphoofolo.

Mafu le likokoanyana

Ho lema lifate tse phetseng hantle tse hlokang mafu ke mohato oa pele hobane li tseba ho mamella mafu le likokoanyana. Sebelisa manyolo a mangata `me li hlaolele khafetsa.

Mekhoa e meng ea ho etsa lifate tse phetseng hantle:



LIPALESA TSA MARIGOLD



LINOTS'I

- Ho lengoa hoa menkhane, leeks le konofolo e tebela likokoanyana tse ka senyang lifate.
- Linots`i li ka ruuoa e le hore li tsebe ho fetisa phoshoana e etsang litholoana.
- Bona hore likokoanyana tse kang bo-`mantsoai-tsoai, seroala-nkhoana, maleshoane le maroana, le liqaqana li ba teng hoba li ka ja liboko le tse ling tse ka senyang lifate le litholoana.



❖ Ritela metsoako e ka nkhelang likokoanyana tse senyang ha mpe

– **Konofolo (Garlic) le hanyanese**: Khabela kotola ea konofolo kapa ea

hanyanese li inele ka likhabaneng tse peli tsa parafini letsatsi lohle. Sefa motsoako ona,'me o tsoake le metsi a halefo ea lithara. Seha kotola ea sesepa sa "sunlight" se setala ka lehare, se ts'ele ka motsoakong ho fihlela se thuheile. Hona ho tla thusa hore motsoako o lule mahabeng a sefate.

- **Motsoako oa Koae**: Motsoako ona o lokela ho sebelisoa ka hloko e kholo ka ha o le chefo likokoanyaneng tsa bohlokoa joalo ka linots'i le tse ling, o oa libolaea. Belisa litompi tsa sikarete kapa koae ka lithareng ea metsi.sefa motsoako 'me o hlapolloe ka lithareng tse peli tsa metsi joale o fafatse lifate.

- **Sefi sa lintsintsi ka litholoana tse bolileng**: Lintsintsi tsa litholoana li shemola le ho behela mahe ka hara tholoana. Liboko tse nyane li qhotsetsoa kahare ho tholoana ebe lia e bolisa. Litsintsi tsena li rata ho ja lithoaloana tse butsoitseng joalo ka morara, lilamuni le lipolamo. Metsi a kopaneng le lero la litholoana le tsoekere li ka sebelisoa e le ho ts'oasa lintsintsi tse joalo.

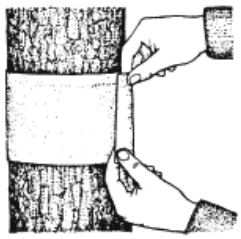




- Mokhoa o mong oa ho ts'oara ntsintsi ea litholoana ke ho tsoaka "Bovril kapa Marmite" le chefo e kang motsoako oa koae joaloka' tlaloso e boletsoeng ka holimo.



❖ Mokhoa o mong oa ho thibela lintsintsi e ka ba oa ho thonaka litholoana tse oeleng tlasa lifate tse bolileng letsatsi le letsatsi, 'me li t'seloe ka emereng e tletseng metsi a tla thusa hore liboko li tebe kahara ona. Litholoana tse joalo li ka sebelisoa ho fepa likhoho le likolobe. Ho bohlokoa hore liboko tseo tse nyenyane li se thetse fats'e ka ha li fumana monyetla oa ho tsoa kahara litholoana e be li kena mobung joale li qalelle ho qhotsa lintsintsi tse ling tsa litholoana.



- Thatela sefate ka lesela kapa pampiri e tlotsitsoeng ka kirisi `empa etsa hore e se thetse sefate ka ha e chefo sefateng, likokoanyana tse nyane tse hloang sefate li tla tsoaseha ebe li a shoa.

- Mafu a kang mildew e leng mofuta oa hlobo, phofshoana e ts'oeu e atisang ho bonahala mahabeng a liapole le lipere, black spot e leng matheba a mats'o a atisang ho bonahala mahabeng a lifate le litholoaneng, leaf curl e leng ho sosobana ha mahaba ho bonahalang hangata lifateng tsa liperekisi le ho tsa matebele e behoa taolong ka ho hlohlora lerole le ka fumanehang lifateng kapa litholoaneng ka lime sulphur kapa copper-oxychloride, 'me meriana ena e ka fumaneha mabenkeleng a rekisang lipeo.



LETHEBA LA LEKHAPETLA



HO SOSOBANA HA LEKHAPETLA LA SEFATE SA PEREKISI

Poloko ea litholoana

Ho boloka litholoana ka mokhoa oa ho li omisa, ho li ts'ela libotlolong kapa ho etsa jeme ke mokhoa o nepahetseng haholo oa ho li boloka nako e telele.

Ho omisa litholoana

Haho thepa e khethehileng e hlokahalang sebakeng sa ho omisa litholoana, le hoja liomisi tse entsoeng ka mokhoa o bonolo li ka thusa. Tholoana e omme ha fela ho se na metsi a tsoang ka nako eo e pepetoang.

Li ka lokisoa ho latela liresepe tse tlang ho latela eaba li behoa moo ho tsetsitseng kapa holima boto. Li ka omisetsoa ka tlung kapa ka ntle letsatsing. Ka mokhoa o ts'oanang, ho molemo ho li koahela ho li ts'ireletsa likokoanyaneng le leroleng le ka li bolisang, li ka koaheloa ka lesela, pampiri kapa terata e ts'esanyane (wire mesh).

Liresepe ho tokisetsong ea ho omisoa oa litholoana:

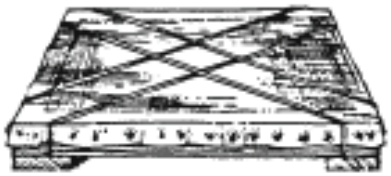
- Liperekisi, lipolamo le mabolilana: seha litholoana lihalefo e be u tlosa tholoana kahare. Beha litholoana holima terei li shebile holimo.
- Liapole: Ebola liapole e be u nts'a litholoana tse kahare. Li khabele ka mokhoa oa selikalikoe (rings) e be a hanyeoa terateng holima setofo se chesang. Liapole li hloka hore li ome ka potlako ka ha li fetola 'mala, li ba sootho kapa li be nts'o joale e ba ha li sa hebahala hantle sebakeng sa ho jeoa.
- Lipere: Li ebole 'me o tlose litholoana tse ka hare. Etsa motsoako oa metsi a lithara tse peli le letsoai ebe li karoloana tse sehiloeng la lipere li akheloa ka teng. Li nts'e ka motsoakong e be ua li omisa ka tloaelo.

FOREIMI E OMISANG EA TERATA





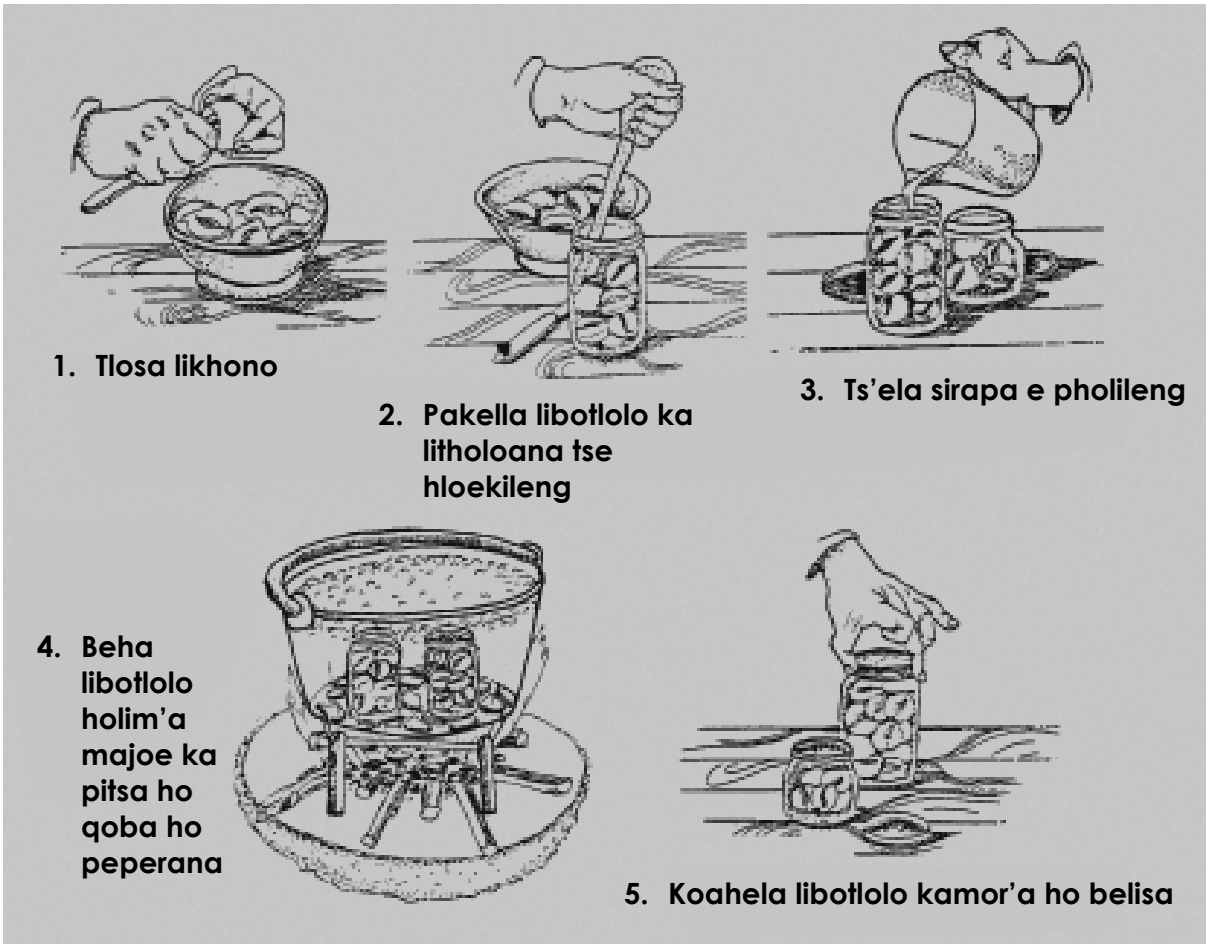
FOREIMI EA BOSEKA



FOREIMI E OMISANG EA LELAPI LA CHISI

Ho ts'ela litholoana ka libotlolong

Ho ts'ela litholoana ka libotlolong ke mokhoa o bonolo oa hoba le litholoana tse tsoekere le tatso e monate ka lapeng selemo sohle. Ho tla hlokahala theko ea libotlolo tsa polokelo tse nepahetseng ho netefatsa hore litholoana ha li bole. Libotlolo tse nepahetseng ke tse nang le sekoahelo sa ts'epe le rabara kapa libotlolo tsa mofuta o sothoang likoahelo ho qoba hore moea o se kene.



- Ho hlokahala litholoana tse sa butsoang haholo. Liperekisi, lipurumu, le liapolekose li ka arola ka ho lekana. Lipere le liapole li hloka ho ebeloa.
- Libotlolo li hloka hore li bolaoe likokoana-hloko (sterilize) pele li ts'eloa litholoana ka ho li belisa ka metsi 'moho le likoahelo tsa tsona nako ea metsotso e leshome
- Libotlolo li ts'eloe litholoana tse hloekileng
- Ts'ela sirapa: Halefo ea kopi ea tsoekere metsing a futhumetseng a lilithara tse peli le halefo. Thetsa-thetsa botlolo ho netefatsa hore haho moea o tlaba teng lipakeng tsa litholoana.
- Belisa litholoana tse ka libotlolong nako ea hora le halefo: Beha likoahelo le lokolohile botlolong 'me libotlolo li behoe holim'a majoe a manyenyane ka pitseng e kholo e ts'etseng metsi. Metsi a loketse ho koahela libotlolo.
- Nts'a libotlolo ka pitseng kamor'a metsotso e leshome e pholile. Tiisa likoahelo ho lekana.

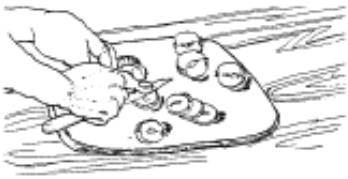
Ho etsa Jeme

Litholoana lia tiea ha li belisitsoe 'moho le tsoekere ka lebaka la boteng ba lero le bitsoang "pectin" le hlahang ha litholoana le tsoekere li bela. Litholoana tse ling li khona ho etsa jeme ha bobebe ho feta tse ling hobane li na le pectin e ngata.

Litholoana tse ntle bakeng sa ho etsa jeme: Liapole, lipurumu, liperekise le liapolekose

Litholoana tse ling li hloka pectin ka mokhoa oa lero la lamune (1 lemon/kg ea tholoana). Litholoana tsena ke licherri, feekha le merara.

Rasepe:



1. Hloekisa 'me u khaole tholoana ka likaroloana tse nyenyane, likhono le maqeba a mang li tlositsoe.



2. Ts'ela litholoana ka pitseng. Metsi a koahele litholoana. Belisa ho fihlela ho ba bonolo.



3. Ts'ela tsoekere. Ho hlokahala tsoekere e lekanang le litholoana. Litholoana tsa boima ba kilograma ele 'ngoe bo lekane le kilograma ea tsoekere.



4. Ts'ela lero la lamuni haeba ho sebelisoa litholoana tse haelloang ke pectin.

5. Belisa butle metsotso e leshome hoisa horeng ho fihlela jeme e loketse ho tiea. Ho fumana bonnete bona, ts'ela jeme e nyenyane sekotloloaneng ho fihlela e pholile. Ha bokaholimo boba thatanyana joalok'a jeli ke sesupo sa hore jeme e tiile 'me e ka ts'eloa ka libotlolong.

6. Belisa libotlolo metsotso e leshome. Ts'ela jeme libotlong tse ntseng li chesa. Koahela ka thata. Li lumelle ho phola.



Kkoahela libotlolo tse ts'etseng litholoana ka pampiri e boka

References:

Robyn Neeson. 1997. AgnoteDPI/190. Organic Fruit Production. NSW Agriculture. Australia

Sheard, Andrew. 2007. Fruit Production in KwaZulu-Natal. Department of Agriculture and Environmental Affairs, KZN, South Africa.

Parker,W., Bolus, R. and Hosack, P. 1985. The Soil is Good for Fruit; A guide to fruit growing in the Transkei. The Transkei Appropriate Technology Unit, Umtata, Eastern Cape, South Africa.

Ho faola lifate tsa litholoana

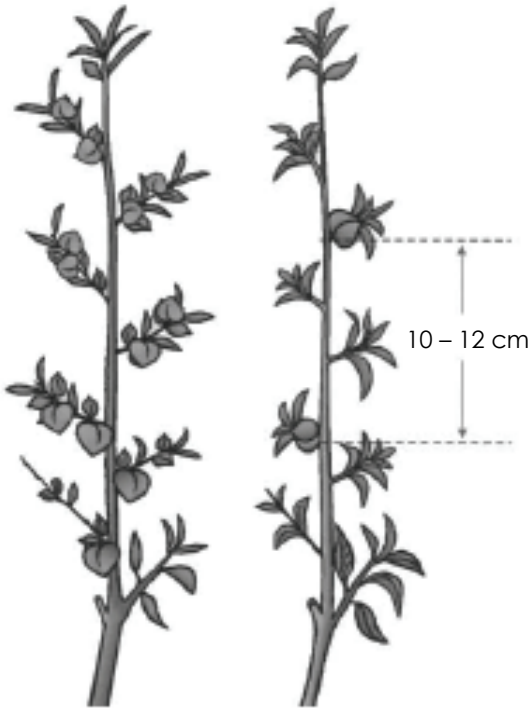
Selelekela

Ho faola lifate ke ho li tlosa likarolo tse ling tsa tsona e le ho atlehisa kholo ka mokhoa o ts`oanang. Ho tloaelehile hore ke makaee, kutu kapa makhasi, athe methapo kapa tsona litholoana le tsona ekaba karolo tse ling tse ka faoloang ho atlehisa kholo ea sona ka mokhoa o ts`oanang. Tholoana e atleha hantle makaleng a macha ho feta a khale. Ka hona, sefate se metseng makala a macha kamor'a ho faoloa se bea litholoana tse atlehileng ho feta se sa faoloang hohang.

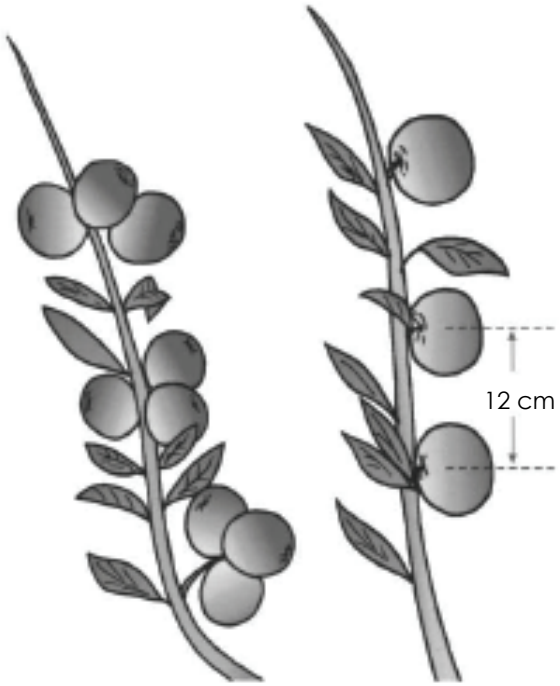
Litholoana li ka qalella ho fokotsoa makaleng libeke tse 6-8 ha li lekana le mapanaki, `me boleleleng ba mithara ba lekala ho sale litholoana tse 7-8, kapa litholoana tse `ne boleleleng ba sephaka.

Ho lifate tse etsang pete (tholoana) joalo ka liperekisi, lipurumu, le apolokose, le tse senang pete joalo ka apole, pere le mefuta ea lilamonu, li ka beha selemo sa pele empa tsa beha ha nyenyane selemong se hlahlamang kapa tsa se behe hohang. Makala a tsona a ka imeloa ke litholoana tse ngata `me a robeha, ke ka hoo ho hlokahalang hore ho fokotsoe litholoana e le ho thibela sena le hona ho fa tse fokolang monyetla oa hore li atlehe hantle. Hona ho ka thusa hore litholoana tse beoang ke sefate se joalo li be nyane ka palo empa li be tenya, ho feta ha li ka ba ngata empa li le ts`esanyane.

LIPEREKISI LE LIPOLAMO



LIAPOLE LE LIPERE



`Me boleleleng ba methara ba lekala ho sale litholoana tse 7-8, kapa litholoana tse `ne boleleleng ba sephaka

Mabaka a ho faola lifate tsa litholoana

Ho faola makala sefateng sa lithoalaona ho etsa hore:

- Sefate se be matla khahlanong le meea e ka se robang
- Sefate se tsebe ho jara boima ba litholoana
- Kotulo ea litholoana e be bobebe ho ba se sa phahama.

Ho faola sefate sa litholoana ho thusa ho eketsa khanya le ho foka hoa moea lipakeng tsa makala `me sena se thusa ho fokotsa mafu le hore litholoana li bope le hore li butsoe ka potlako.

Ho faola lifate tse ‘nyane tsa litholoana

Lilemong tse tharo tsa pele ho bohlokoa ho bopa sefate kamoo u lakatsang hore sebe ka teng, `me hona ho tla fokotsa mosebetsi oa ho faola makala a mangata ha se sentse se hola.

Ho faola lifate tse kholo tsa litholoana

Sefate se qalang ho faoloa se se se holile se hloka ho faoloa haholo, ka hona se ka beha palo e fokolang ea litholoana selemong seo, `me sa beha haholo selemong se hlahlamang.



SELEMO SA PELE

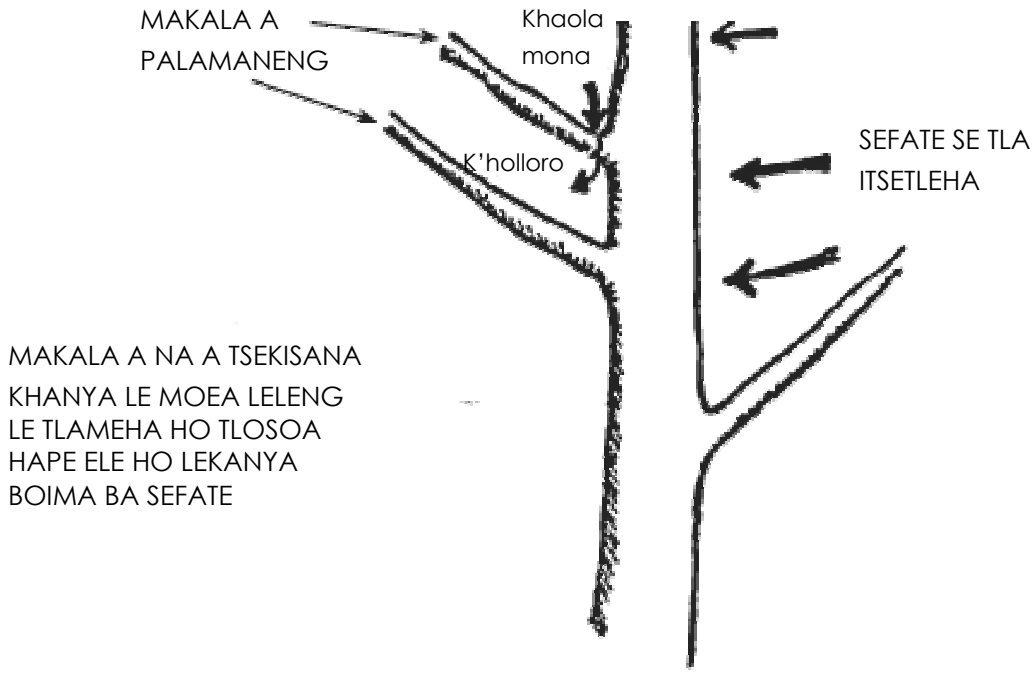
Mehato e lateloang ha ho faola lifate tsa litholoana

Kamehla faola lifate ha ho omme ho phema mafu maqebeng a bulehileng.



SELEMO SA BOBELI LE TSE LATELANG

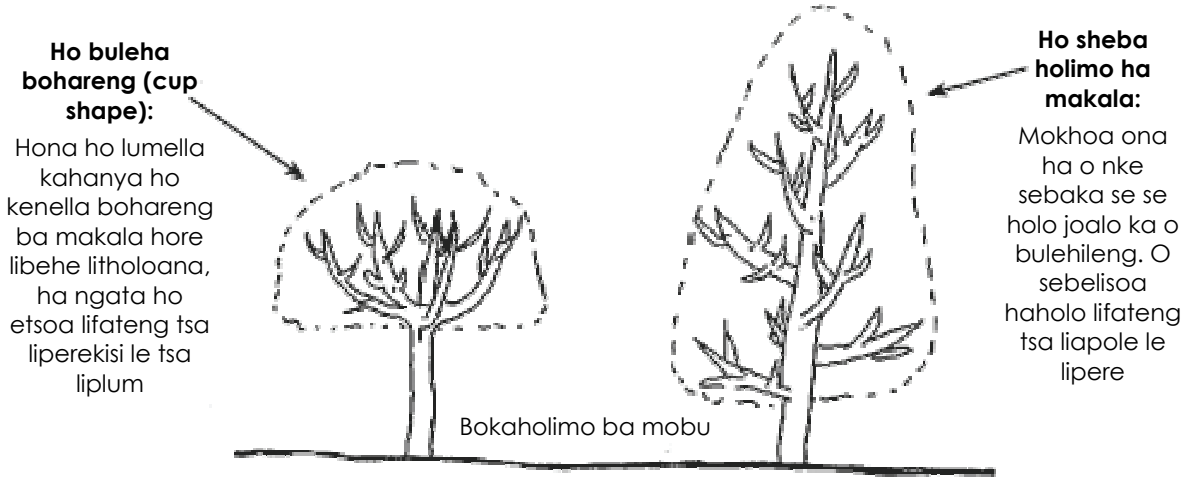
- Mohato oa pele: qala ka ho tlosa makala a omeng a nang le ts'oaetso ea mafu.
- Mohato oa bobeli: tlosa makala a palamaneng, a atamelaneng kapa a thetsanang.
  Poma ka tsela e bontsitsoeng setsoantsong se latelang.
-



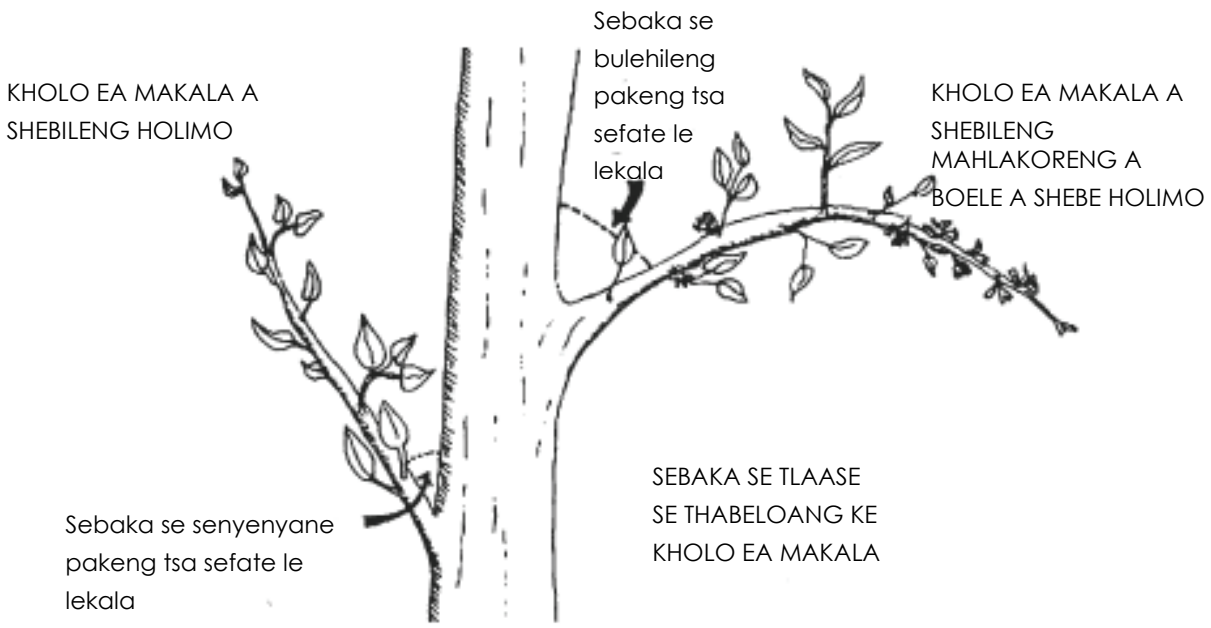
- Kamehla poma makala ohle a hlahang katlase ho leqeba moo sefate se nyalisitsoeng teng, ka ha makala ao a tla jella karolo e ka holimo ho leqeba matsoai ao e a hlokang.



- Lifate tsa litholoana li faoloa hore li bulehe bohareng kapa li shebe holimo.

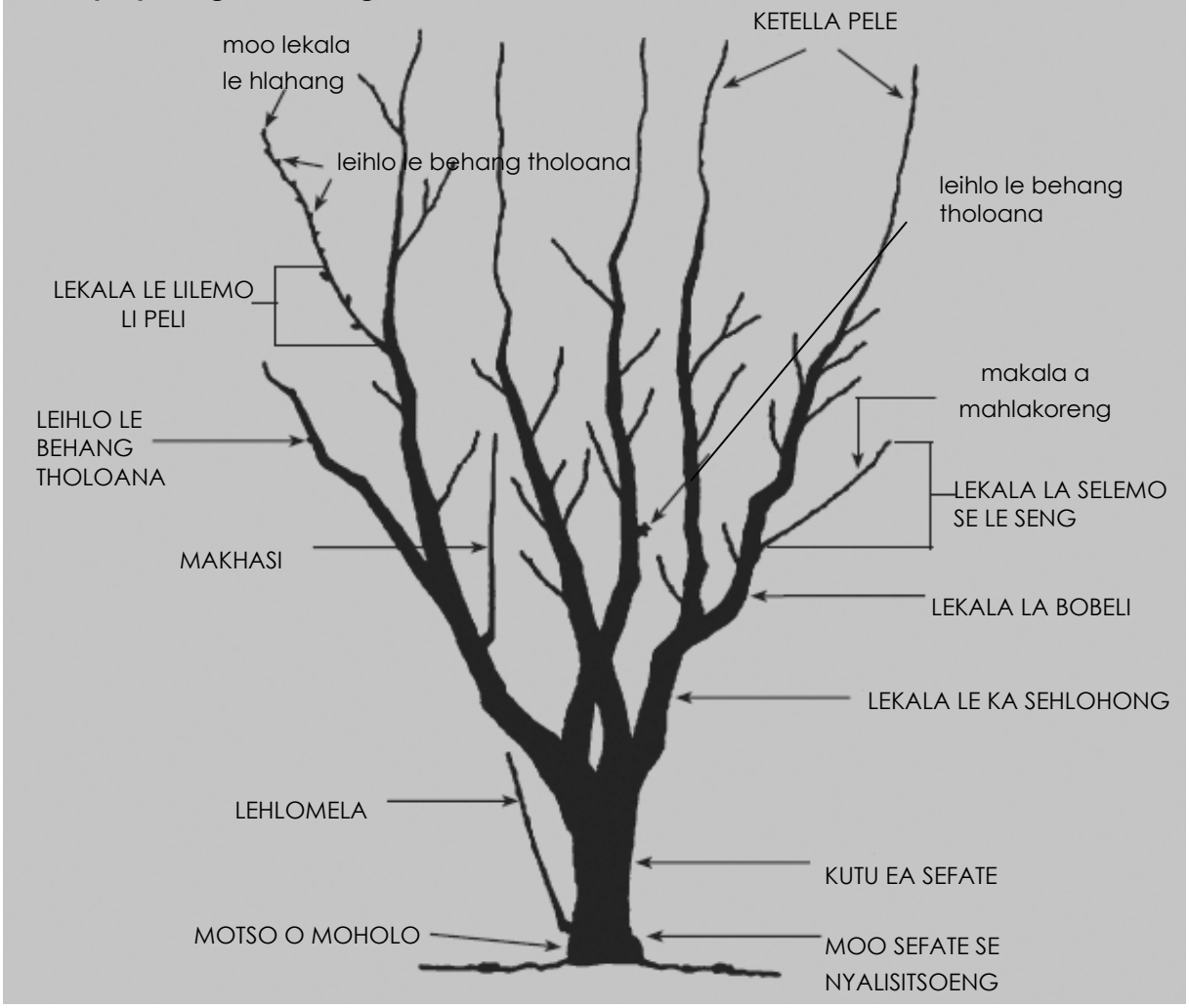


- Hangata makalana a behang litholoana ke a mahlakoreng a lekala le bohareng eleng lona le tsoereng boima ba sefate, ha ele a sa kobehang a robeha ha bobebe ha meea e tla ka sekhahla. Ka hona ho molemo ho sia lekala le bohareng le a mahlakoreng e le ho akofisa tlhahiso ea litholoana ho feta ho hola ha sefate.



KA HOLIMO: SEBOPEHO LE SEBAKA BAKENG SA MAKALA A LITHOLOANA

Likarolo tsa sefate tseo ho ngotsoeng ka tsona holima ho faola lifate maqhepheng a latelang:



Ho faola lifate tse etsang li-pete

Ho tseba hore na sefate se beha litholoana joang, ho ka thusa hore na se faoloe jaong:



KA HO LE LETS'EHALI:
MAKALA A BEHANG LIPEREKI

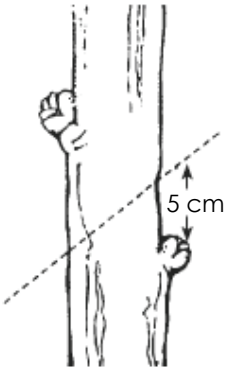
LIPEREKISI:
Tholoana e hlaha makalaneng a ngoahola feela.

LIPLUM:
Tholoana e hlaha makalaneng a lilemo tse peli tse fetileng kapa a khalenyana ho moo.



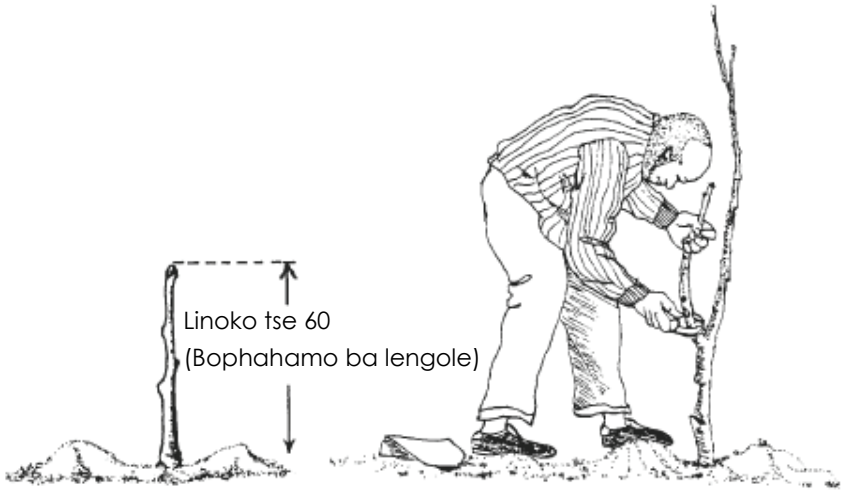
KA HO E LETONA:
Fruit spur on older wood of plum trees

Khaola lekala ka holimonyana ho moo leihlo le leng hona teng e le ho khothaletsa ho hlaha ha lekala le lecha joalo ka ha ho bontsitsoe setsoantsong se ka tlase.



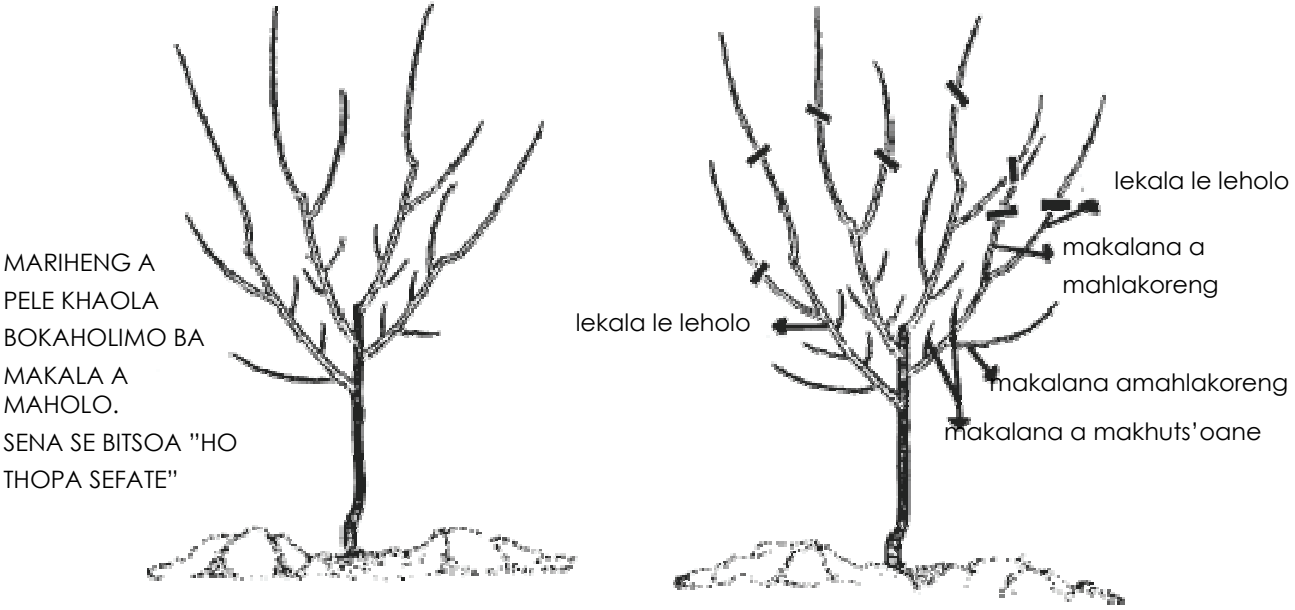
1. Nakong ea ho lema sefate:

Poma metso ea sefate pele u selema, `me le sona se pome bophahamo ba lengole, e leng linoko tse mashome a tseletseng (60cm). Hona ho tla thusa sefate hore makala a sona a hole a ea mahlakoreng ho feta ho ea holimo.

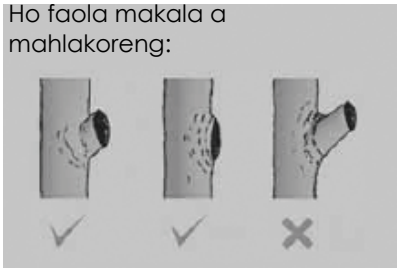


2. MARIHENG A PELE:

- Khaola bokaholimo ba makala a maholo.



- Poma makala a maholo ka holimo, Makaee a mangata a tla be a hlahile makaleng a maholo. Siea makaee a 2-3 lekaleng kangoe; lekalana la pele le be bolelele ba seatla ho tloha lekaleng, la bobeli le be leteletsana, joalo joalo.



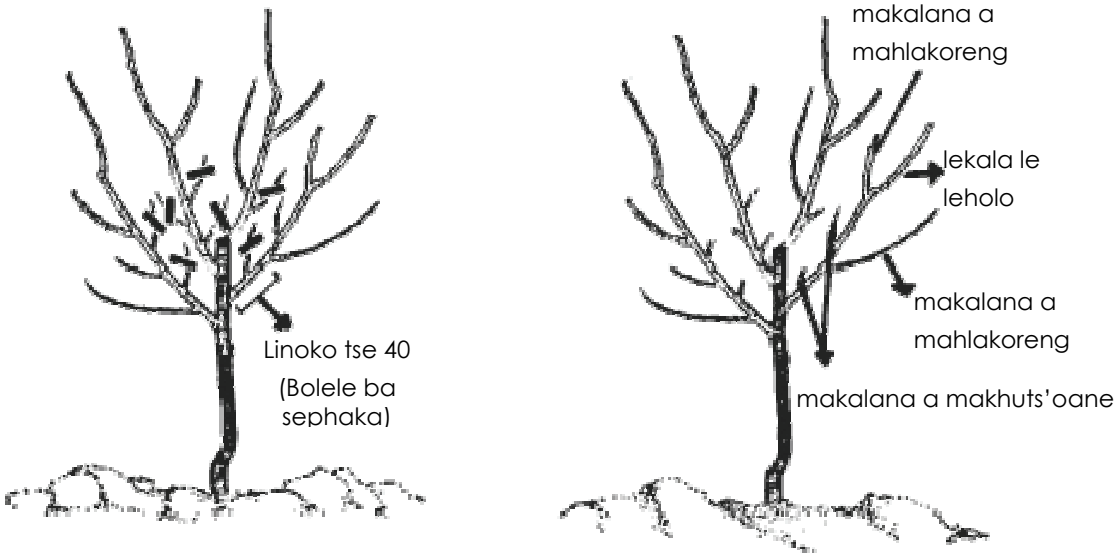
3. Mariha a bobeli le a bararo sefate se lengoe:

- Fokotsa hanyenyane bo kaholimo ba makala a maholo kaha ha a ka khaolelloa tlaase a tla lieha ho beha litholoana.

- Khutsufatsa makaee ka senoko holima leihlo le thuntseng kapa moo le neng le pongoe selemo se fetileng.

- Khutsufatsa makalana a mahlakoreng a lekaee. Siea a 2-3 lekaeeng ka leng.

Selemong sa boraro litholoana li tla hlaha makaleng ona oa. Ha a se a tiile, a faole hanyenyane Mariha a mang le a mang.



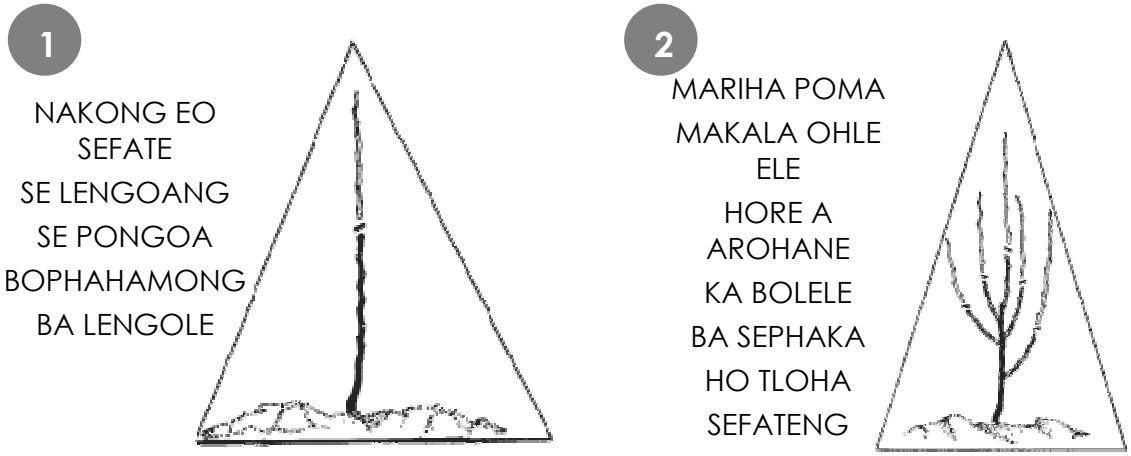
Ho faola lifate tsa litholoana tse sa beheng li-pete

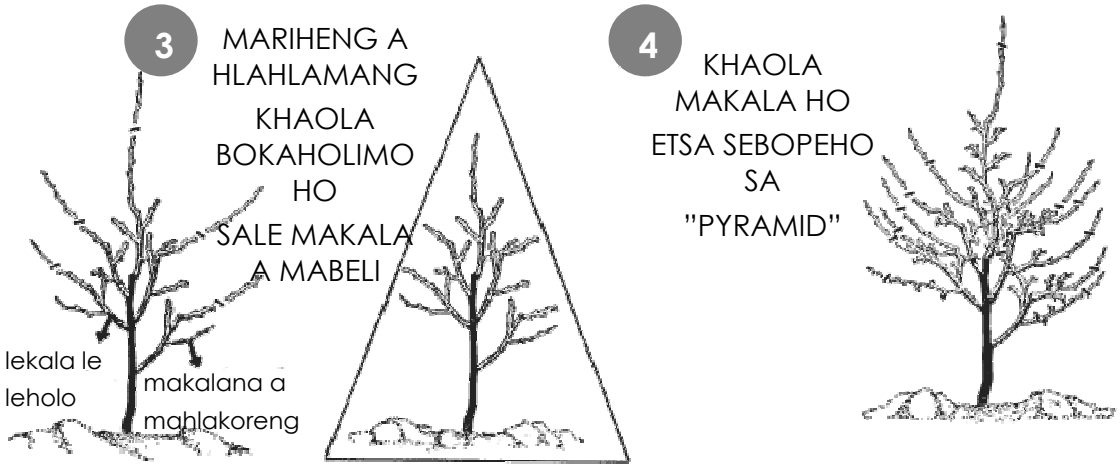
Lifate tsena li qallela ho beha litholoana selemong sa bohlano. Litholoana tsa teng li ka khuoa tsa butsoa li se sefateng. Mokhoa o amoheloang oa ho faola ke oo makala a shebileng holimo.

Litholoana li hlaha makalaneng a manyenyane a mahlakoreng ho tloha makaeeng, a beha lithoalana lilemo tse ngatanyana.

Ho faola lekhetlo la pele

- Khaola sefate se lengoeng ho isa bophamong ba lengole.
- Fokotsa makala a maholo u sie le le leng le bohareng, e be u siea makaee a mabeli lekaleng ka leng.
- Mariheng a bobeli le a boraro fokotsa makala a maholo le makaee, u siee makala a 2-3 a mahlakoreng ho tloha lekaeeng ka ngoe.





Ho faola merara

Merara e beha litholoana lehlomeleng la ngoahola leo lona le hlahang ho la ngoahola koola. Haeba le beha lehlomeleng la khale ho feta moo le tla beha litholoana tse nyane.

- Mariheng a pele poma lekala ho ea boleleleng ba linoko tse mashome a mararo (30 cm).
- Mariheng a bobeli faola makala haholo o siee a 3-4 a bolelele ba linoko tse mashome a mararo ho isa ho a mane (30-40 cm). Siea makalana ao lehlomela le tla mela ho ona.
- Selemong sa boraro le tse sehlahlamang tlosa boholo ba lehlomela u siee ho lekaneng bakeng sa beha litholoana.

7. Mokgwa wa ho jala sefate sa ditholwana se seng (Grafting)

Ke eng grafting? (Ho jala Sefate ho se seng)

Difate tse hlaha tsa ditholwana di hlaha mebung e mengata e fapaneng le boemong ba lehodimo bo fapaneng di ema le metso e matla, empa ditholwana tsa tsona dise kgolo ebile di sena tatso. Tse ding tsa difate tse se nang matla, dika hlahisa ditholwana tse tatso e monate e bile di le kgolo.

Hoba le sefate se matla se nang le ditholwana tse hlobosehang, methapo ya sefate sesetle se nonneng se e ka kopanqwa ho kapa ho hokelwa makaleng a sefate se nang le ditholwana tse hlabosehang. Ketsahalo ena e bitswa GRAFTING; ho na ho ka etswa ka ho kaola kutu mona feela ka hodima methapo ya sefate se seng se matla le ho hokela lekala la sona; sefteng se behang ditholwana tse monate kapa tse hlabosehang. Difate tsena ebe mona moo di tang ho hola mmoho ese ele sefate se le seng.

Dikeletso ho etsa GRAFTING e atlehileng

- Sebedisa sekere se hlwekileng ho kqaola sefate – indla thipa ya hao pakeng tsa dikgaolo ka 10% tsa bleach motswako (1 telepele ya bleach e tswakilweng le 9 telepele ya metsi.)
- Ha ose o entse dinoko, sebetsa kapele-pele patsi ta thupa ya hao e so omdle.
- Seke wa tshwana karolwana e sehilweng.
- Etsa bonnete ba hore kutu ya bao le moo ho kgaotsweng; di nepana hantle. O ka botsa ra nusery kapa otketsetse teko. Ka kekeretso o ka iketsetsa ka sefate sa apole ho sa apole se seng; pere ho pere, mora ho mora, ditholwana tse lejwe ho tsa lejwe tse ding (diperekisi; diapolkosi) le dilamune ho di lamune tse ding.
- Jala kutu ya methapo mobung o nonneng ose tebise ka mobung sebe letsatsing le moo ho senang moya ha ho hlokahala. Noketsa kgafetsa.
- Se nyahane ha o qala mokqwa ona wa ho jala hoba osa ithuta. Etsa mekgwa e mengatanyana haeba esa loke. Boikwetiso boa atehisa.

Scion ke lekala leo o le jallang ho sefate se seng. Scion e tswa sefateng se ditholwana di hlabosehang.

Rootstock: Kutu-metso ke karolwana ya metso e etsang bokatlase ba grafting. Ho kgomatretsa (grafting) sefate sa ditholwana, ho kgomaretsa lekala le leng le tswang sefateng se seng le kgomaretse motso-kutung. Ktetha motso-kutu o atlehileng se melang hantle moo o phelang teng.

Difate tsa ditholwana tse rekwang hotswa dinuserng di sentse di graftilwe. Molimi aka iketsetsa ka bo yena difate tsa hae lapeng hoiketsetsa phapang ho iphumantsa mofuta wa ditholwana oo a o hlokang mohlomong leha ekaba ka mefuta e fapa – paneng ya ditholwana sefateng sele seng!

Melemo ya GRAFTING

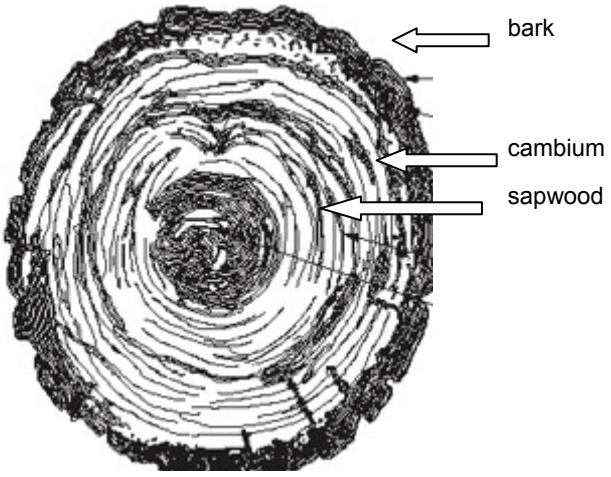


Emeng ya melemo ya GRAFTING ho molemi ya iketsetsang diteko eka tlisa:

- O ka itlhahisetsa difate tse kang tsa diapole tse pedi ka ho lema tse pedi tse tlang ho itswadisa ka bo tsona.
- O ka kgetha kutumothapo o tsa ntsha sefate se boholo bo botle se tla ho thibela mafu le dikokwanyana le tse kotulehang haholo mme o se kopanye se etsang ditholwana kgahlisang tse monate tseo o dihlokeng.
- O fumana ditholwana kapotlako kerolwana eka hodimo (scion) e kopanqwa ho semela (rootstock) ka methapo e metle e nontshitsweng. Ho hlalosa hore methapo etla khola ho fepa karolo eka hodimo (scion) hantle, ho bolelang hore o se o na le hlooho ya ho qala ya selemo kaofela.

E etswa jwang grafting?

Hona le mefuta e mengata ya ho etsa grafting. Ntho ya bohlokwa ke hore mekqwa kaofela ke ho netefatsa hore bokehare ba kutu (cambium) le bokahodimo (scion) le kutumetso ditlangwa mmoho hantle hore di tle di hole mmoho. Bokahare (cambium) bo fumanwang ka hare ho (bark) letlao la kutu, ke yona e hlahisang kapa ho medisa kerolo ya kutu.



Ho kgaolwa jwang

- Kgaola hotswa sefateng se setle se matlafetseng.
- Sebedisa thipa e motsu kapa lehare ho kgaola dikarolo tsa kutu tse botenya ba pitiloto.
- Kgetha butu e nang le dinolo.
- Kgaola koka hodimo o be o sale ka sekoto se nang le dinoko tse 4 (4 buds)
- Kgala boka hodimo sekgutlong le boka fatshe pentong e tsepaneng e tsebe ho fapana.

Mariha:

Nka bokahodimo ba kutu (scion). Hopola, seng setswa sefateng sa ditholwana tseo o di batlang kapa tseo o di hlokang tseo o batlang hore kutumothapo eo hlahisetse tsona. Ha o kepola bokahodimo ba hao, kgetha makela a tsepameng le a nonneng. (Hopola, di tla etsa kutu ya sefate sa hao se tsepameng.) Kqaola 23-25 cm (bolele bofetang bophara ba

letsoho) sekoto se ka bang 4 cm ka tlasa senoko (bud). Netefatsa hore bophareng ka fatshe (moo okqaotseng) bolekana le baphara ba kutumetso (1 cm). Kgaola thupa ka fatshe e seng thata ho hang. Kgaola dikarolwana tse itseng tsa bokahodimo ba kutu. Bo kopanye kapa botlame ka ho hong, o di thatele ka plastiking ebe o di beha moo ho phodileng ho bile hole lefifi.

Jwale o se o kanna wa kgaola (grafting)

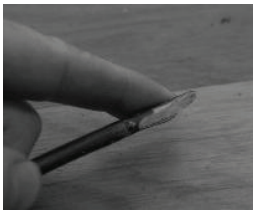


Phato kapa lwetse

1. Hang pele dinoko di hlaha maqalong a hlabula, kgaola bo ka hodimo metsokutung ho ema 15-30 cm (letsoho le le leng) kahodima mobu. Faola makala ohle a hlomang kutung. (Ha ho kgaotswe lekaleng le hlahang, kgaola ha nyenya morao.



2. Kgaola morao kutumotso moo bokantle bo loketsweng ho kgaolwa teng. Etsa ho kgaola o tshekabiditse.

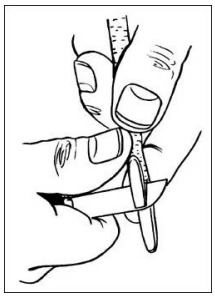


3. Lokisa bokahodimo: kgaola hodimo ka hodima senoko hoba 4 dinoko tloha kgada hotswa botsitsong ba bokahodimo o etse sekqutlo ho lekena le kamoo motsokutu ya hao e kgaotsweng ka teng.



4. Tshekalatsa moseo wa hao hodima motsokutu wa hao hotswa 1/3 tlasa sebaka se sekameng.

5. Seha ka botebo ba bokahodimo ho tloha 1/3 ho dima bokgalong babo bo sekameng.



6. Kenya moo a kgaotseng kaha kutumotso hore mmoho ditsebe ho kopana.



7. Tlama makopanong ka theipi. Tiipa bokahodimo ka setlotlo ebe owa ethatela theipi ya hao ka setlotso ha ho hlokahaba.



8. Kamorao ho kqwedi tse pedi, ha dinoko se di hlaha kapa dibonahala, tlosa ntho eo o tlammeng ka yona (tape). Kgaola motso kutu ofe kapa ofe o kahlahang – o ntse o tlatsa hotswa senokong moo ho kgaotsweng tsohle tse hlahang hotswa mobung.

8. Tlhophiso la ditholwana le meroho

Ha ona le tamati, diperekisi, kapa ditholwana le meroho ka tshimong ya hao. Ke botle ho tseba hore o diboloka jwang. Hore o disebedise pele di ka fellwa ke boleng (kapa di re boleng bo botle). Ka ho ithuta ho diomisa, ho etsa jeme kapa o di tshele dibotlolong. O ka etsa bonnete ba hore matla ao o a sebedisitseng tshimong ya hao ha a senyehe. Haeba ona le jheseho ya ho etsa kuno hotswa tshimong ya hao, oka fumana ho hlophisa kotulo ya hao pele o ka etsa kuno e ngata ha o rekisa disa le (fresh) kapa disale maemong a matle.

Bohlweki dijong

Ho bo hlokwa ho tshwara dijo ka bohlweki nakong ya ho lokisa dijo, ho thibela peo tsa mahloko hlwekisa matsoho a hao pele o tshwara dijo, ha o tswa ntlwaneng, ha o hleka ka (kitjihning) ka kamoreng ya ho phehelwa (ha holo nama). Etsa bonnete ba hore tlapa la ho sehela, dithipa, mabekere, dijana di hlwekisitswe ka makgethe. Etsa bonnete ba hore metsi ao o wa sebedisang ho hlatswa disebediswa tsa ka kitjhining le diperekisi kapa meroho a hlwekile. Haeba a sa hlweka hantle a bedise metsotso e leshome o tshele (Jik) (1 : 50 mixture).



Komiso ya ditholwana le meroho

- Meroho e meng e batla ho fubetswa pele e omiswa ho bolelwa hore ditshelwa ka metsing a belang nakwana e itseng.
- Komiso e batla maemo a futhumetseng, maemo a ommeng a nang le moyanyana o fokang.
- Komiso e nka nako e telele e kaba hora tse tsheletseng (6) hoya matsatsing a mahlano (5 days) komiso e etswa ke mongobo o merohong kapa ditholwaneng le mokgwa wa ho omisa o sebediswang ho omisa.
- Kamehla sebedisa meroho kapa ditholwana tse satswa kguwa ho etsa bonnete ba ho hlahisa mangangajane a boleng bo hodimo.

Mekgwa ya komiso

<u>*Komiso ka letsatsi:*</u> Dihlahiswa di bewa hodima raka e kwahetsweng ka sefe. Ho thibela dikokonyana le lerole, o behe mo letsatsi le jhabetseng.

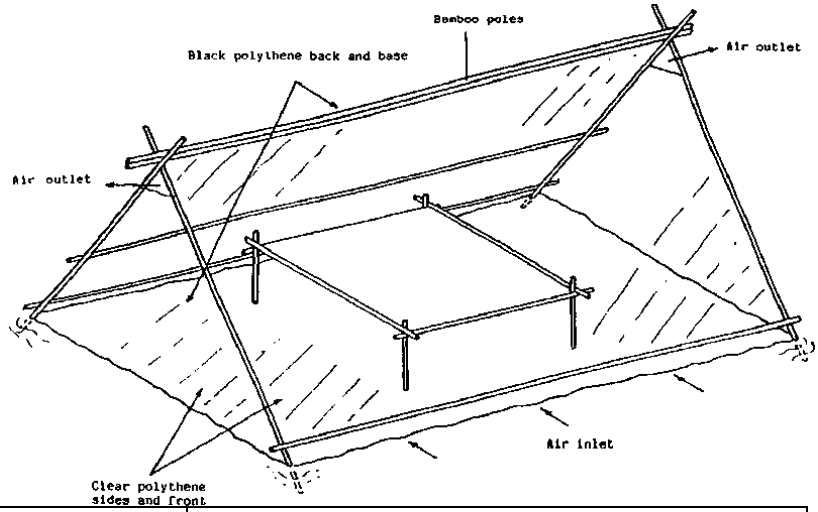
Komisi e ka nka matsatsi a 3-5.



Dimpe tsa komiso	**Melemo ya komiso**
Dihlahiswa di lokela ho tloswa ha maemo a lehodimo a le mabe (moya kapa pula ena). Ha dihlahiswa di sa tshireletswe, di ka ba ditshila tse tshabehang.	Komiso ya di raka e bonolo hape hae batle tjhelete e ngata.

<u>*Ho omisa ka tente:*</u> Dihlahiswa di bewa ka hara moralo wa dithupa mme e kwahetswe ka plasitiki. Mme e bewe moo letsatsi le tjhabelang teng.

Komiso e kaba matsatsi a 3-5.



Dimpe tsa ho omisa ka tente	**Melemo ya tente**
E batla basebetsi le dipalo ho etsa tente.	E tshireletsa dihlahiswa puleng le moyeng.

<u>*Ho omisa ka onto*</u>: Dihlahiswa di kenywa ka ontong ho dima di raka mme di hadikwe ka motjheso wa 140°C.

Nako ya komiso: dihora tse 8 kapa ho feta.

Dimpe tsa komiso ya onto	**Melemo ya komiso ka onto**
E tura haholo. E loketse ho etsa diteko.	E omisa ka pelenyana.

Ho omisa

Tlhwekiso

- Sebedisa tse boleng bo hodimo, tse butsuweng.
- Tlhwekisa di sebediswa tsohle le moo ho sejeletswang. Sebedisa dihlwekisa le metsi. (20L metsi + 400ml Jik)
- Sebedisa dihlwekise tsatsi le leng le le leng
- **O se kgephole letlalo la dihlahiswa ka nako eo o omisang!!**
- Beha dihlahiswa ka hara sejana se hlwekileng ka mora ho hlatsuwa.

Kebolo

- Ho se ebolwe sebakeng sa moo ho ntseng ho hlatsuwa dihlahiswa tse tala.
- Ebola ka hloko o tlose letlalo le ka hodimo feela.
- Beha makgapetla moo ho loketseng kapele.

Ho fubetsa ho etsang?

- Ho thusa hore mmala wa sehlaiswa se dule se le jwalo.
- Ho kgutsufatsa nako ya komiso.
- Thibela ho fetola tatso.
- Ho thusa hore di dule dile mongobo.

Ho seha le ho kgabela

- Mofuta wa dihlahiswa o hlalosa botenya bo lekaneng ba bokuabelwa.
- Karolo e tenya enka nako e telele ho oma (slices)
- Karolo (slices) se se sesane se manama borotong e omisang.
- Ha o ikemiseditse ho rekisa etsa bonnete ba hore dihlaiswa tsohle di a lekana ka botenya.

Fubetsa (Ho bohlokwa ho meroho le ditholwana)

- Bedisa metsi a lekaneng se hlahiswa.
- Tshela sehlahiswa se kgabetsweng ka hara sefe e fubetsang.
- Di kenye ka metsing a belang.
- Dintshe ka matsing a belang.

Ho aneha ho dima lepane la ho aneha

- Lepane le lokelina ho hlakolwa le ho hlatswuwa hantle pele.
- Ha o ntse o kgabela, di hlahiswa di bewe di atamelang, empa di se hatane hodimo.
- Lepane le bewe moo ho leng level moo ho senang moya kapa moo letsatsi le tjhabetseng kapa moriting.

Komiso

- Haeba ho le phofudi ka moo o omisang ka teng bula monyako hanyane.
- Ha ho hlokeha kenya lepane kamoo le satlo wela ke phoka.

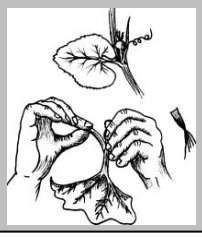
Poloko ka ho beha

- Ka ditshelong di behe ka makgethe, o qobe mongobo.
- Dithshele ka makgethe ho qoba, tshilafatso.
- Ho bewa holoketswe ho etswa hang kamora komiso.
- Dula o lekola dihlahiswa letsatsi le leng le le leng matsatsing a pele a 7 tlosa tse senyehileng le tse nang le hlobo.
- Di tshele ka hara di khemfuruti, mabokoseng mabekereng a kwetsweng ka thata kapa ka di polasitiking tsa mekotlana.
- Boloka ka ditselong tse nyane ho thibela tahlehelo e kgolo ka baka la hlobo.
- Boloka mofuta ole mong ka setshelong.

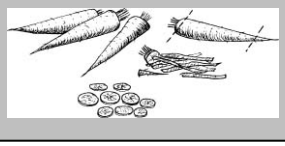
- Dikgalase tsa ditshelo di loketswe ho bolokwa moo ho leng lefifi.
- Ditshelo di lokela ho bewa letsatsi leo di bolokilweng ka lona.
- Di boloke moo ho phodileng, ho ommeng le moo ho hlwekileng.
- Di hlahiswa dika bewa selemo hoisa ho tse pedi (1-2 dilemo).

Di hlahiswa tse boleng bo hodimo di tla omiswa hantle di sena hlobo. Di lokela ho ba le mmala o motle, empa hoba swotho ke tlwaelo. Di la tsweha jwalo ka tse ntjha. Di jalo tse omisitsweng di lokela ho oma.

Ho omisa mahaba a mokopu:
Kgetha a matjha, a bonejwana.
A ebole makgapetla a hlabang.
A hlatswe ka metsi a hlwekileng.
A habele metsotso e 3 ho isa 5 metsotso.
Beha paneng o loketswe ho omiswa.
Teko ya hore o oomme: o robeha ha bonolo hao o fupara.



Diwete ho diomisa:
Kgetha diwete tse ntle tse bonolo tse senang dithupa.
Di habole ho fihla di butswa empa ese dibe phere.
Tlosa makgasi le mehatla (methapo)
Di kgaole ka di reng (2-3 mm) kapa ka bolelele.
Di behe lepaneng hore di ome.
Teko ya ho oma: dikobe di lokela hoba thata empa di tla kobeha.



Souse, dijo tse dibotlolong, le jeme



Kgetho le tokisetso

- Kgetho dihlahiswa tse ntle tsa boleng bo hodimo.
- Se sebedise tse nang le hlobo kapa tse nang le mahloko. Motjheso oka bolaya boteng ba kato ya dikokwana, empa eke se tlose tatso e ka bakwang ke hlobo.

Tihwekiso

- Di hlatswe hantle (le haeba oka tlosa letlalo) ho tlosa lepole, ditshila le hlobo.
- Hlatswa tse lekaneng metsing a mathang a bile a bata.

Kgetho ya dibotlolo

- Botlolo ha e ya tlameha hobal e ho petsoha.
- Dikwahelo tsa masenke di se kobehe kafa tse kobehileng tse senang rusi mme di kwale hantle.
- Hlatswa dibotlolo ka sesepa hape o di hlatswe ka metsi a hlwekileng.

Ho bolaya mahloko

- Beha botlolo ka hara pane e tshetswe metsi.
- A bedise metsotso e 15.
- Sebedisa tang ya dibotlolo ho ntsha botlolo o tsholle metsi ka hara botlolo.
- Dikgaba le dikwaelana le tsona di lokela ho bediswa metsing.

Ho tshela dibotlolo

- Ho tshela ha dijo di sa tjhesa (±80-85°C).
- Se di tlatse ha holo siya 1-2 cm.
- Ntsha moya ka thipa dipakeng tsa dijo.
- Hlakola molomo wa botlolo ka pampiri e mongobo.
- Kwala botlolo hantle feela.

Ho futhumatsa di botlolo

- Ho etsa bonnete ba nako e telele kenya di botlolo ka metsing a futhumetseng metsotso e 10-15.
- Sebedisa pane e fetang dibotlolo ka 5 cm. O e tlatse metsi a futhumetseng o ka tshela metsi hape nakong e o boloyang mahloko.
- Futhumetsa metsi ka 82°C. Kenya dibotlolo ka metsing di kwahelwe ke metsi. Bedisa metsi ao metsotso e 10-15. Hlokomela hang ha metsi a bela.
- **Ho bohlokwa ho siya 20mm sebaka ka hodimo ha o tshela dibotlolo ho thibela kopano le metsi ha ho bolawa mahloko.**

Phodiso ya dibotlolo

- Ntsha dibotlolo ka metsing di behe rakeng. Dihlakole ka lesela kapa koranta di arohanse ka 3 cm.
- Difodise ka tekanyo ya motjheso wa ntlo 12-24 hora.
- Hlokomela hore dikwaglana di kwetse hantle.

Mekgwa ya ho kwaholla dibotlolo

- Ha dikwaelo di sa kwale hantle. Sheba ho petsoha. E tjhentjhe ha ho hlokeha. Phejha o hlatswe ka metsi a futhumetseng di horeng tse 24.

Ditshwaye o dibehe

- Ditshwaye ka lebitso le letsatsi, kgedi le selemo.
- Dibehe moo ho hlwekileng, ho phodileng ho leng lefifi (kapa lerotho).

Kgetha le ho hlokomela botlolo tse sa lokang

- **Seke wa latswa dijo tseo odi belaellang.**
- Sheba dijo tse omisitsweng mahlakoreng a botlolo, dibudulwana tse phahamang ka botlolong kapa ho fetoha ha mmala.
- Arohanya ho thetsana ha ditshelo le dijo.
- Ha kopana hwa dijo le setshelo.

The following should be blanched before bottling:

- All *greens* should be blanched about 5 minutes to reduce the bulk.
- In order to prevent loss of the milk, *maize* should be blanched on the cob until it is firm to the touch and until the milk does not ooze out when it is pricked with a fork.
- *Beets, carrots and parsnips* should be blanched until the skins will slip off easily.

Mekgwa ya ho pheha

Jeme ya tamati (Tomato Relish)

1 eeye
800 g tamatie kgabetsweng
1 granny smith apple: cored and chopped
250 ml asane
160 g sultanas
83 ml fresh orange juice
¼ teaspoon mixed spices
1 whole clove
¼ teaspoon chilli powder

Beha tsohle ka paneng le leholo.
Di bidise.
Fokotsa mollo o bidisetse fatshe hora (1 hour). Fuduwa kgafetsa. Tlose mollong. Bolaya mahloko botlolong metsotso e 15. Tshela dijo disa tjhesa ka botlolong e bolailweng mahloko, o e kwale.

Tomato Chutney

1 kg tomatoes
500 ml vinegar
12.5 ml mustard powder
2 ml red pepper
½ clove garlic
300 ml brown sugar
12.5 ml ginger
125 ml sultanas
2 onions

Tshela tamati ka metsing a belang mme o e ebole. E kgabele. Tshela disebediswa ka lepaneng mme o bedise butle, fuduha kgafetsa ka kgaba ya thupa, hofilhela e ba beholo e be borethe. Tshela ka hara botlolo e hlwekileng.

Piccalilli Relish

2,75 kg prepared vegetables (Enough vegetables to fit into one big pot. You can use cucumber or cabbage, marrow or carrots, small onions, cauliflower, beans)

3 pints (6 cups) white vinegar

6 teaspoons dry mustard powder

2 teaspoons ginger

250 g sugar (1 cup)

37.5 g plain flour (1/3 cup)

4 teaspoons turmeric

Brine (Very salty water. To make add approx. ½ cup salt to 1.5 litres of cold water)

Hlwekisa le ho hlophisa dijalo (ebola, kgabela 2 cm dinoke kgabela eeye, roba cauliflower). Inela meroho ka metsing a letswai.

Kopanya asene le mustard le ginger tshela tswerere futhumatsa butle ho fihlela tswekere e qhibidiha. Tsokotsa o ditlhotle hantle (meroho) di tshele ka pitseng o ntano tshela asene e tjhesang. Pheha metsotso e 20. Butle butle. (Ka mollo o fatshe). Ekga meroho ka kgaba e masoba o di tshele ka ditshelong. O se tshele ho feta tekano.

Kopanya flouru le turmeric ho etsa paste e bonojwana o sebedisa asene e lekaneng. Fuduwa tsena ka hara motswako o tjhesang. Bedisa metsotso e mmedi jwale tshela hodima meroho o ntano kwala.

Curry Cabbage Atjar

2 cabbages

4 onions

500 g white sugar

30 ml corn starch (or flour)

15 ml curry powder

15 ml mustard powder

7 ml salt

625 ml white vinegar

Kgabela khabetje hasesane. Ebola eeye oe kgabele. Pheha cabbage le onion ka hara metsi a manyane ho fihlela eba bonolo. Ntsha metsi hantle.

Kopanya sugar, corn starch, curry powder, mustard powder le letswai.

Tshela tsohle ka asene e lekaneng.

Tshela asene, mme o e bedise. Phehe nako e etsang metsotso e 5.

Tshela khabeche e phehe hofihla e butswa hantle. E tshele ditshelong e sa tjhesa mme o e kwale hantle.

Resource Material for Homestead Food Gardeners

Chapter 4: Handouts (isiZulu)

Handout 1	Ukutshala izitshalo ezinhlobonhlobo engadini (Mixed cropping)
Handout 2	Ukushinshanisa izitshalo engadini (Crop rotation)
Handout 3	Lwezinye zezitshalo, ezisiza ekwakheni amakhambi kanye nezichazelo zokuthi asetshenziswa kanjani nokuthi alungiswa kanjani (Some plant remedies for pest and disease control, how the remedy is prepared and what it is used for)
Handout 4	Ukubekwa kwezimbewu (Seed saving)
Handout 5	Ukutshalwa kwezihlahla zezithelo (Growing fruit trees)
Handout 6	Ukukhiqizwa Kwezihlahla Zezithelo (Pruning Fruit Trees)
Handout 7	Ama "Tower Gardens"
Handout 8	Ukukhiqizwa kwezithelo – Ukwandiswa kwezitshalo (Making cuttings)

1. Ukutshala izitshalo ezinhlobonhlobo engadini

Singathanda ukuthi sibone ezingadini zethu kutshalwe izinhlobonhlobo zezitshalo, uma kungenzeka. Izinhlobonhlobo zezitshalo engadini zenza sibe nesiqiniseko sokuthi izingadi zethu ziqukethe konke okudingekayo ngokwemvelo (natural balance). Lokhu kubandakanya ukwenza umhlabathi wethu ube ngophile kahle, amanzi asebenziseke ngendlela efanele, kwehliseke nezinga lezinambuzane/lezilokazane kanye nezifo ezihlasela izitshalo zethu.

Lokhu kuchaza ukuthi eplothini iyinye sizobona kutshalwe izinhlobonhlobo zezitshalo. Izitshalo zingatshalwa ndawonye eplotini ngesokhathi esisodwa (inter planting), noma kungatshalwa izitshalo ngendlela yokushintshanisa (rotation). Lokhu kuchaza ukuthi izinhlobonhlobo zezitshalo ziyatshalwa lapha ngezikhathi ezahlukene. Ukusebenzisa zombili lezizindlela - ukutshala izitshala ezinhlobonhlobo ndawonye (inter- planting) kanye nokushinshaniswa kwezitshalo olunye uhlobo emuva kolunye (rotation) kungumbono omuhle.

Ukutshala izitshalo ezinhlobonhlobo ndawonye ngesikhathi esisodwa

Uma utshala izinhlobo nhlobo zezitshalo ndawonye kufanele uqikelele lokhu okulandelayo:

- **Ukusebenziseka komsoco osenhlabathini:** Sixuba ndawonye isitshalo ezinezidingo ezahlukene zezondlo. Ezinye zalezizitshalo zidla kakhulu (heavy feeders), ezinye azidli kakhulu (light feeders) kanti ezinye zazo zondla inhlabathi ngokufaka isikhuthaza (nitrogen) enhlabathini. Isibonelo esikahle salokhu yindlela endala yokutshala ubhontshisi nommbila ndawonye. Ummbila udla kakhulu bese kuthi ubhontshisi ube yisitshalo esingadli kakhulu ubuye futhi wondle umhlabathi ngesikhuthaza

- **Ukujula kwezimpande:** Tshala lezozitshalo ezinezimpande ezijulile ndawonye nalezozitshalo ezinezimpande ezingajulile ukuze uqinisekise ukuthi azibangisani ngamanzi nangomsoco. Izibonelo esihle kulokhu ukutshala ummbila ndawonye nezintanga. Ummbila ukhula ubheke phezulu kanti futhi unezimpande ezijulile, kanti izintanga izitshalo ezenabayo futhi ezinezimpande ezingajulile. Lezizitshalo azibangisani ngendawo ezikhulela kuyona ngaphansi kanye nangaphezulu

- **Izitshalo ezixosha izinambuzane:** Kukhona izitshalo ezinephunga elixakayo elingathandwa yizinambuzane, lokhu kwenze izinambuzane zibaleke.

Ngokwesibonelo, u-anyanisi unephunga elikhethekile elingathandwa yizimvemvane. Uma ngabe u-anyanisi utshalwe ndawonye ne khabishi, kungehlisa inkinga yezibungu ezilihlaselayo. Izitshalo ezitshalwa ndawonye ngenhloso ethile ezinjengo-anyanisi kanye ne khabishi zibizwa ngokuthi ngama "*companion plants*". Loluhlelo lokutshala olubizwa nge "*companion planting*" yilona oluhle kakhulu ekuxosheni izinambuzane nezilokazane engadini.

- **Ukuqondanisa nesikhathi esithile:** Ezinye izinhlobo zezitshalo ziphila isikhathi eside kunezinye. Kungenzeka ukuthi umuntu atshale isitshalo esishesha sivuthwe phakathi kwezitshalo ezephuzayo ukuvuthwa. Ngalendlela ungakwazi ukuthola isivuno engadini noma ensimini lapho olunye uhlobo lwesilimo lusaqhubeka nokukhula kuleyondawo ovuna kuyona. Izinga lokubangisana kwezilimo ngomsoco namanzi liyehla. Isibonelo ukutshala I "radish", I "mustard spinach" noma umasihlalisane kanye namazambane ndawonye. I "radish" ishesha ivuthwe kanti ingavunwa emasontweni ayisithupha itshaliwe. Amaqabunga e "mustard spinach" ayaqala ukukhiwa ezinyangeni ezimbili kuya kwezintathu. Lokhu kunciphisa umncintiswano futhi njengoba amazambane esezosala wodwa ensimini, futhi esebonakala ekhulile. Amazambane avunwa emuva kwezinyanga ezintathu nesigamu kuya kwezine. Lokhukutshala ngokuhlanganisa kusiza ekuqikeleleni ukujula kwezimpande, ukusetshenziswa komsoco (nutrient consumption) kanye nasekuxosheni izinambuzane.

- **Ukumelana nethunzi:** Kubalulekile ukuqikelela lokhu uma engadini kutshalwe izitshalo eziphekeme kanye nalezo eziphila isikhathi eside (perennial plants). Lokhu kubandakanya izihlahla zezithelo. Izitshalo ezifana ne "confrey", u "lettuce" noma uletisi kanye nama strobhisi (strawberrries) ziyakwazi ukumelana nethunzi. Lokhu kuchaza ukuthi zingakwazi ukukhula noma zingaphansi kwezihlahla.

Izibonelo zokutshala izitshalo phakathi kwezinye engadini yama veji

Embhedeni

Tshala u-anyanisi ndawonye nokherothi: Ukherothi uvikela u-anyanisi ukuthi ungahlaselwa yimpukane ebizwa ngokuthi yi "Onion fly" kanti u-anyanisi uvikela ukherothi ukuthi ungahlaselwa yimpukane ebizwa ngokuthi yi "carrot fly". U kherothi unezimpande ezijulajulile kuno-anyanisi kanti ushesha uvunwe kuno-anyanisi, bese unikeza u-anyanisi uma usuvuniwe isikhala esanele sokuthi ukhule kahle uma ususele wodwa.

Tshala ukholiflawa noma ikhabishi, uletisi, I"fennel" (imbozisi) kanye no-anyanisi ndawonye: Lenhlanganisela yokutshala ivikela ngokuphelele izitshalo zakho kwizintwala zekhabishi, nakwi "diamond black moth" (ibhu elikhonjisiwe esithombeni) elihlasela ukholiflawa. Lendlela iyakuqikelela



ukusebenziseka komsoco (nutrient consumption), ukujula kwezimpande, ukuxoshwa kwezinambuzane (kwenziwa ngu anyanisi nembozisi), ukuqondanisa nezikhathi ezithile (timing) kanye nokumelana nethunzi kwezitshalo.

Tshala uTamatisi, u anyanisi noma ugalikhi kanye no kherothi ndawonye: Lokhu kubandakanya izitshalo ezixosha izinambuzane, indlela izitshalo ezisebenzisa ngayo umsoco (nutrient consumption) ukujula kwezimpande kanye nokulwa nezifo zezitshalo. Utamatisi lapha utshalwa ugqagqane ukuze izitshalo zingathintani. Lokhu kwenza ukuthi umakufika izifo ezifana ne "early blight" noma "late blight" zingalokothi zigijime kalula kuzo zonke izitshalo.

Tshala isipinashi (swiss chard) kanye nobhontshisi ndawonye: Lendlela iqikelela indlela umsoco osetshenziswa ngayo, ukujula kwezimpande, kanye nokulwa nezifo ezihlasela ispinashi. Ukutshala imigqa yespinashi uyigejanise nemigqa kabhontshisi kwehlisa izinga lokuhlaseleka kwespinashi yisifo esibizwa ngokuthi yi "bacterial spot" esihlasela amaqabunga espinach.



Ispinashi utshaliwe nembozisa no galikhi

Uanhanise utshaliwe nekhabishi, uletisi nespinashi.



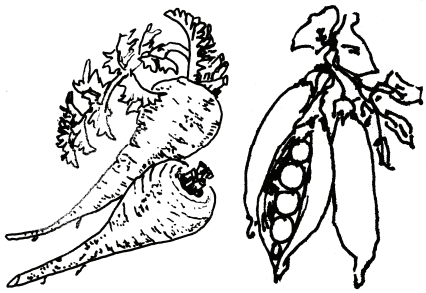
Ukutshala inxubevange yezitshalo engadini:

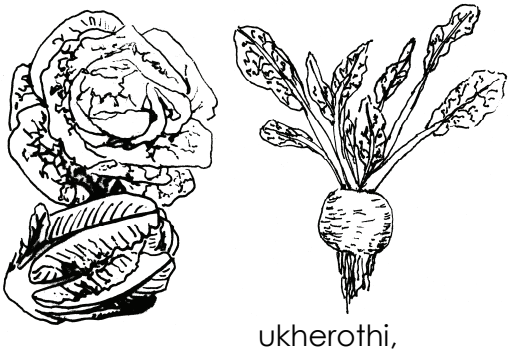
Kukhona izitshalo ezingenankinga uma zitshalwe ndawonye, kanti ezinye azihlalelani. Uma utshala izithombo embhedeni, sebenzisa lezizithombe ezilandelayo ukuze ukwazi ukubona ukuthi yiziphi izitshalo ongazitshala ndawonye futhi ungabinankinga.

Ezinye zezitshalo ongazitshala ndawonye:



Ubhithirudi - anyanisi
Ukherothi - uphizi, uletisi, anyanisi, utamatisi
Anyanisi - ubhithiruthi, amastrobhisi (strawberries), tamatisi, letisi
Ubhilinjolo - u bhontshisi
Ikhabishi - amazambane, ubhithiruthi, u-anyanisi
U Green pepper - uzwana nawo onke amaveji
U Letisi - ukherothi, u "radish", amastrobhisi, ukhukhumba (cucumber)
Amathanga - ummbila
Spinashi - amastrobhisi
Utamatisi - anyanisi, ukherothi
Ummbila - amantongomane, uphizi, ubhontshisi, ukhukhumba, amathanga, amazambane
Ujikanelanga - ukhukhumba
Ubhontshisi - amazambane, ukherothi, ikhabishi, lanye nezinye izinhlobo zamaveji





Izitshalo okungeke kulunge ukuthi zitshalwe ndawonye:

Zikhona ke lezo zitshalo ezingeke ziphilisane kahle uma sitshalwe endaweni eyodwa. Zama ukugwema ukuthi uzibone usuxuba lezizitshalo endaweni. Zihlolele ngokwakho ukuthi ziyaphilisana na lezizitshalo.

Ubhithiruthi - ubhontshisi obizwa ngokuthi yi "pole beans"
Anyanisi - uphizi noma ubhontshisi
Ikhabishi - amastrobhisi
Amathanga - amazambane
UTamatisi - amazambane kanye ne khabishi
Ubhontshisi - anyanisi
Ujikanelanga - amazambane



Ubuhle nobubi bokutshala izitshala ezinhlobonhlobo ndawonye

UBUHLE BAKHO	UBUBI BAKHO
Indawo yokutshala phezulu naphansi isebenziseka ngendlela efanele nangokuphelele	Kubukeka kabi
Yehlisa izinga lezifo nezinambuzane ezitholakala enhlabathini nasezitshalweni, futhi ikunqande lokhu kungandi	Ingenza kube nzinyana ukudayisa umkhiqizo
Yehlisa izinga lokuhlushwa ukhula	Ezinye izitshalo kungenzela ukuthi sezisithekile, ikakhulukazi uma zingagqagqene ngendlela
Kwemboza inhlabathi yonke futhi isebenzise nomsoco ngendlela efanele. Lokhu kuholela ekutheni kwakheke inhlabathi ephilile nenomsoco	Ukuhlakulela kungadla isikhathi esiningi uma usaqala, njengoba izitshalo zisuke zisagqagqene, uma uqhathanisa nanxa kutshalwe kolayini
Izitshalo ziyaxhasana, zondlane futhi zivikelane nasezifeni kanye nasezinambuzaneni. Lokhu kuholele ekutheni izitshalo zikhule ngomfutho omkhulu.	Ungathola ukuthi ezinye isitshalo zingancinsheka amanzi, kuthi ezinye ziwathole mawala, kuye nendlela ezikhula ngayo. Ngokwesibonelo ezinye izitshalo kungenzeka ukuthi seziyaqhakaza sezizosakaza imbewu entsha kanti ezinye yima zisakhula
Amanzi asebenziseka kahle kakhulu	

Izinguquko esingazenza ngokutshala ngendlela exubile

Ukuze kuhlale kukhona okukhona engadini: Sifuna ukuthi sihlale sinokuthize esingahlala sikuvuna engadini unyaka wonke. (Sidinga ukuthi silinde isikhathi eside ngaphambi kokuthi sikwazi ukuvuna ikhabishi noma isipinashi) Singabandakanya izitshalo ezifana nalezi ezilandelayo:

- U-anyanisi oxhantayo (Spring onions) - Ugalikhi (Garlic chives)
- Ishaladi (Leeks) - Parsley
- Coriander - imbozisa (Fennel)
- Uletisi (Lettuce) - Kale, Broccoli, Cauliflower
- Masihlalisane (Mustard spinach) -
- Sweet potato (ubhatata – kanjalo nalowo obomvana ngaphakathi ngoba unovithamin A)

Ukuze kutholakale amaprotein: Sifuna ukuthi sibe nezitshalo ezizosondla ngamaprotein, ikakhulukazi kubantwana abancane (iminyaka 1 – 5 ubudala).

Singabandakanya izitshalo ezifana nalezi ezilandelayo:

- ❖ Turnip green
- ❖ Imbumba (Cowpeas)
- ❖ Uphizi (Peas)
- - Sugar beans, izindlubu (jugo beans)
- - Amantongomane (Peanuts)

Kufanele ukuthi ekulimeni kwethu sibuye sibe nemfuyo efana nezinkukhu, amadada, onogwaja, izimbuzi nezingulube, ngoba nenyama yazo isinikeza amaprotein.

Ukuze kutholakale u-vitamin c no vitamin a: sifuna ukuthi sihlale sidla izithelo eziluhlaza neziphuzi nsuku zonke. Lesisondlo sibaluleke kakhulu kubantwana kanye nakulabo abagulayo. Singabandakanya izitshalo ezifana nalezi ezilandelayo:

- ❖ Tree tomato (*isithombe kwesokudla*)
- ❖ Granadilla, uGqumgqum (gooseberry)
- ❖ Upopo, umango, ubhanana, ukwatapeya
- ❖ Amapetshisi, amabhilikosi, ulamula-Amagwava
- ❖ Ama bhathanathi, nezinhlobo ezahlukene zamathanga



Kufanele ukuthi kube nezinhlobo nhlobo zezithelo ekhaya ukuze kuhlale kudliwa izithelo ekhaya unyaka wonke.

Ukomisa izithelo namaveji

Ukulungisa ukudla ngalendlela kwenza ukuthi kube nesiqinisekiso sokuthi kuhlala kukhona ukudla ekhaya ngaso sonke isikhathi.

Indlela yokusebenzisa amashalofana okomisa (drying racks) ambozwe ngofefe (shade cloth) yiyona ekahle ngempela (*njengoba sibona esithombeni*). Cishe noma yini ungakwazi ukuyomisa!! (Lokhu kwacwaningwa esizindeni zikaHulumeni socwanigo e Dundee – Dundee Agricultural Research Station)



Isithombe esingenhla kwesokudla: Kukhonjiswa ishalofu eleneke amaveji nazithelo ezomiswayo ezinjengotamatisi, ubhilinjolo, amanantshi, kanye nabopelepele abaluhlaza, abaliphuzi kanye nababomvu. Lomkhiqizo owomiswayo wembozwa ngenethi ukuze kuqinisekiswe inhlanzeko ngaphambi kokuthi kusetshenziswe.

Amaveji omisiwe angagcineka iminyaka emibili nangaphezulu ngaphambi kokuthi asetshenziswe.



Isithombe esingezansi kwesokudla: Amabhodlela okufakwe kuwona amaveji omisiwe, kusukela kwesobunxele uphepha, ubhatata, upelepele ogayiwe, kanye nobhilinjolo.

2. Ukushinshanisa izitshalo engadini

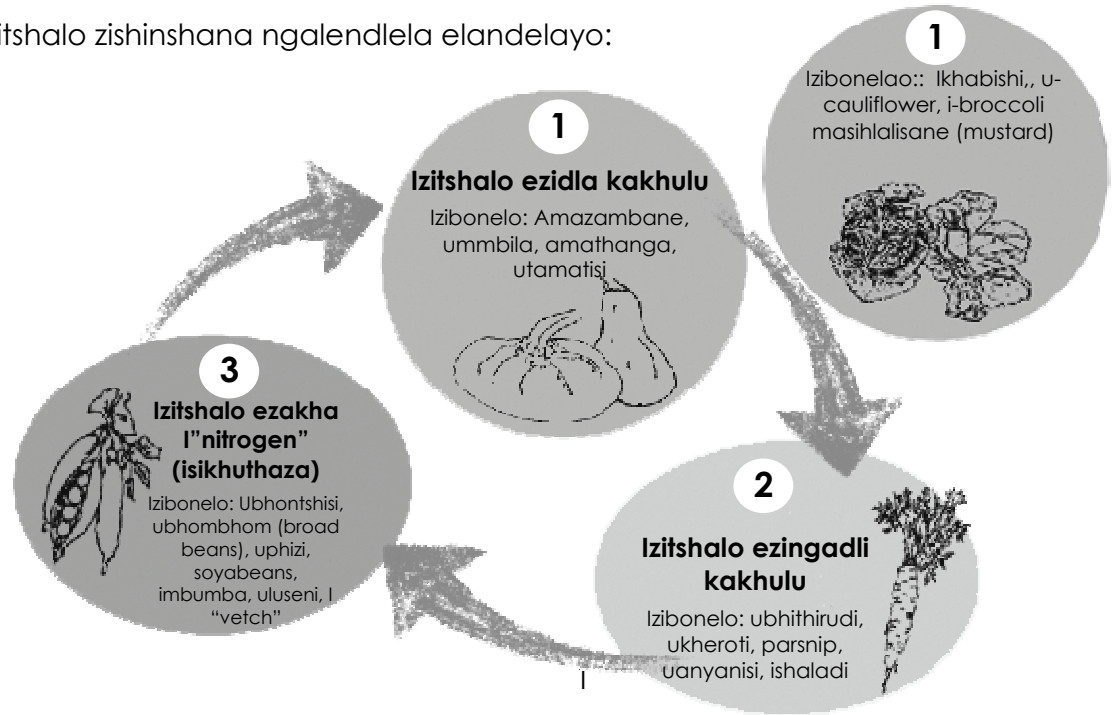
Lapha sichaza ukuthi akufuneki utshale uhlobo lwesitshalo esisodwa endaweni eyodwa iminyaka ilandelana. Uyaqinisekisa ukuthi itshala isitshalo esehlukile ngonyaka olandelayo. Lokhu kungumqondo omuhle ngoba:

- Kunqanda ukunqwabelana kwezifo nezinambuzane engadini. Uma utshala uhlobo olulodwa lwesitshalo izifo nezinambuzane ezithile ziyathokoza zigcina sezizwa zisekhaya ngoba ukudla kwazo kuhlala kukhona!
- Izitshalo ezehlukene zisebenzisa izinhlobo ezehlukene zomsoco ogcinwe enhlabathini. Ngokushinshanisa izitshalo awenzi kusebenziseke uhlobo olulodwa lomsoco enhlabathini olunye uhlobo lomsoco lube kungasebenziseki.
- Kuhlala kukhona izitshalo engadini unyaka wonke.
- Ezinye izinhlobo zezitshalo zifaka isikhuthaza (nitrogen) enhlabathini. Isibonelo salezi zitshalo ngu Bhontshisi, uphizi, Ubhombhom (broad beans), isoyabeans kanye ne "Vetch" (isitshalo esifana nophizi esisetshenziselwa ukwenza umanyolo oluhlaza).
- Kugwema ukuthi inhlabathi ingaze ibe sesimweni sokuthi singezwani nezitshalo ezithile. Isibonelo lapha ukuthi ezinye izinhlabathi zigcina sezinezibungwana ezincane ezibizwa ngama "nematodes", ezenza ukuthi kube lukhuni ukutshala otamatisi nesipinashi kuleyondawo. Lezibungwana ngeke sikwazi ukuzibona ngamehlo enyama. Zihlala enhlabathini kanti ziziphilisa ngokuthi zidle izimpande zezitshalo.
- Akwenzeki ukuthi sigcine sibona ingadi igcwele ukhula oluthile.

Lapha sizobonisana ngezindlela ezimbili zokushinshanisa izitshalo. Ungazama ukuzihlola zombili ubone ukuthi iyiphi indlela ekusebenzela kangcono.

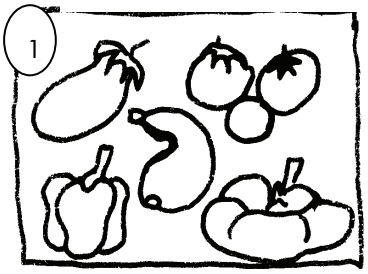
Indlela Yokuqala

Izitshalo zishinshana ngalendlela elandelayo:



Indlela Yesibili

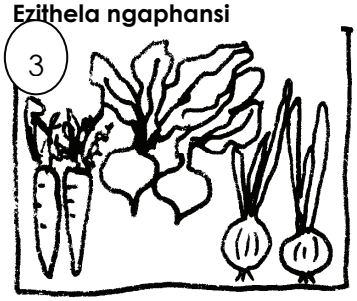
Ezithela phezulu



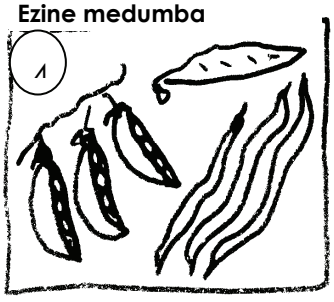
Ezithela ngamaqabunga

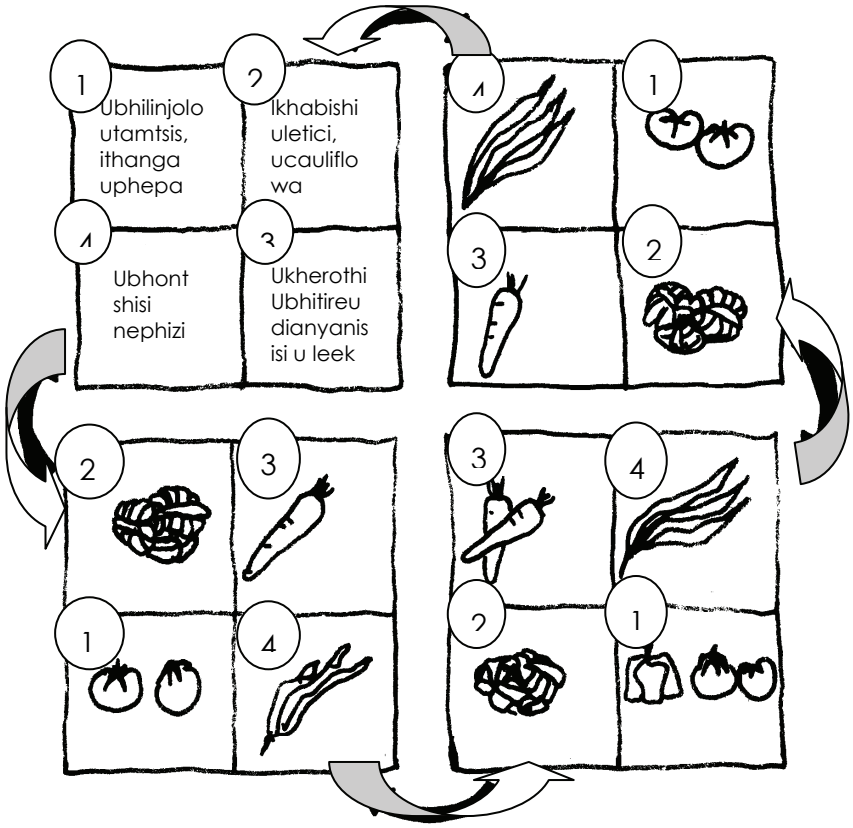


Ezithela ngaphansi



Ezine medumba





Ukushinshanisa okulula: ingadi ihlukaniswe amaploti amane alinganayo. Ngesikhathi esilandelayo sokutshala, dlulisela uhlobo lwezilimo eplotini elandelayo.

Lungisa indawo ozotshala kuyo noma umbhede kahle. Faka ikhomposi eningi noma umquba omningi embhedeni wakho (amafosholo amane kwi square metre esisodwa).

Qala ngokuthi utshale isitshalo esithela ngaphezulu (fruiting crop). Lezizitshalo zidinga ukudla okuningi. Izitshalo ezithela ngamaqabunga (leaf crops) azikudingi ukudla okuningi, ngakhoke zingalandela ama "fruiting crops". Okulandelayo kungaba yilezo ezithela phansi (root crops) ngaphandle kokuzikhathaza okungakanani ngokuvundisa inhlabathi. Izitshalo ezithela phansi ayawuthanda umhlabathi ovundile kepha aziwudingi umquba osemusha, umquba kumele kube ovuthiwe. Izitshalo

ezisabhontshisi (legumes) zingalandela, kulekelelwe ngokuthi kunezezelwe ngomquba othe xaxa. Emuva kwalokho kumele ulungise indawo olima kuyona kabusha kahle futhi. Qala phansi umjikelezo wakho futhi ngokuthi utshale izitshalo ezithela phezulu (fruiting crops).

Ukulamanisa izitshalo engadini

Ngalokhu sichaza ukuthi kumele utshale imbijana yezitshalo kodwa njalo nje. Lokhu sikwenzela ukuthi sibe nesiqiniseko sokuthi kuhlale kukhona izitshalo engadini esidla kuzo isikhathi eside. Uma sitshala iphakethe lonke lembewu ngesikhathi esisodwa, sizolinda isikhathi sokuvuna, bese sivuna kube kanye sibuye sisonge izandla, kanti lokhu akulungile!!!

Umbono ukuthi uhlukanise iphakethe lakho lembewu izigatshana ezine. Kufanele utshale lezigatshana emasontweni amabili kuya kwamathathu.

Uma sitshala imbijana yembewu ngesikhathi, ungatshala esitsheni ezincane noma emabhokisini. Qinisekisa ukuthi lokho otshala kukho kunezimbobo ngaphansi. Kufanele amanzi akwazi ukuphuma ngaphansi uma kade unisela.

- Thatha ingxenye eyodwa yesihlabathi, ingxenye eyodwa yekhomposi esefiwe nezingxenye ezimbili zenhlabathi yangaphezulu esefiwe, ukuxube ndawonye.
- Bulala amagciwane kulenxube ngokuthi uyothele ngamanzi abilayo, bese uyomisa ngaphambi kokuthi utshale imbewu. Lendlela ibulala imbewu yokhula engase ikuhluphe kanye nezifo zezitshalo ezitholakala enhlabathini.

Tshala imbewu ngendlela ongatshala ngayo uma utshala embhedeni



3. Lwezinye zezitshalo, ezisiza ekwakheni amakhambi kanye nezichazelo zokuthi asetshenziswa kanjani nokuthi alungiswa kanjani

Inhlaba (aloe)



Noma iluphi uhlobo lwenhlaba lungasetshenziswa.

- Gxoba inhlaba uyifake emanzini isikalo esingango (1:5). Lokhu kusho ukuthi sebenzisa amanzi aphindwe kahlanu kunesikalo senhlaba. Sefa ngendwangu bese ufafaza ngayo. Noma
- Yomisa amacembe bese uwagaya abeyimpushana. Lokhu kungathintithelwa embewini noma ezitshalweni.

Loluhlobo lokwelapha luqeda lokhu okulandelayo:

Izinambuzane; izintothoviyane nezintethe, izintwala zezitshalo, imiswenya;

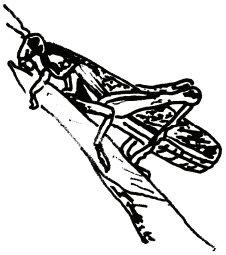
Izilokazane ezitholakala ezinqolobaneni eziyinkinga emmbileni, kukolo, kanye nasemabeleni;

Umuhlwa kanye nezintuthwane.









Ikhambi okuthiwa yi Wormwood noma iLengana



Sika amacembe alelikhambi uwafake emanzini isikalo esingango (1:4) bese ulinda izinsuku ezimbili kuya kweziyisikhombisa (2 – 7 days) ngaphambi kokuba uyisebenzise.

Loluhlobo lokwelapha luqeda lokhu okulandelayo:

Izinambuzane ezejwayelekile kanye neminenke

Ucadolo (blackjack)

Gcwalisa inkomishi egcwele imbewu kacadolo ngamanzi bese ubilisa imizuzu elishumi (10 minutes), noma uma uthanda ungakubilisi, uvele ukuyeke kulale ubusuku bonke.Emuva kwalokho faka ilithat elilodwa lamanzi anensipho bese ufafaza.

Loluhlobo lokwelapha luqeda lokhu okulandelayo:

Izinambuzane: Izintwala zezitshalo, izintuthane, amabhungane, amacimbi, imiswenya, imihlwa, izinhlwabusi kanye ne "white fly".



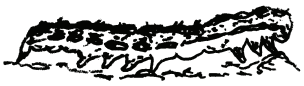
Upelepele (chillies)



- Qoba upelepele obabayo futhi obomvu uwugcwalise enkomishini (qaphela ungazithinti emehlweni)
- Faka amalitha amabili amanzi
- Ungakuyeka lokhu kuhlale emanzini isikhathi esingangezinsuku ezimbili kuya kwezintathu noma ukubilise imizuzu engu 15.
- Faka uhhafu wenkomishi yensipho ecweciwe bese ukuhlanganisa insipho ize incibilike.
- Sefa lengxube ukuze ususe amakhafilithi kapelepele
- Fafaza lomuthi ezitshalweni zakho kanye ngesonto uma izulu libalele.

Loluhlobo lokwelapha luqeda lokhu okulandelayo:

Amacimbi, izintwala zezitshalo kanye





Ugaliga kanye noanyanisi

Gxoba izigaqa ezintathu ezinkulu zikagalikhi noma u anyanisi bese uxuba lokhu nezipuni ezimbili zika cooking oil noma uphalafini, ukubeke lokhu izinsuku ezimbili. Xuba lomxube namalitha amabili amanzi anensipho. Lona sekungumxube onamandla kakhulu odinga ukwehliswa amandla. I Litha elilodwa lalomxube lihlanganiswa namalitha alishumi amanzi (1:10). Usungawufafaza ke uma usuhlanganise namanzi.

Loluhlobo lokwelapha luqeda lokhu okulandelayo:

Izinambuzane: Izintwala zezitshalo, ama "mites", izibungwana zenhlabathi (wireworms), imihlwa kanye nezintuthwane.





Izifo ezifana ne "leaf spot", "blight" kanye ne "damping off". Ezinye izibonelo isifo esigqwalisa ubhontshisi okuthiwa yi "beans rust" kanye nesifo esibunisa isihlahla sika tamatisi okuthiwa yi "blight".

Amakhambi emvelo

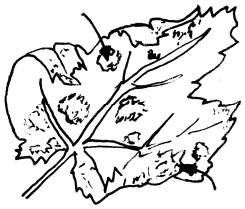
Lamakhambi akhiwa ngezinto ezaziphila ngaphambilini kepha hhayi ngezitshalo. Ezinye zezibonelo yilezi ezilandelayo.

Umlotha wezinkuni (wood ash)

- Xuba isipuni esisodwa somlotha elitheni elilodwa lamanzi anensipho .Kuyeke ubusuku bonke. Fafaza ukulwa nezinambuzane ngokujwayelekile

- Xuba isipuni esisodwa somlotha wezinkuni elitheni lamanzi anensipho .Xuba nenkomishi eyodwa yamasi bese ufaka 3 wamalitha wamanzi.

Ukugwema: ukukhunta ezitshalweni kanye nokulwa nezinambuzane




- Thela umlotha wezinkuni kwisiyingi uzungeze lapho kuqala khona isitshalo sakho bese uthelela kancane emhlabathini .

Ukugwema: Iminenke umswenya kanye nezinye izilokazane

Ufulawa (flour)

Xuba isipuni esikhulu sikafulawa ku 1litha wamanzi .Bhulasha lokhu ecaleni elingaphansi lamacembe lapho izibungu kanye nezintwala zezitshalo zitholakala . Bhulasha ekuseni elangeni elishisayo

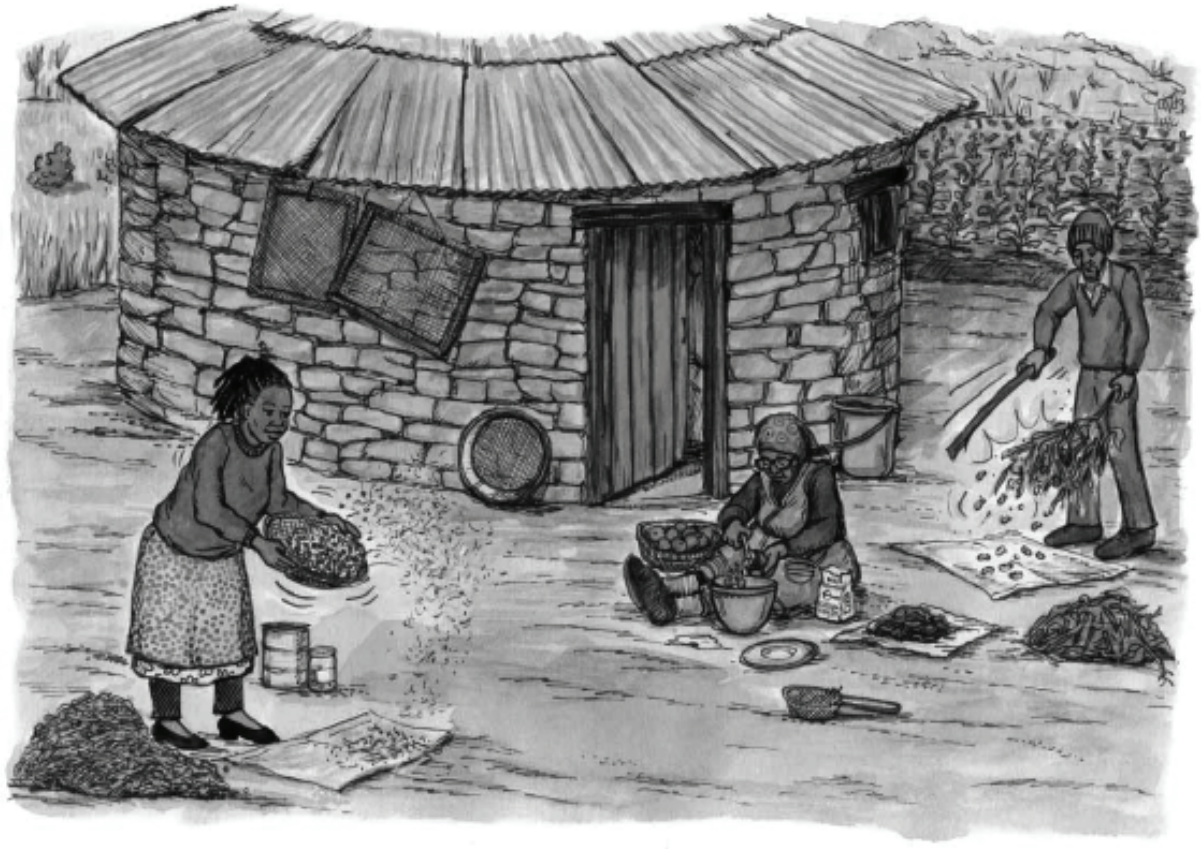



Ukugwema: Izicabucabu ,izibungu ,amacimbi kanye nezintwala zezitshalo .

Ubisi (milk)

Fafaza inxubevane yobisi elingango 1litha emanzini alingana no 10 litha ukugwema izibungu eziyizicabucabu kanye nezifo ezifana nokukhunta emathangeni ,ukusha kutamatisi nasemazambaneni kanye nasegciwaneni eliba kuphepha. Kwenze lokhu njalo ngemuva kwezinsuku eziyishumi.

4. Ukubekwa kwezimbewu



Ukuzigcinela imbewu kungumgogodla wokuzimela unguMlimi. Uyakwazi ukuzikhethela ukuthi nhlobo zini zezithsalo ofuna ukuzitshala .Awunasidingo sokuyothenga izimbewu esitolo.

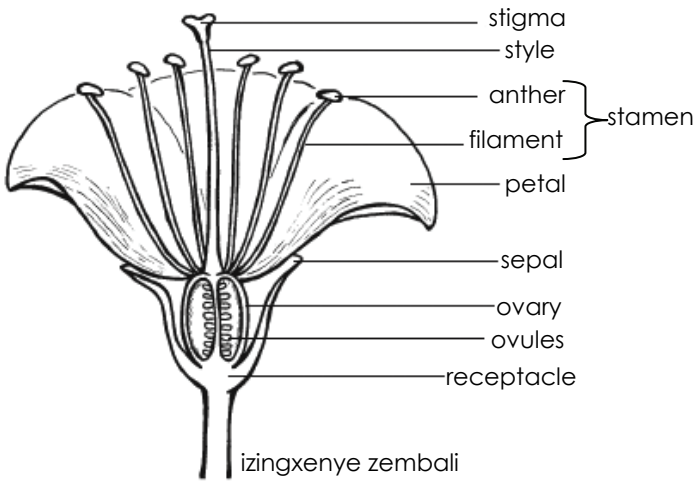
Kunezinhlobonhlobo eziningi zezimbewu ongazigcinela zona noma uzithenge esitolo bese ugcina izimbewu emva kwesivuno.

Ukutshala ngembewu ukuze uthole enye imbewu kudlula ezigabeni eziningi okuhlanganisa nokugqunywa kwezithombo, ukutshalwa kwazo kuze kube ukukhetha izitshalo ezinempilo lapho uzovuna khona imbewu yakho.

Izitshalo zikhula zejwayele indawo ezimile kuyo bese zikhiqiza imbewu ekwaziyo ukumelana nezimo zendawo ezikhulele kuyo.

Ukwakheka kwembewu (IPholineshini)

Lena indlela youkukhwelana kwezitshalo lapho impova ephuma engxenyeni yesilisa (stamen) yesitshalo iqathakela noma indizela engxenyeni yesifazane (stigma) yesitshalo. Uma impova seyithubeleze yaze yafika esizalweni sesitshalo kuba sekulumbana bese imbewu yakheka.



Kwezinye izitshalo zinezimbali eziqukethe ubulili bobubili embalini eyodwa lezo ke zibizwa ngezimbali eziphelele.

- Ohlobeni lwezimbali eziphele singabeka eceleni amaKhabe, amathanga, umbila kanye no khukhumba, lezizitshalo zinembali yesilisa neyesifazane ezahlukene esitshalweni esisodwa.

- Kunezinye izihlahla ezifana ne sikaPopo, zona zinezimbali eyesilisa neyesifazane ezihlahleni ezahlukene.

Izimbewu zemvelo kanye namabhasistela (ezilumbanisiwe ngabantu):

Ngokwemvelo izitshalo zonke zazizizalanela ngokwemvelo, zizandela njengabantu, impova kufanele iwele engxenyeni yesifazane yesitshalo bese zande. Lendlela yokukwanda kwezitshalo isizwa yizimo zemvelo ezinjengomoya kanye nezilwanyazane ikakhulukazi izinyosi.

Amabhastela alunjaniswa abantu ezindaweni ezihlelelwe. Lezizitshalo ngokuvamile azilumbani nezinye. Lokhu kuchaza ukuthi akufanele/ noma angeke ukwazi ukubeka imbewu yalezizitshalo. Imbewu yalezizitshalo ayimili futhi ingakwenzela imihlola ehlukene. Izitshalo zalezimbewu azifani nhlobo no nina bazo futhi zivamise ukuba ntekenteke.

Lezizimbewu zibonakala ngophawu **F** ephaketheni lazo.

Ukulumbana ngokwemvelo -imbali eyodwa (Self Pollination)

Lendlela yenzeka lapho impova isuka engxenyeni yesilisa ingena engxenyeni yesifazane embalini eyodwa.

Izitshalo ezilumbana ngaloluhloba: Utamatisi, ulethisi, Uphepha kanye nobhontshisi wona okwenzeka ngaphambi kokuba imbali ivuleke.

Lezizitshalo zingamila ziminyane ngaphandle kokuba zilumbane nezinye, kodwa kuyinto enhle ukuhlukanisa izimbewu ezahlukene zisitshalo ezifanayo ngoba ukulumbana kusengenzeka.

Izitshalo ezilumbana ngokwemvelo –imbali eyodwa:

Ubhontshisi izinhlobo ezahlukene, Izindumba ,Amakinati, Uphizi, Utamatisi kanye nogrini phepha.



Ukulumbana ngokwemvelo – Izimbali ezahlukene (Cross Pollination)

Kulezizitshalo impova isuka embalini enye iye kwenye imbali esihlahleni esisodwa noma kwezihlukene zohlobo olufanayo. Izitshalo ezilumbana ngaloluhlobo zikhiqiza izimbewu ezikwazi ukumelana kangcono nezimo ezishintshayo zemvelo.

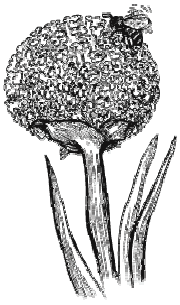
Ukulumbana kwenzeka uma impova ihamba isuka kwenye imbali iya kwenye ngomoya noma izinambuzane ezifana nezinyosi, amalulwane kanye nezinyoni. Izinyosi yizo ezibamba elikhulu iqhaza ekulumbaneni noma ekwandeni kwezitshalo.

Asithathe isibonelo samathanga, uma utshale izinhlobo ezingafani zamathanga ndawonye izimbali zawo zizolumbana bese imbewu yakhona ikhiphe ithanga elimofuzo lwezinlobo zombili ezazitshaliwe. Kwenzeka kanjena kuzo zonke izitshalo ezilumbana ezimbalini ezahlukene.

Izitshalo ezilumbana ngokwemvelo - izimbali ezahlukene (ngenxa yezinambuzane)

Ubrinjolo, iKabishi, uKherothi, uPelepele, iNtufeshe, uMbila, uAnyanisi kanye neSipinashi.





Izinsiza kwanda/kulumbana kwezitshalo

Izinyosi zidlala indima enkulu ekulumbaneni kwezitshalo ikakhulukazi amaveji, uma zindiza ziqoqa uju lwezimbali ezenza ngalo olwazo,

impova inamathela emilenzeni yazo. Kuthi lapho zidlulela kwenye imbali, impova ibe isisalela esizalweni saleyombali, bese kwenzeka ukulumbana (pollination).

Izitshalo ezilumbaniswa izinambuzane:

Ubrinjolo, iKabishi, uKherothi, uPelepele, uGrini phepha, iNtufeshe, Intufeshe, Ishaladi/itshobho, masihlalisane, uAnyanisi kanye neSipinashi (swiss chard).



Izimila ezisanhlamvu eziningi ezifana nombhila imfe kanye namabele, okusatshani iNyalothi kanye neMihlanga , kanye nezihlahla zincike kakhulu emoyeni ukuze impova yembali enye ifikelele kwenye imbali.



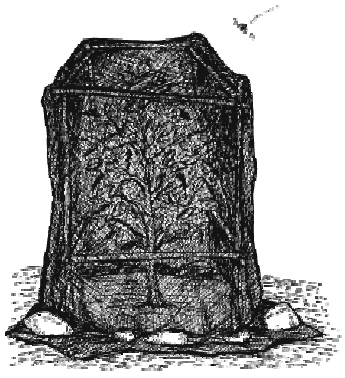
Izitshalo ezilumbaniswa umoya:

Beetroot, iSipinashi (swiss chard), imbuya

Ukugcina izimila zakho zimsulwa

Noma yisiphi isitshalo esidinga umoya noma izinambuzane ukuze sizalane/siumbane nezinye sidinga ukwehlukaniswa okucacile kwezinye ukuze usigcine simsulwa ekuhlanganeneni nezinye. Ngezansi kunezindlela ezine zokuzigcina zimsulwa:

Zehlukanise: Hlukanisa izimila zakho ezilumbanayo ngamamitha angengaphansi kuka 500. Lesilinganiso ngesindizwa yezinye zezinambuzane,yize izinyosi zingandiza nangaphezu kwamaKhilomitha amane (4km). Izinto ezivimba umoya nezinambuzane ezifana nezintango kanye nezakhiwo zingasiza ekugcineni izitshalo zakho zimsulwa.



Ukuzivalela

Yehlukanisa ngezikhathi zokutshala: Lokhu ungakwenza ngokuthi lezozitshalo eziqhakaza kanye kanye uzitshale ngesikhathi ezahlukene, tshala ezinye lithwasa ihlobo ezinye maphakathi ezinye liphela ukuze ziqhakaze ngesikhathi ezingafani.

Ukuzivalela: Lokhu kusiza kakhulu kuzitshalo eziqhakaza isikhathi eside njengoPelepele kanye neKlabishi. Zivalele ngenethi yenaliyoni ezimbalini zezinlobo

ezahlukene bese izilumbanisela wena ngesandla.

Zivalele ngezinsuku ezahlukene: Lendlela ungayisebenzisa ukunokulumbanisa ngesandla. Vala uhlobo oluthize lwesitshalo izinsuku ezimbalwa ube uyekele umoya kanye nezinambuzane zilumbanisa olunye uhlobo ofisa lulumbane. Shintshanisa lokhu ukudedela olwesibili uhlobo ukuba lulumbane nalo(njengokukhwelanisa imfuyo).

Ukukhetha nokuqoqwa kwembewu

Kuthatha isikhathi esingakanani?

Kufanele uvune izithombo eziyisithupha (6) zalolohlobo ofuna ukulubeka, ulonge. Ezinye izitshalo ezifana no - anyanisi kufanele uvune ezithonjeni ezingamashumi amabili(20) kanti kwezifana nobhekilanga kanye nommbila udinga ukukhetha ezitshalweni ezngamashumi amahlanu kuya kwezilikhulu.(50-100). Emmbileni ongo gatigati (onemibala eminingi) ungalahlekelwa yimibala kanye nofuzo lokulwa nezifo uma ukhethe ezinhlangeni ezimbalwa kakhulu.

Ezonyaka (Annuals):

Lezizitshalo zikhiqhiza izivuno kanye nezimbewu zazo kanye enyakeni bese zifa . zivanise ukuphila isikhathi esifikela ezinyangeni eziyisithupha kuya kweziyisishiyagalolunye (6-9) isibonelo uTamatisi.

Biennials:

TLezizitshalo zimila entwasahlobo kuya ehlotsheni bese ziyashazwa ebusika zivuke seziqhakaza ehlobo elilandelayo. Lezizitshalo zidabuka emazweni akoYorophu lapho ubusika bakhona bubanda kakhulu futhi singekho isikhathi esanele sezitshalo ukuba zikhiphe imbewu ehlobo elilodwa. Lezizitshalo zimila isikhathi esize sifikele ezinyangeni ezing 18. Izibonelo uKherothi, uTenebhu kanye noRedish.

Ama Phereniyali (Perennials):

Lezizitshalo ziphila isikhathi sonke sonyaka, akhona namanye amaveji awela mgaphansi kwaloluhlobo lwezitsthalo. Isibonelo izihlahla zezithelo amakhambi afana ne comfrey.

Indlela yokukhetha imbewu

- Imbewu kufanele ibe nofuzo lohlobo lwembewu eyayitshaliwe, ifane nayo. Uma ngabe wawutshale imbewu ka brinjolo omude onombala oqgamile, nembewu iqoqe konjalo futhi. Uma isithelo sibukeka sehlukile kanjalo nembewu izokwehluka.

- Suphula izitshalo ezincikinciki ngaphambi kokuqhakaza. Ngokwesibonelo susa lezo ezikhula kancane noma ezihlabeke yizifo kanye nalezo ezibhangazelayo-ezithela kungakabi yisikhathi.

- Vuna imbewu ezitshalweni ezinhle ezinempilo.

- Vuna/khetha imbewu ezitshalweni ezikhombise ukumelana nezimo ezinzima izinambuzane kanye nezifo.

- Khetha imbewu ezitshalweni einempilo, ungakhethi kwezikhombise ukuhlabeka emacembeni noma ukubola ezithelweni nasezinhlamvini. Izifo ezitholakale embewini ziyadlulela naseszitshalweni ezintsha.

- Unga khethi imbewu ezitshalweni ezibhangazelayo, ngokubhangazela sichaza iztshalo ezikhiqiza imbewu kungakabi isikhathi. Lokhu kungabangwa ukungaphatheki kahle kwesitshalo ngenxa yesimo sezulu uma ivula ingekho lishisa, kanti futhi kungaba ufuzo. Ngakho-ke uma ukhetha loluhlobo lwembewu kungenzeka ukuba ukhetha isitshalo esisheshe siqhakaze singa kabekeli. Lokhu kubaliulekile ezitshalweni ezinjengemifino lapho ulindele khona ukudla amakhasi iskhathi eside.

- Khetha uvune imbewu eseyivuthiwe ngoba imbewu ekhiwe isengamaklume ivamise ukunga qhumi/ukungamili uma seyitshalwa.

- Ungakhethi imbewu edliwe zinambuzane nanoma yikuphi nje ukulimala, imbewu imila kahle ima ingenamyocu.

- Ungakhethi imbewu enesikhunta noma hlobo luni lwesifo.

Ubona kanjani lapho ungathola khona imbewu esitshalweni?

Ubhontshisi



Izinhlokwana zembewu

Ezinye izitshalo zinamakhanjana aqukatha imbewu, njengobhontshisi no phizi. Lokhu kubizwa ngemidumba. Lezinhlobo zivamise ukuzilumbanela zodwa ngokwemvelo ngakho awudingi ukuzikhathaza ngokuhlukanisa izinhlobo.

Lethisi



ikabishi



Okusamakhas, imifino njengo lethisi nesipinashi, kuqhuma intshakazi maphakathi nesithombo. Imbali kanye nembewu kuphuma kule ntshakazi.

Brassicas (umndeni weklabishi) liqale lakhe isigaxa bese kuthi imbali iphume phakathi nesigaxa lapho kuzophuma khona imidunjanyane yembewu. Lokhu kuvamise ikuthatha isikhathi esingaye sifike ezinyangeni ezingu 18. Umndeni weklabishi udinga

izinyosi kanye nezinye izinambuzane ukuthwala impova iyekwezinye izimbali zalo iklabishi. Udinga ukubeka izihlahla eziningi ukuthola imbewu eyanele(iziyi6 kuya ku 20) isihlahla esisodwa sikhiqhiza imbewu encane kakhulu. Umndeni weklabishi ungalumbana nanoma yisiphi isihlobo salo kusukela eklabishini kuya kubrokholi nelamashayina, ngakho kufanelekile ukuthi wehlukanise lemindeni uma ufuna ukuthola imbewu eqondile.

Ezisampande njengo Kherothi: Kulezizitshalo impande iqala ngokuqina salukhuni bese ikhipha isiqu eside lapho imbali kanye nembewu izomila khona. Lokhu kuvamise ukuthatha izinyanga ezingu 9. Izinyosi kanye neminyovu kusiza ukuthwala impva isika kwesinye isihlahla iya kwesinye.

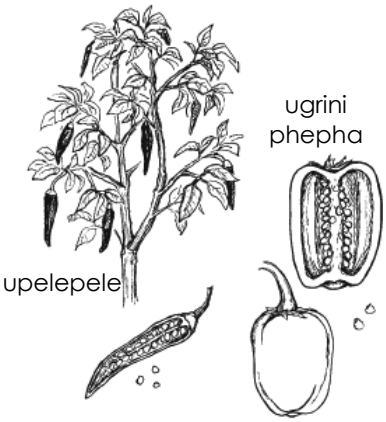

uAnyanisi

Ezisampande njengo Anyanisi: Kulezizitshalo ezithela ngaphansi isiqu esikhiqhiza imbewu simila ehlotsheni lesibili sitshaliwe, lesiqu simila singabi namacembe siqine kodwa isba nomgodi phakathi nendawo sibe side.

Olunye uhlobo lwalwezizitshalo (Amaryllidaceae) olufana no galigi, amashaladi. Lezizitshalo zilumbaniswa noma zizalaniswa zinyosi. Lokhu kwenzeka phakathi kwezimbali zesihlahla esisodwa. Imbewu yezitshalo ezingengaphansi kuka 20 idinga ukubekwa ukugcina uhlobo lwembewu oyifunayo igcinekile. Imbewu yalezizitshalo ayivuthwa kanyekanye idinga ukuvunwa ngesikhathi ibonakala ukuthi isulungela ukuvunwa ngaphambi kokuthi isakazwe wumoya.

Kuyisu elingcono ukuziyeka zomele esihlahleni sazo lezizimbewu ngaphambi kokuthi uziwohloze.

Izmbewu zokusazithelo



Isithelo sakheka emva kokuba kuchamiseleke okusaqanda emva kokulumba okwenzeka ezimbalini. Kuba sekwakheka isithelo salesosihlahla isizokhipha imbewu yaso.

- **Izithelo** zivunwa lapho sesivuthwe ngokweqile, isibonelo –Utamatisi, upelepele, ubrinjolo anye nogrini phepha.



Utamatisi kanye nezinye izithelo ezisemndenini wawo zilumbana ngokwemvelo embalini eyodwa, kodwa izitshalo ezifana nopelepele zona ezidinga umoya nezinyosi ukulumbana zidinga ukuhlukaniswa ukuqikelela ukuthi imbewu yakho ihlala ingadungekanga ngezinye izinhlobo zikapalepele. Upelepele obowazi ungababi ungakumangaza sewubaba ngendlela eyisimanga.

Amathanga – amabheca kanye namakhabe avunywa uma esevuthwe ngokweqile uwuyeke ukuze nembewu ephakathi ivuthwe ngokwanele. Ziningi izinhlobo zamathanga kanye namakhabe ongazithola sezilumbana kodwa angeke uthole ikhabe selilumbane nethanga noma nokhukhumba. Izmbali zesilisa nezesifazane zimila esitshalweni esisodwa, ezesilisa zibancane ngesidumbu zibe zinde zivuleke kuqala ukunalezi zesifazane ezivame ukumila zibe mfishanyane zibe nkulu. Ukhuhumba kanye naMabhece knona kudingwa ukuyekwa esihlahleni ukuze kuvuthwe ngokwanele.Ukhukhumba uba nsundu lapho ibhece liba ncombo libe likhulu.

- Ukhuhumba kanye naMabhece knona kudingwa ukuyekwa esihlahleni ukuze kuvuthwe ngokwanele.Ukhukhumba uba nsundu lapho ibhece liba ncombo libe likhulu.

Izimbewu ezidliwayo

Izibonelo zalezizimbewu kungaba nguMbila uBhontshisi, uPhizi kanye noJikanelanga. Lezizitshalo ziyayekwa ezihlahlahleni ukuze zivuthwe ngokwanele.

Ubona kanjani uma imbewu yakho seyilungele ukuvunwa?

- The Imbewu iba **nomsindo osakukopoza** phakathi noma **isikwebu siwe ohlangeni**. Isibonelo: ithanga kanye nommbila.

- **Umbala kanye nesidumbu nobume besithelo buyashintsa.** Isibonelo utamatisi nopelepele kuba bomvu, nogrini phephe udinga ukuyekwa uze ube bomvu, usuke ungakavuthwa mawuluhlaza ngebala.



- **Ukuqhuma kwemidumba.** Isibonelo: uphizi ,ubhintshisikanye nezindumba

- **Ukoma** Isibonelo: iklabishi, isipinashi kanye nokherothi

Ukuhlanzwa kwembewu



Ukuyela

Udinga ukususa izinsalelela zeziqu kanye namakhoba amakhulu ngoba engaba yisidleke sezinambuzane embewini yakho.

- Ukuphosa imbewu yakho emoyeni – ukuyela kuhlukanisa imbewu namakhoba ,imbenge enkulu ingakusiza kulomsenbenzi.

- Faka imbewu yakho embengeni ukushukuzise kuze kuhlale amakhoba ngaphezulu.

- Imbewu eningi kabontshisi namabele engabhulelwa esakeni ukuze kwenzeke ngokushesha ukuhlakaniswa kwawo emakhobeni bese uyakwela uma usuqedile.

Ukuhlanzwa kwezimbewu eziswakeme noma ezimanzi

Lokhu kusetshenziswa ezitshalweni ezigcina izimbewu zazo ezithelweni eziswakeme ezifreshi njengotamatisi kanye namathanga nokhukhumba.

- Khipha imbewu esithelweni uyikiphela esitsheni esinamanzi ahlanzekile iziwashisise. Chitha amanzi womise izimbewu zakho endaweni evulekile enelanga.

- Izmbewu zika tamatisi kanye noKhukhumba kungadinga ukuthi keziyekwe emanzini zithi ukuqgunywa. Lokhu kungenxa yokuthi zivikelwe uketsezi ulushibilikayo. Loluketshezi ludingwa ukususwa mgaphambi kokuba imbewu imile futhi kusiza ekutheni imbewu ingabi nesifo sezimbewu.

Inndlela yokususa lolu ketshezi:

Faka imbewu yakho emanzini imbozeke. Thela izipuni ezimbili zikashukela ugoqoze zize zincibilike.



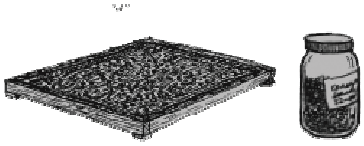
Yeka lengxube izinsuku ezintathu kuya kwezinhlanu kungeqi. Igwebu lizokwakheka phezulu okusho ukubila nokuthi lusukile lolungwengwesi.



Hlambulula imbewu yakho ngmanzi amaningi.



Yendlale ukuze yome bese uyivalela ebhodleleni uma seyomile.



Ukomiswa kwezimbewu

Izimbewu eziningi zidinga isikhathi eside zomisiwe ukunezinca ngokwenani nagezidumbu. Ukuhlola lokhu kubhontshisi ukuthi uwulume ngezinyo, uma ungafacaki kusho ukuthi imbewu seyome ngokwenele.

- Kufanenele womise izimbewu zakho endaweni eshaya umoya kude nelanga.
- Uma isimo sezulu singabalele kufanele uyomise endlini ekhudumele uyemboze ngamnethi ukuvukela izinambuzane.

- Ungalengisa ezinye izimbewu ngezikhwanyana zamaphepha endaweni eshaya umoya.

- Yendlala imbewu eningi ezisefweni noma uyilengise emasakeni. Ungasebenzisi oplasitiki.

Ukubekwa kwezimbewu



Ukugcinwa kwembewu isikhathi eside noma esifushane kuncike ekutheni:

- Hlobo luni lwembewu
- Ingabe ingeyekhethelo kangakanani
- Ibekwe kanjani

Imigomo yokubeka noma yokugcina imbewu

Ubumnyama

Thola indlela yokubeka imbewu yakho ethunzini ebumnyameni. Sebenzisa izikhwanyana zephepha, uplastiki abamnyama noma amabhodlela uwavalele emabhokisini ephepha. **Ungabeki** izimbewu zakho emabhodleleni engilazi besse uwabeka emakhabetheni.

Iningi lezimbewu zingabekwa kusuka eminyakeni emithathu kuya kwemihlanu(3-5) zihlale zithembakele. Ukuthembakala ukukwazi kwembewu ukumila uma seyitshaliwe. Imbewu yakho kufanele ihlale ibukeka iphelele kudwa uma ingethembekile mawuyibuka angake imile.

Umswakama

Noma ngabe izimbewu zakho zomile, uma uzigcina endaweni enomswakama zizomunca umswakama zonakale. Lokhu kuzophazamisa isikhathi ebekade sizophilwa zimbewu zakho ngaphambi kokuba

Uma ugcina imbewu yakho endaweni eshisayo,enelanga, nenomswakama imbewu yakho iyokwehlelwa amazinga okomila ingathembakali. Kungenzeka ugcine ungasakwazanga ngisho ukuzithsala ngonyaka olandelayo. Izimbewu zithanda indawo epholile, efiphele neyomile ukuhlala zisesimweni sokumila.

uzutshale. Ngokujwayelekile kufanele somise izimbewu zethu ngomoya. Masingalokothi sizomise ngelanga, kodwa asizibeke ethunzini lapho kushaya khona umoya. Uma isimo sezulo singesihle lina linenkungu, kulukhuni ukomisa izimbewu ikakhulukazi ezinkulu ezifan nobhontshisi.

Impilo yembewu iphindwa kabili uma ingenamswakama.

Temperature

Izimbewu ziphila kahle endaweni epholile hayi ebanda kakhulu. Khetha indawo epholile efana nasoswebeni lomfula, phansi kwezihlahla noma okhambeni/embizeni yobumba.

Impilo yembewu iyaphindeka kabili uma izinga lokushisa ebekwe kulo lehle ngo 5C.

Izinambuzane

Izinambuzane ezifana nembovane, iskhunta namagciwane kunganqamula impilo yembewu yakho.



- Izimbovane ziyanda uma imbewu yakho ithole umswakama. Zizalela amaqanda azo kuyo imbewu achamuseleke khona lapho.
- Isikhunta sona siqala uma umswakama wanda kakhulu usunga phezu kuka 20%. Ekufanele sikwenze ukgcina izimbewu zethu zome ngokuphelele.

Beka/ Gcina izimbewu zakho endaweni eyomile necocekile , emabhodleleni angangeni umoya bese UYAWABHALA UKUTHI KUMBEWU YINI. Kungenzeka ukhohlwe wawubeke ini kwelinye lamabhodlela.

Izinto esingazenza ukugcina izimbewu zethu zingenazinambuzane:

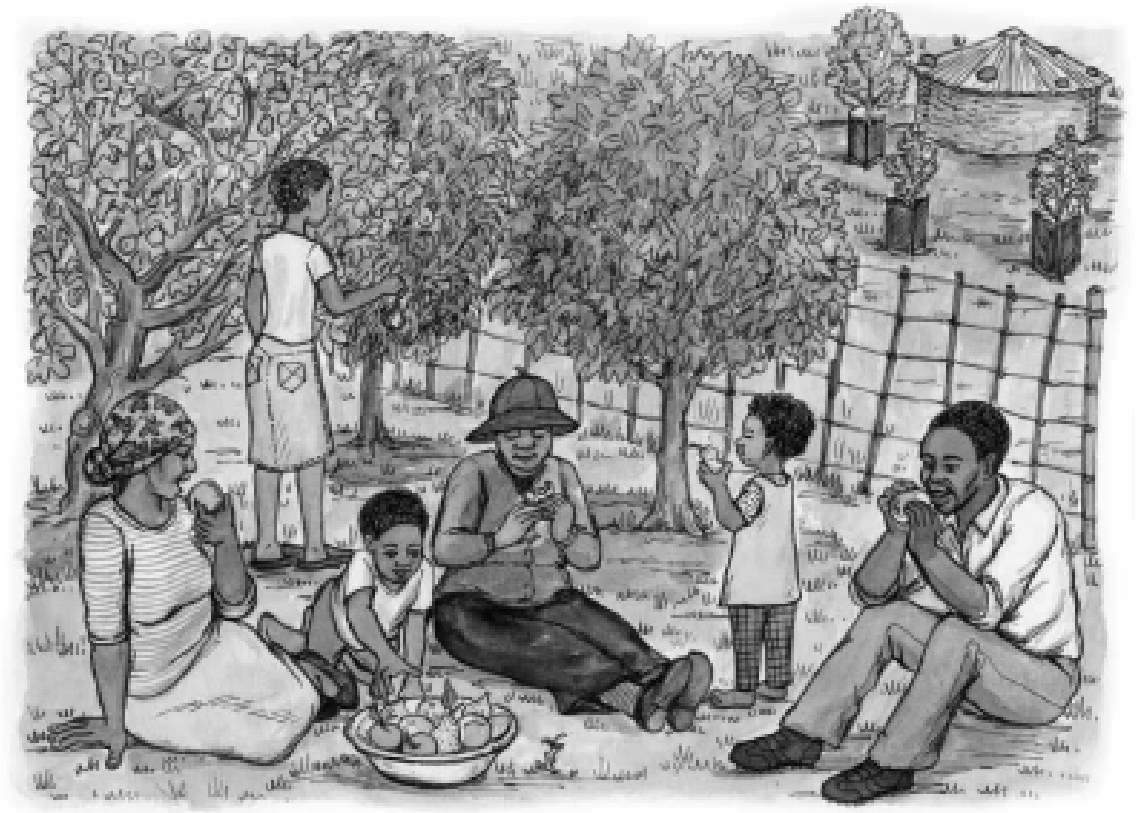
- **Umlotha**: usiza ekubambeni umswakama esitsheni obeke kuso imbewu yakho, lokhu kuvikela ukuba imbovane ingaveli. Faka uhhafu wekhilogramu womlotha embewini engangekhilogramu elilodwa.
- **Ukalika:** ungasethsenziswa ngendlela efanayo nomlotha. Xuba amathespuni angu 15 kakalika kulelonalelo kilogramu lembewu oligcinayo.
- **Amafutha okupheka**: Hlanganisa imbewu yakho namafutha okupheka ukuvikela imbovane. Faka ithespuni eyodwa embewini engango khilogram elilodwa.
- **Ingxube yamakhambi egayiwe yezihlahla ezinukayo:** Izimbovane azizwani namakhanbi anukayo, zama lokhu okulandelayo.

- UPELEPELE: Izipuni ezine kuya kweziyisithupha kulelonalelo khilogramu lembewu.

- UMHLONYANE: Yomisa amaqabunga bese uwagaya uwaxube enmbewu yakho, 4-6 wamathespuni kwikhilogramu lembewu.

- INHLABA: Yenza njengangenhla.

5. Ukutshalwa kwezihlahla zezithelo

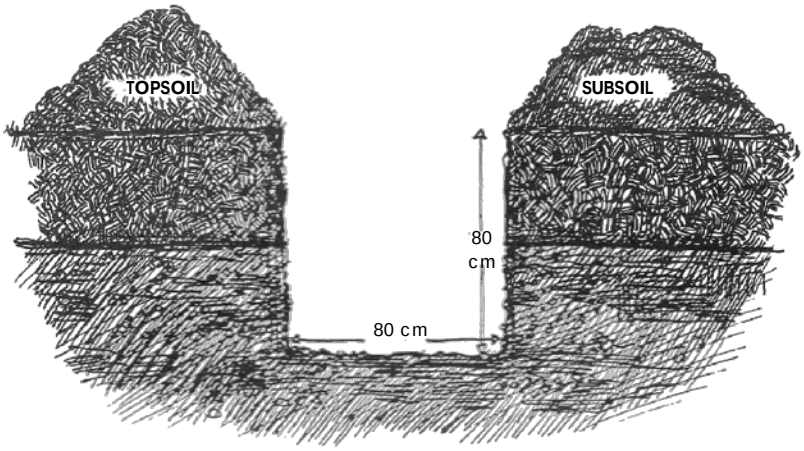


Isingeniso

Kungumqondo omuhle ukulungiselela umgodi ozotshala kuwona isithombo sakho sezithelo kusasele amasonto ambalwa ngaphambi kokuthi usitshale. Umhlabathi uzothola isikhathi esanele sokuzinza kahle emgodini owumbile kanti nomquba owufakile ngeke uzishise izimpande zesithombo ngoba uzothola isikhathi esanele sokuvuthwa.

Ukulungisa umgodi ozotshala kuwo

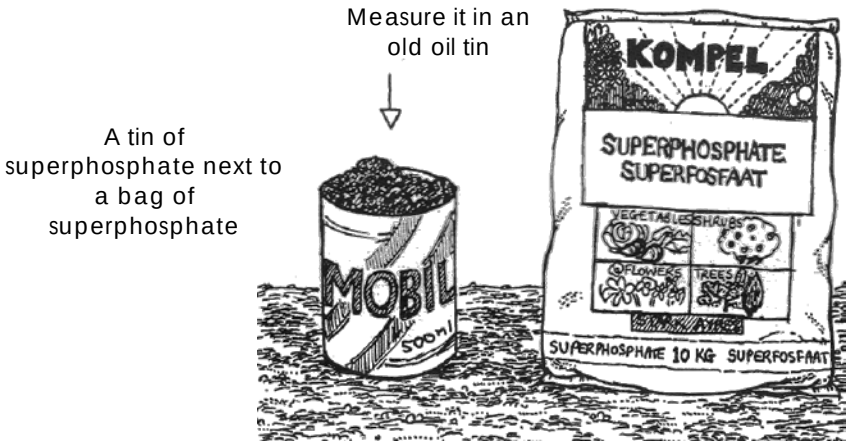
- Umgodi kufanele uwumbe ube yisikwele esinobude nobubanzi obungu 80cm kanjalo nokujula kwawo kube ngu 80cm. Umgodi uma umkhulu uzokunikeza umphumela omuhle wokuthi isihlahla sakho sibe sihle. Ngenkathi umba kufanele ukuthi inhlabathi yangaphezulu emnyama uyithele ecaleni elilodwa kuthi eyangaphansi nayo uyithele ngxenye.



- Thela phakathi emgodini umquba ogcwele ibhakede elingu 10 litres. Wuxube namabhakede ambalwa enhlabathi yangaphansi.



- Xuba lengxube ngomanyolo obizwa ngokuthi yi Superphosphate engu 500g noma ikhilogramu elilodwa lamathambo agayiwe.



- Okulandelayo thela amabhakede amabili omquba uwaxube nenhlabathi yangaphezulu.

- Emuva kwalokho umgodi wakho wugcwalise ngenhlabathi yangaphezulu. Kungenzeka ukuthi ubuye udinge enye inhlabathi emnyama. Kungadingeka ukuthi uyimbe kwenye indawo ukuze kweneliseke umgodi.

Ukutshala isihlahla

Ukunakekela isihlahla sakho esisesincane ngaphambi kokuthi sitshalwe

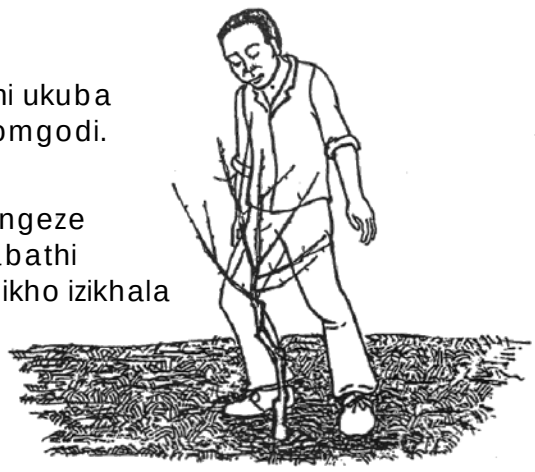
- Uma ngabe kungukuthi sisesikhwameni esiyi plastiki, sinisele njalo nhe emuva kwezinsuku ezimbalwa.
- Uma ngabe izimpande zinqunu, zingafakwe ndawo, yemboza izimpande ngesihlabathi esiswakeme, usonge ngesaka elimanzi kuze kufike isikhathi sokutshala.

Ukutshala isithombo esisesikhwameni seplastiki

- Nisela isithombo esisesikhwameni ngaphandle kokuhlikiza inhlabathi ephakathi
- Yenza umgojana emgodini owulungise ngaphambilini, ulingane nobukhulu beplastiki.
- Khipha isihlahla sakho esikhwameni esiyiplastiki.
- Tshala isihlahla sakho, uqinisekise ukuthi izimpande zembozwe kahle yinhlabathi. Ukujula kwesihlahla kufanele kulingane nokujula obebukade buyikona ngenkathi isithombo sisesesikhwameni.

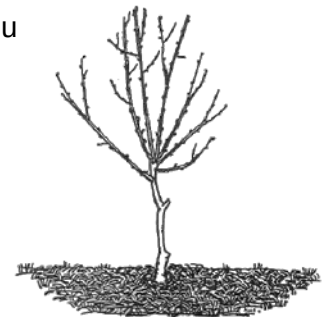
Ukutshala isihlahla esifike izimpande zingaphandle (zingafalwe ndawo)

- Yenza umgojana emgodini owulungise ngaphambilini. Lomgojana kufanele ubemkhulu kunezimpande zesihlahla.



- Bamba isihlahla usiphakamise emgodini sithi ukuba ngaphezudlwana kancane ngaphandle komgodi.

- Ngokucophelela thela inhlabathi yakho izungeze izimpande zesihlahla. Qinisekisa ukuthi inhlabathi ingena kahle ezimpandeni ukuze kungabibikho izikhala zomoya. Isihlahla kufanele sijule ngokufanayo kunangesikhathi sisatshaliwe lapho esikhishwe khona.



- l"dolo" (bud union) elibonakayo esithonjeni kumele libe ngu 3cm ngaphezu kwenhlabathi.

- Uma ususitshalile isihlahla sakho, kufanele usithene. Injongo yalokhu yilokhu okulandelayo:

  - Ukuthena kusiza ekuthini izimpande zesithombo zomelele

  - Uma singatheni, isihlahla sethu sizomila amaqabunga amaningi, kodwa singakhuli sibe side.



Ukunisela isihlahla esisanda kutshalwa



- Mbambatha kahle inhlabathi ezungeze isithombo esitshaliwe

- Yakha idanyana endaweni ezungeze isihlahla ukuze amanzi abambeke

- Nikeza isihlahla sakho amabhakede amabili amanzi.



- Yendlala utshani obomile, amaphephandaba amadala noma amatshe duzane nesihlahla, kanti lokho okwendlalile kumele kungasondelani nesiqu

salokho okutshalile. Lokhu kuzokonga amanzi futhi kusize ekunqandeni ukukhula mawala kokhula.

- Nisela isithombo sakho ngamakhakede amabili amanzi njalo nje emuva kwamasonto amabili kuze kufike isikhathi semvula. Uma ngabe kunasomiso, kumele ukuthi usunisele isithombo sakho. Uma ngabe kunesomiso noma kusebusika, kumele ukuthi unisele isihlahla sakho nyanga zonke.

Ukondla izihlahla zakho

Ukusebenzisa umquba wezinkomo

Yendlala umquba emhlabathi endaweni ebanzi ngokungangendawo engembozwa yithinzi lamagatsha. kugweme ukuthi umquba wakho uthinte isiqu sesihlahla. Yemboza umquba wakho ngesembozo sotshani, ngaphandle kwalokho umquba wakho uzophelelwa ngamandla.

Ubudala besihlahla	September	December
Unyaka ubudala	Ibhakede elilodwa 1	Ibhakede elilodwa 1
Iminyaka emibili ubudala	Amabhakede amabili	Amabhakede amabili
Iminyaka emithathu ubudala	Amabhakede amathathu	Amabhakede amathathu
Iminyaka emine ubudala	Amabhakede amane	Amabhakede amane
Iminyaka emihlanu ubudala	Amabhakede amahlanu	Amabhakede amahlanu

Emuva kweminyaka emihlanu kumele ukuthi ufake umquba olinganayo minyaka yonke.



6. Ukukhiqizwa Kwezihlahla Zezithelo

Ukuthena

Ukuthena kuyindlela yokusika ngokukhetha izingxenye ezithile zesihlahla, ukusabalalisa izindlela ezithilw zokhukhula kwezihlahla. Kuhambisnana kakhulu namagaya, iziqu kanye namaqabunga, kodwa kuyenzeka kube izimpande kanye nezithelo uqobo.

Kulezithelo ezinenhlamvu eqinile (amapetshisi, amaplamusi, amapilikso). Kanye nalezo zithelo ezimuncwana noma ezisa wolintshi (amawolintshi ulamula kanye namanantshi). Uma isihlahla kade sithele izithelo kyuenzeka ngonyaka olandelayo sithele kancane noma singatheli nhlobo. Kuyisu elihle ukuphungula izithelo esihlahleni uma zithele zaba ningi kakhulu / uma isihlahla sithele kakhulu. Lokhu kwenza uthole izithelo ezingeningi kodwa ezinkulu, kunokuthola eziningi ngesibalo kodwa zibenance ubuqhata



Ukuphungulwa kwezithelo: Ngokwejwayelekile kufanele ushiye okungenani izithelo eainngu 7-8 egatsheni eliyigxathi, noma izithelo ezine egatsheni elingagne ngalo.

Kungani kufanele uthene?

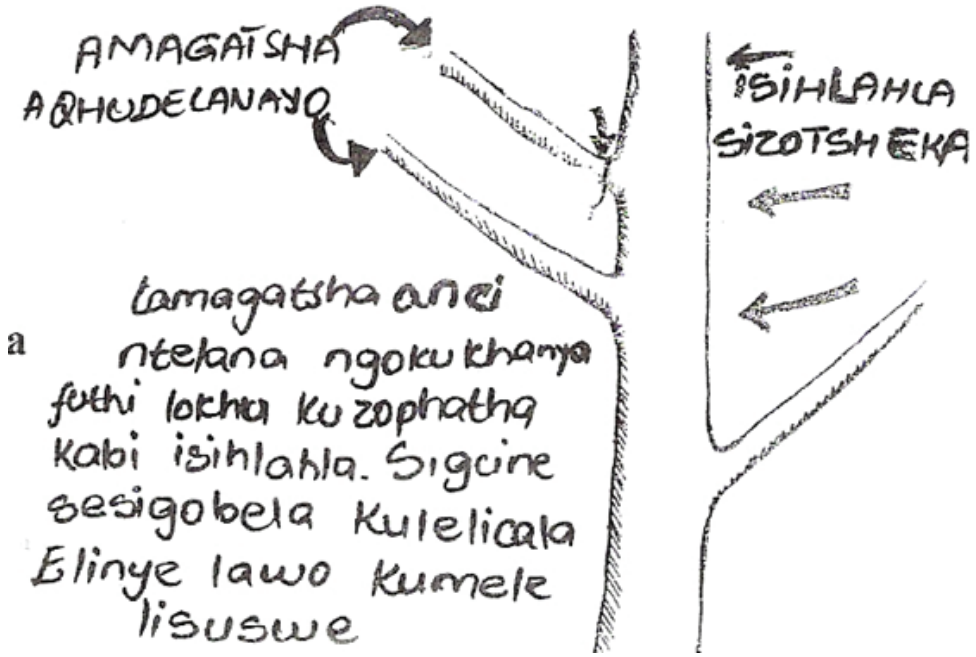
Ezihlahleni zezithelo ukuthena amagatsha kwenza isihlahla sakheke siqine sikwazi:

- Ukumelana nomoya onamandla singakuphi
- Sithwale izithelo ezisindayo
- Kuvuneka kakula njengoba isihlahla singabi side.

Ukuthena futhi kwandisa ukukhanya kanye nokuzungeza kokoya oshaya esihlahleni. Lokhu kunciphisa izifo futhi kusize uwakha isithelo nokusivuthiswa.

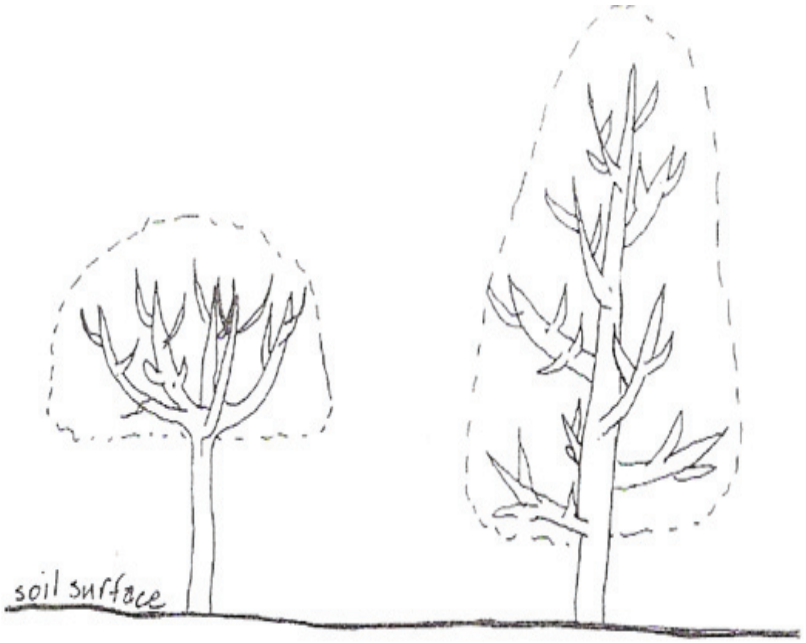
Izigaba Zokuthena

- Okokuqala, susa wonke amagatsha agile nagulayo.
- Bese ususa nanoma imiphi imixhantela engadingekile. (Isib.ezixhantelene elinye kwelinye, nesondelene kakhulu noma ezikhuhlana esinye kwesinye). Sika phezudlwana kancane nalapo igatsha lixhuma khona



- Nquma njalo amagatsha ngezansi kwalapho isihlahla sahlanganiswa khona. Leligatsha elisuke likhula lizoncintisana nezingxenye zesihlahla ezizothela isithelo.





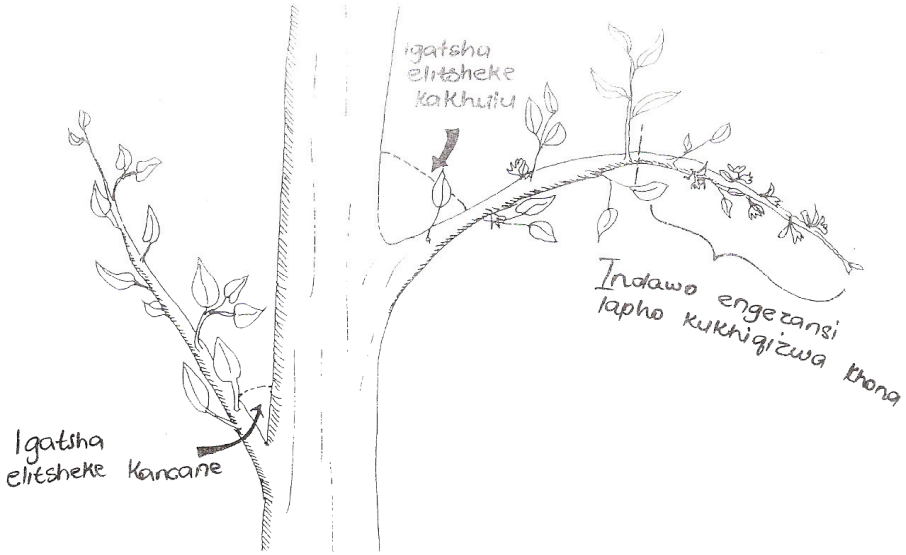
- Ngokwejwayelekile izihlahla zezithelo zithenwa zilandeliswe lezi zimo zokuma.

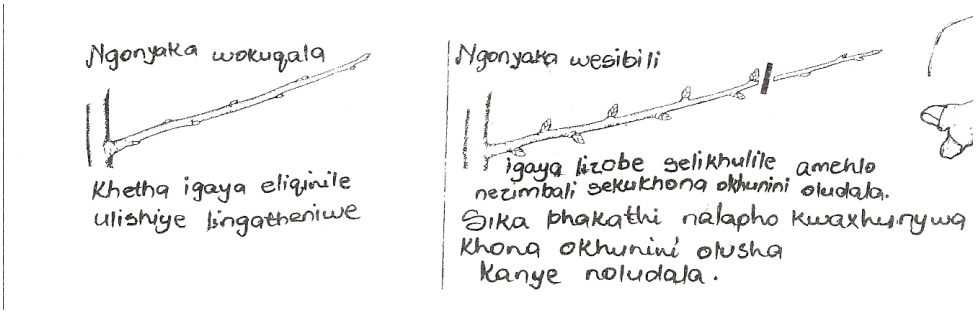
Indawo evulekile:*(left): Yenza isihlahla sisabalale lokhu okuvumela ukukhanya okwanele kungene phakathi nesihlahla isetshenziselwa ukuze sithele. Ngokwejwayeekile lendlela isetshenziselwa izithelo ezinenhlamvu eqinile (amapetshisi…*

Umholi ophakathi nendawo *(far left): Nogkwejwayelekile izithelo ezinjengama – apula namapheya.*

- Ngokwejwayelekile amagatsha amahle ekutheleni akwi elingu 45-65 "degrees" ukugqagqa emagatsheni amkhulu. Amagatsha anesikhala esincane pahkathi kwawo negatsha elikhulu kumbe isiqu (i-engela) ayephuka uma kunamoya. Ukuyeka igatsha elilodwa elikhula libheke phezulu esihalhleni, kanye nalawo abheka emaceleni, akhuthaza ukuthi isihlahla sithele kakhulu kunokuthi siqonge sibheke phezulu. Isihlahla sichitha amandla amaningi sikhiqiza izithelo kunokuthi sizama ukukhula sibheke phezulu.

Ukuma nokushiyana kwamagatsha athela kahle





Ukuthena izithelo ezinenhlamvu eqinile

AMAPETSHISI: *Izithelo zithela kulawo magatsha amila ngonyaka ophelile kuwo womabili amagatsha asemaceleni kanye nalawo asethela*

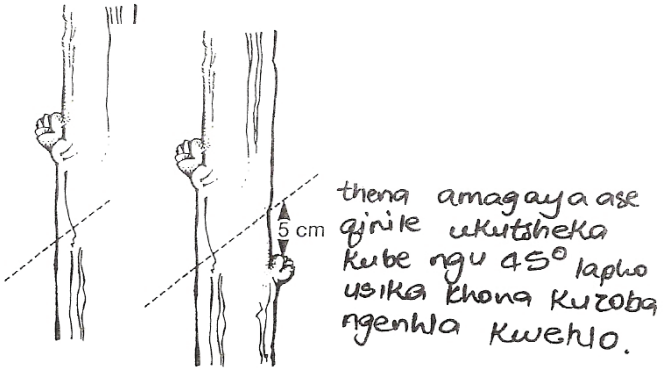
AMAPULAMUSI: *Izithelo zithela emagatsheni asemaceeni aseneminyaka emibili nangaphezudlwana (ezihlahleni ezinance amaqhuzwana asamehlwana abukeka njengeqoqo lamagatsha asemaceleni kuthi ezihalhleni ezindala zibukeke njengamahlumela amaningi*

Ukhuni oluthelayo epetshiseni olukhombisa amagatsha asemaceleni kanye namehlawana athelayo.



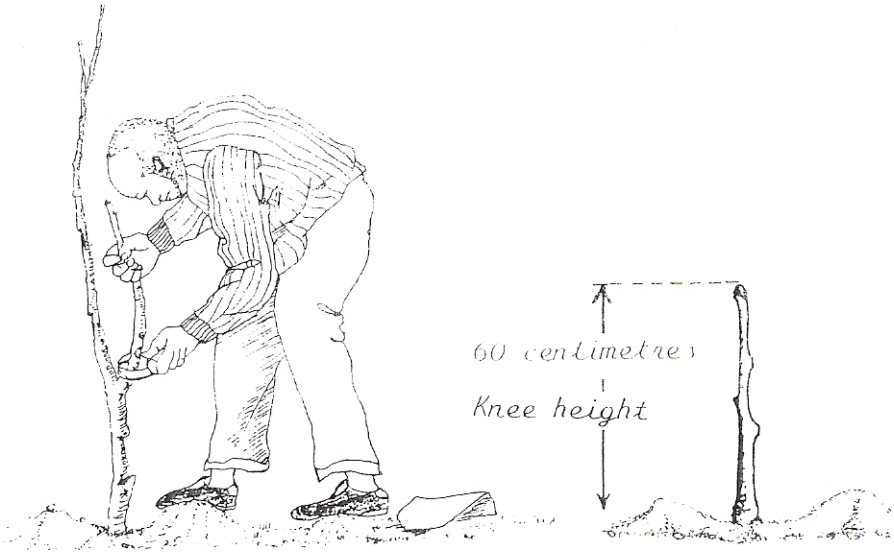
Lapho kuqhuma khona isithelo esihlahleni esidala sepulamusi

Uma uzosika igatsha, ukwenzela ukuthi kumile kabusha, sika ngasenhlana kancane kweqhutshana elikhombe ngaphandle noma igatshana



1. Ngesikhathi ukutshala,

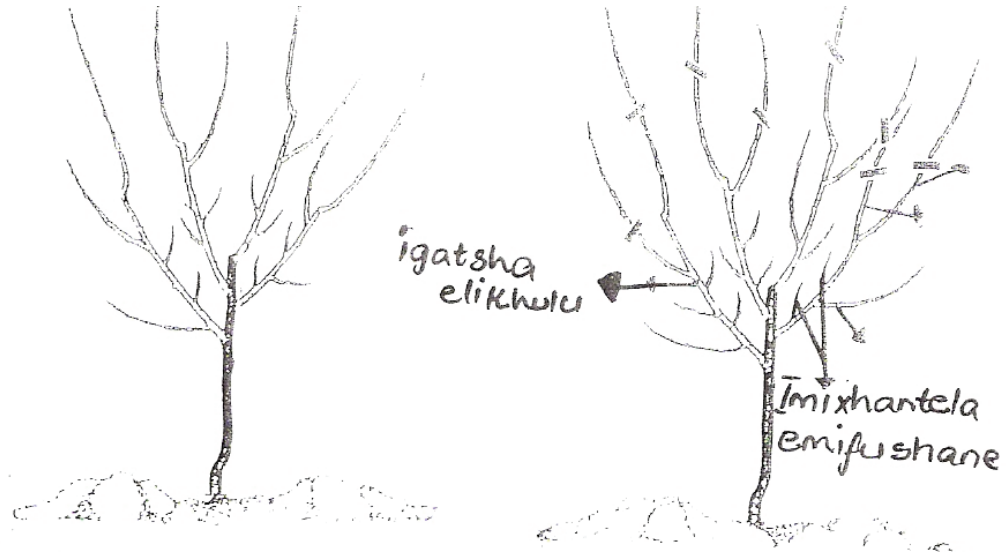
- Thena izimpande futhi tuene ensílala sibe side ngangedolo (60cm). Lokhu kuzophoqa isihlahla ukuthi sikhule siphumele ngaphandle sisabalale kunokuthi sikhule sibheke phezulu.



2. Ebusikeni bokuqala

- Sika amagaya amakhulu phezulu
- Eminye imixhantela yamagaya athelayo izobe isikhulile emagatsheni amakhulu

-Shiya imixhantela emibili noma emithathu kulelo nalelogatsha elikhulu kwelokuqala udede ngo 40cm ukususka egatsheni elikhulu uqhele kakhudlwana kwe lilandelayo



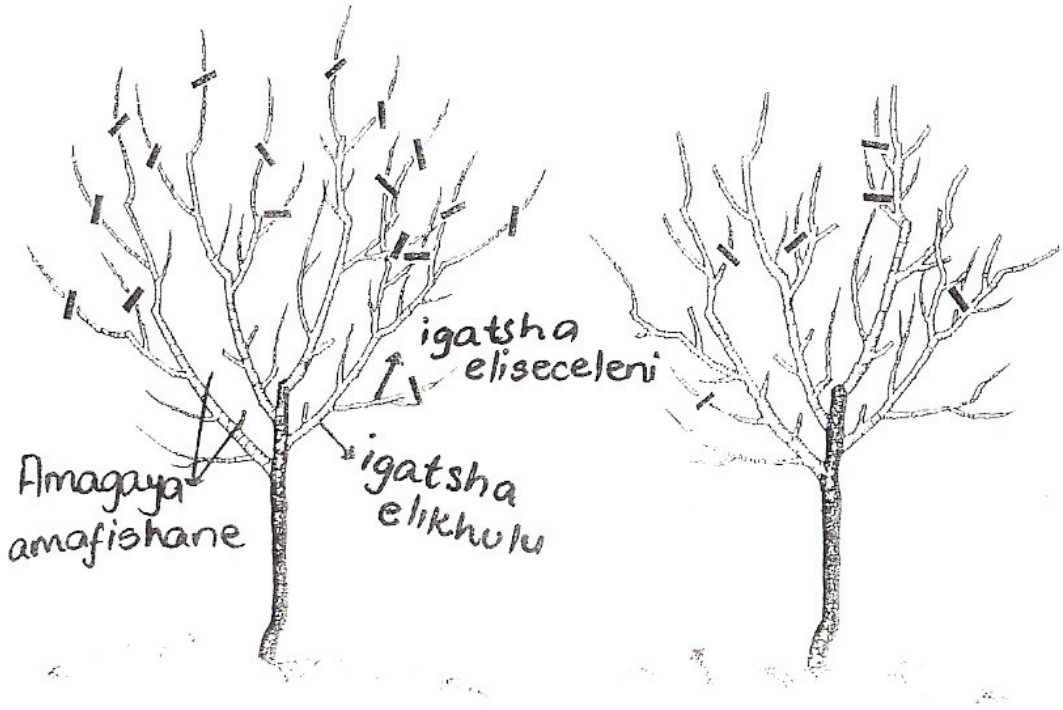
3.Ebusikeni besibili kanue nobesithathu

- Phungula amagatsha amakhulu phezulu. Uma uwasika abe mancane ngaphezu kowawuwasike kona ngonyaka odlule, lokhu kuzokwenza ukuthi isihlahla singasheshi ukuthela izithelo

- Nquma imixhantela yamagatsha ibe mifishane. Wasike kugqagqe ngo 1cm phezu kwalapho kuqhuma khona imbali. Noma usike emuva phakathi kokhuni oludala nolusha.

- Nquma amagaya asemaceleni ephuma kwimixhantela. Phinda futhi ushiye amagaya amabili noma amathathu izithelo zizothela kumxhantela owawuthenwe ngokwedlule.

-Uma izihlahla sezikhule kahle, zithene kancane njalo ebusika



7. Ama "Tower Gardens"

Ayini ama Tower gardens?

Ama Tower gardens yilolo hlobo lwezingadi ezakhiwele ukonga amanzi, ngokusebenzisa okwesibili amanzi asesebenzile, kanye nokwenza ukukhiqiza izithombo kubelula kubantu abadala. Loluhlobo lwezingadi lubuye lubizwe nge "lazy gardening" okusho ukuthi izingadi ezilula ukuzisebenza. Njengoba kuthiwa ngama Tower gardens, kuchaza ukuthi ziphakeme. Lokhu kwenziwela ikakhulukazi abantu abadala, asikho isidingo sokuthi balokhu begoba uma besebenza. Kuyabasiza ke bona ngoba bahlushwa ngamaqolo. AmaTower gardens ayasondezeka futhi lapho abantu abadala bekwazi ukufinyelela khona kalula.

Yini I "gray water"

Ama "Grey water" yilawomanzi ekade esetshenziswa ekhaya. Ngenxa yokuswelakala kwamanzi emakhaya, amanzi asesebenzile angakwazi ukubuye asesetshenziswe engadini. Indlela yokusebenzisa lamanzi ichazwe kabanzi lapha ngezansi.

Ukusebenzisa amanzi asesebenzile

Ingezikhathi eziningi, amanzi athwalwa ngamakhanda ngezipakupaku ekhiwa kompompi, hayi ngenhloso yokuchelela engadini, kepha yokupheka nokuwasha. Lamanzi angasetshenziswa futhi uma esesetshenzisiwe, ekucheleleni ingadi ngokuiyimpumelelo. Lena yindlela yokonga amanzi. ngokusebenzisa amanzi asesebenzile (grey water) ekuniseleni.

Amaveji atshalwa enhlabathini egxishwe esakeni. Kubhotshozwa izimbobo emacaleni esaka bese kuyatshalwa, bese kuthi, njalo ngosuku uma kukhona amanzi avela endlini ayothelwa kulelisaka.

Amaveji angatshalwa ngokuyimpumelelo ngokuniselwa ngamanzi anensipho! Lensipho ingagezeka ngokuthi uthele amabhakede amabili amanzi ahlanzekile phakathi nendawo kuleTower garden kanye ngesonto.

Lolu wuhlobo lwezingadi zabantu abavilaphayo

Okunye okuhle kakhulu ngaloluhlobo lwengadi ukuthi alufukuzisi kanti futhi aludingi ukuthi umuntu achithe isikhathi esiningi kuzona. Zinhle kakhulu ukuthi zisetshenziswe ngomama ngoba azidingi isikhathi sabo esiningi ngoba bahlala bexakekile. Uma abantu sebewajwayele ama Tower gardens, bakhetha ukuthi bawenze abe semnyango ongemuva ukuze bangalahlekelwa isikhathi esiningi uma bezochitha amanzi asesebenzile.

Kunzima ukuqagela ukuthi kudingeka amanzi angakanani kulezizingadi, lokhu kuzotholakala emuva kwesikhathi. Uma kwenzeka ukuthi kwakheke ichitshanyana laphayana ezansi ne Tower lakho, kungenzeka ukuthi maningi kakhulu amanzi athelwa khona. Lokhu kuzochaza ukuthi kudingeka ukuthi kwakhiwe I Tower lesibili.

Indlela yokwakha I Tower

Indlela I Tower elisebenza ngayo ilula ngalendlela:

- **Inhlabathi** ifakwa phakathi izungeze amatshe, bese kuthi I "shade cloth" isebenze njengesikhumba emaceleni. Phakathi nendawo kubekwa amatshe.
- **Amatshe** apakishwe ngaphakathi yiwona aqondisa amanzi ukuthi ahlale esezingeni elifanele ukuze akwazi ukubhekana nokukhula kwezitshalo.
- **Ingxube yenhlabathi** inikezela imvundo.

Izigxobo



Akubalulekile ukuthi kube yisigxobo kuphela ezifakwa lapha. Ungasebenzisa noma yini enye ezofezwa lokho okwenziwa yisigxobo. Ungasebenzisa amagatsha ezihlahla noma izitandathi, ikakhulukazi uma utshale izitshalo ezifana notamatisi ngaphezulu ezidinga ukusekelwa, ungabuye ulukelele nangocingo.

Indwangu ezungezile

Indlela okhetha ngayo uhlobo lwendwangu ezungezile ibalulekile:

- I - Nylon gunny bags ihlala kuphela iminyaka emibili;
- Amasaka, ***njengoba kuveziwe ezithombeni, zihlala kuphela unyaka owodwa***;
- Amaplastiki amnyama aguga masinyane ikakhulukazi uma eke ahlatshwa yilanga elishisayo;
- I nethi elibizwa ngokuthi yi "Shade netting' lenza umsebenzi ongcono



kakhulu. Kubalulekile ukusebenzisa izintambo ze Nylon noma intambo yokudoba ukuhlanganisa noma ukuthunga lapho kuhlangana khona izinhlangothi zaleli Tower ukuze kube yindilinga kahle njengengilazi yamanzi, njengoba kukhonjiswa esithombeni.

Inhlabathi



- Inhlabathi kufanele ivunde futhi ikwazi ukugcina amanzi.
- Umxube wezingxenye eziyisithupha zenhlabathi, izingxenye ezine zomquba kanye nezimbili zomlotha wezinkuni, yiwona okahle.
- Inhlabathi kufanele yenziwe iswakame kodwa ingagandaywa.
- Amanzi kufanele achelwe enhlabathini angene kahle yonke indawo ukuze afinyelele nakulezondawo ezigangadekile.



Ukugcwalisa

Ukupakisha amatshe ngaphakathi kubaluleke kakhulu. Pakisha kahle amatshe ayizicaba, noma izicucu zamatshe avela endlini endala ediliziwe. Uma kunokwenzeka, sebenzisa amatshe amancane ayizindilinga, inqobo nje uma ezopakishwa ahleleke kahle ukuze amanzi akwazi ukungena yonke indawo ngaphakathi ngokulinganayo.

Luhlobo luni lwamaveji ezingatshalwa kulama Tower gardens?

- Amaveji anamacembe amakhulu (Leafy crops)

  AmaTower Gardens awalungele amaveji anamacembe, ikakhulukazi uhlobo olufana nesipinash, kanti atshalwa ezimbotsheni ezisemacaleni.

  Lezizimbobo kufanele zibesemaceleni esaka futhi zenziwe ngendlela yokuthi leso naleso sithimbo sithole indawo eyanele yokuthi kukhule izimande zaso.

- Utamatisi kanye no anyanisi

  Utamatisi kanye noma anyanisi ungatshalwa ngaphezulu, ngoba lezizitshalo zidinga ukusekelwa ngocingo uma sezikhulile.

- Izitshalo ezihambisana nezinye (Companion crops)

  Lapho kungenzeka, kubalulekile ukutshala lezizitshalo ukuze kuvikeleke izifo kanye nezinambuzane ngokwemvelo. U *Garlic* kanye *onions* yizona zitshalo ezibalulekile kulokhu.



Okunye okuhle okutholakele ngama Tower gardens yindlela akwazi ukumelana ngayo nokushisa, uma uqhathanisa nengadi ejwayekile. Isizathu salokhu asicaci kahle. Kungenzeka ukuthi umoya ukwazi ukuzungeza yonke indawo kwi Tower garden ngokukhululeka, inhlabathi ephakathi ihlala ipholile, noma mhlawumbe ukuthi kuhlale kunomswakama owenele kuleTower.

8. Ukukhiqizwa kwezithelo – Ukwandiswa kwezitshalo

Izitshalo zingatshalwa ngembewu kumbe ngezingxenye zezihlahla ezinkulu. Ubuhle bokusebenzisa izihlahla ezingabazali, ukuthi izihlahla ezincane ziba nezimpawu ezikumzali maqondana nokukhula kanye nezithelo. Izinhlobo ezithile zezitshalo kanye nezihlahla zingatshalwa ngqo kuthathelwa kwezinkulu (ukuzalanisa izitshalo).

Ziningi izindlela zokutshala ezingasetshenziswa.

Imisiko

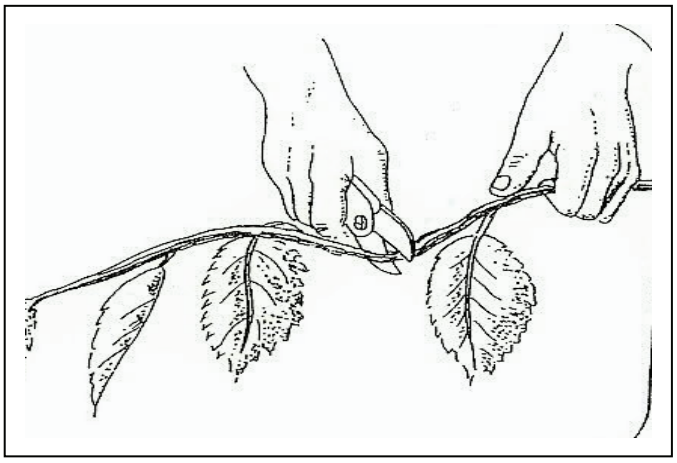
Imisiko yizingxenye zezitshalo, ngokwejwayelekile iziqu kanye namagatsha angamila izimpande ezintsha. Imisiko ingathathwa kulezo zihlahla ezivuthuka amaqabunga ebusika ezinjengamapetshise, umkhiwane no malibhele. Ingathathwa futhi kwezinye izitshalo izinjengamakhambi kanye nobhatata.

Imiskiko akufanele isikwe ngesikhathi izihlahla zigqilazekile, kushisa kakhulu, kunamagade noma kunesomiso. Imixhantela ekhipha izimbali noma izithelo akufanele isetshenziselwe imisiko. Ngokwejwayelekile zimbili izinhlobo.

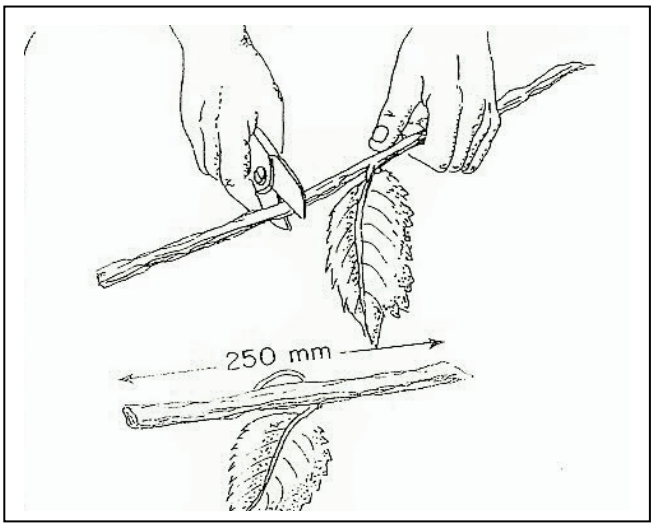
Imisiko ethambile	Imisiko yokhuni oluqinile
Lena imifanekiso "eluhlaza" ethathwe kokumilayo ngenkathi yonyaka / entwasahlobo.	Lezi ngezindadlana imixhantela eyizinkuni ngenkathi yonyaka odlule.
Yejwayele ukuthi ithathwe uma kuqala intwasahlobo.	Izihlahla eziwohloka amaqabunga ebusika zithathwa ngenkathi kungakahlumi, ngaphambi kokuba amehlo aqhume ebusika. Kulezo zihlahla ezihlala ziluhlaza kufanele zisikwe ngaphambi kokuthi kukhule ngokushesha (kunzima ukuhlukanisa, kufanele wenze ubone).
Susa konke kodwa ushiye amaqabunga ambalwa angasenhla.	Lemisiko ayinawo amaqabunga futhi ngokwejwayelekile nezihloko ziyasuswa. Kusetshenziswa amagaya asemancane anamehlo amaningi.

Ithathwa kanjani imisiko

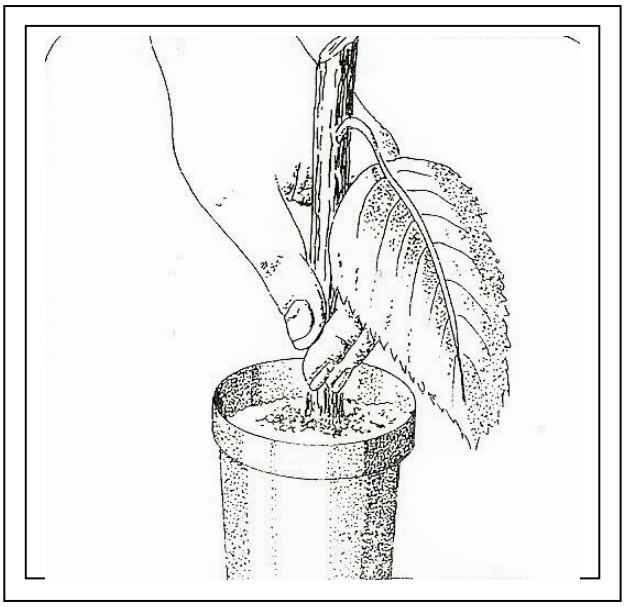
- Sika ngezansi kwalapho kuzophuma khona iqabunga/ihlo.
- Yiba nesiqiniseko sokuthi okungenani umsiko unamaqabunga amahlanu asondelane.
- Sebenzisa imixhanti ebheke phansi namagatsha abheke phezulu, kunezinsunsu ezilula ezibheke phezulu.
- Zibheke phezulu futhi zinezikhala ezinde phakathi namalunga nezihlahla ezitshalwe ngawo zizobukeka kanjalo.



- Sika iziqu zibe ngu 0.5 cm ubuqatha ubude bube phakathi kuka 25-30 cm. Isingezansi somsiko senziwa / sithathwa ngezansi kweso bese kuthi isingenhla sithathwe mangenhlana kweso.



- Zidinga ukubekwa enhlabathini engabambi kakhulu amanzi (okungcono isihlabathi) okungenani kube namaqhuzu amabili okukula. **Yiba nesiqiniseko sokuthi imisiko ima ibheke phezulu kahle!!!** Isihlabathi kumele sihlale siswakeme ngaso sonke isikhati futhi sivikelekile emoyeni nasekushiseni.
- Uma ungase uthole impushana yehomoni isingezansi somsiko singacwiliswa kulempushana ukusiza umsiko ukuthi umile izimpande.



Agricultural Water Use for Homestead Gardening Systems

Resource Material for Facilitators and Food Gardeners

Chapter 5

Garden and Homestead Water Management for Food Gardening

Chapters: Resource Material

Introduction to the Learning Material **(TT 431/1/09)**

Chapter 1 Rural realities and homestead food gardening options **(TT 431/1/09)**

Chapter 2 - Facilitation of homestead food gardening **(TT 431/1/09)**
- Handouts: Chapter 2 – Homestead Food Gardener's Resource Packs

Chapter 3 - Living and eating well **(TT 431/1/09**
- Handouts: Chapter 3 – Homestead Food Gardener's Resource Packs

Chapter 4 - Diversifying production in homestead food gardening **(TT 431/2/09)**
- Handouts: Chapter 4 – Homestead Food Gardener's Resource Packs

Chapter 5 - Garden and homestead water management for food gardening **(TT 431/2/09)**
- Handouts: Chapter 5 – Homestead Food Gardener's Resource Packs

Chapter 6 - Soil fertility management: Optimising the productivity of soil and water **(TT 431/3/09)**
- Handouts: Chapter 6 – Homestead Food Gardener's Resource Packs

Chapter 7 Income opportunities from homestead food gardening **(TT 431/3/09)**

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Aims

This Chapter aims to open your eyes to the typical problems and challenges households have with watering their gardens – and to offer workable solutions for almost all circumstances. The following will be covered:

Typical problems with watering household gardens

Irrigation is a complex and interesting science, covering too many aspects to deal with in depth here. But what are the main problems householders face when they want to water their gardens? What are the typical mistakes people make and how can we best advise them to avoid these mistakes?

The key problems for householders are:

Water is scarce and often expensive for rural households, even just for drinking and domestic use. Most households believe that it is nearly impossible for them to get hold of enough water to grow a food garden at home.

In the section on **water sources**, we will discover how much a household can grow just by **recycling** their little **household water**.

Usually, most of our rainwater runs away unutilised. In fact, many people build barriers to keep rapid-flowing water out of their yards during rainstorms to avoid erosion damage to their property. We will look at **rainwater harvesting** methods that help households to **slow down, capture, store** water, and so, still **benefit from rainwater** long after a rainstorm has passed.

We will also look at what other water sources a household can try to tap into for food production in the backyard.

Gardeners often plant their crops at the start of the season, only to find that they don't have enough water at the end of the season when the plants need the most water. It is very frustrating to see your plants wither when they are almost ready to be harvested!

In the section on **balancing water needs and sources across seasons**, this aspect is addressed.

Often, people don't realise that they are not making best use of the little water they have. The most common mistake is to give your plants small quantities of water every day. Most of the water evaporates into the air before the plants can use it.

In the section on **applying water sensibly**, we look at two questions facing every irrigator: **How much? How often?** We will see that one or two deep waterings per week have many advantages: less water is lost to evaporation, and more water seeps deep into the soil to enable strong root growth and thus strong plants.

A good guide is to pour one 20-litre bucket per 1 m x 1 m portion of garden, once a week in winter, and twice a week in summer (except when it has rained well).

Small ridges around the beds keep the water where it is applied, ensuring that all plants are watered equally.

Simple methods are used to understand how deep the water goes into the soil.

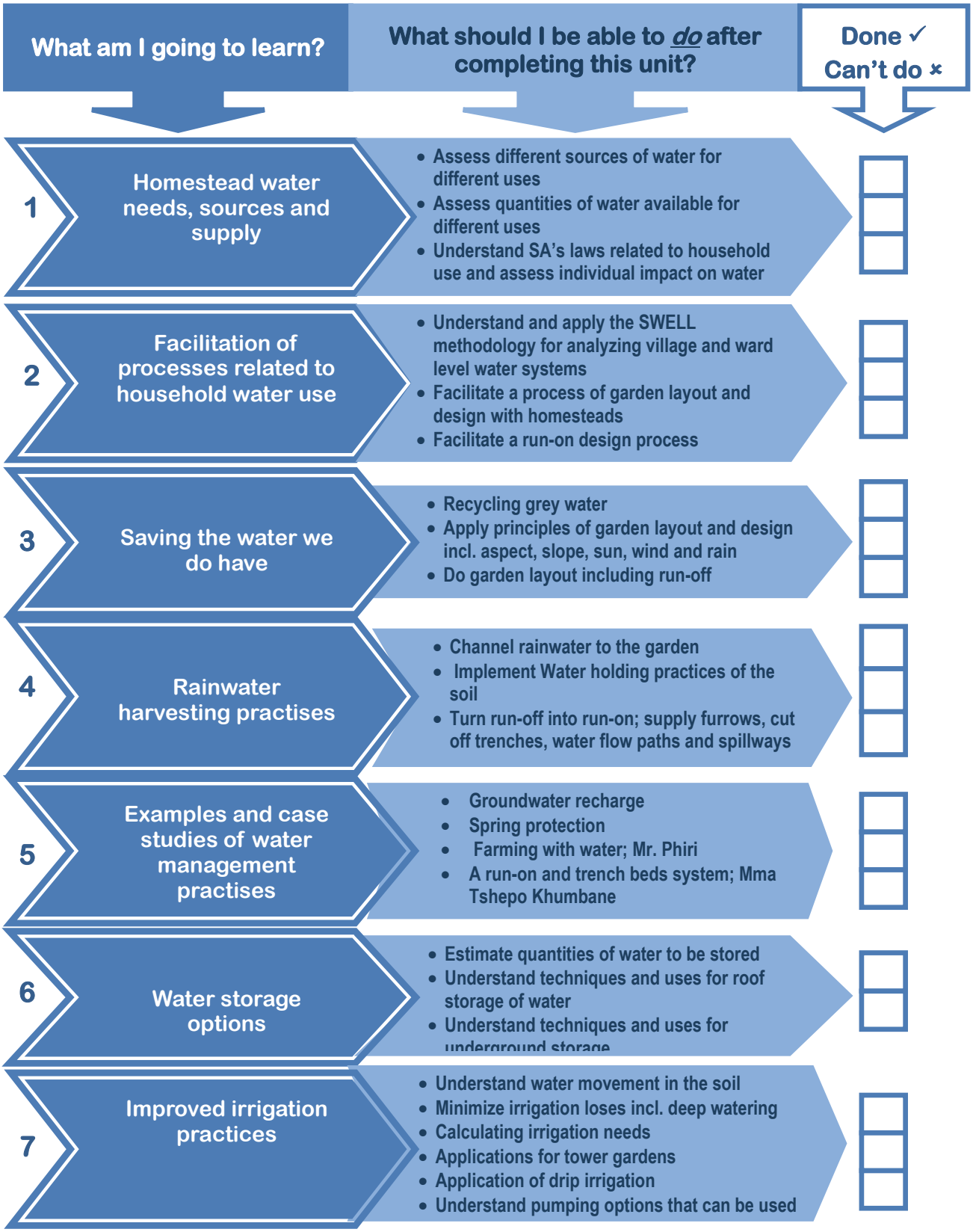
What can I use to water my garden?

In the section on **irrigation technology**, the most appropriate pumps, pipes and irrigation systems for small gardens are discussed.

What am I going to learn?

On the next page is a list of the things you should be able to do when you have successfully completed this chapter. This list gives you some idea of what to expect when you start working on the chapter, but, more importantly, you should come back to the list when you have completed the chapter to check if you have achieved all the objectives set out for the chapter. This means that you can monitor your own progress quite accurately.

The outcomes for this chapter is listed on the following page.


What am I going to learn?
What should I be able to do after completing this unit?
Done ✓
Can't do ×
1
Homestead water needs, sources and supply
• Assess different sources of water for different uses
• Assess quantities of water available for different uses
• Understand SA's laws related to household use and assess individual impact on water
2
Facilitation of processes related to household water use
• Understand and apply the SWELL methodology for analyzing village and ward level water systems
• Facilitate a process of garden layout and design with homesteads
• Facilitate a run-on design process
3
Saving the water we do have
• Recycling grey water
• Apply principles of garden layout and design incl. aspect, slope, sun, wind and rain
• Do garden layout including run-off
4
Rainwater harvesting practises
• Channel rainwater to the garden
• Implement Water holding practices of the soil
• Turn run-off into run-on; supply furrows, cut off trenches, water flow paths and spillways
5
Examples and case studies of water management practises
• Groundwater recharge
• Spring protection
• Farming with water; Mr. Phiri
• A run-on and trench beds system; Mma Tshepo Khumbane
6
Water storage options
• Estimate quantities of water to be stored
• Understand techniques and uses for roof storage of water
• Understand techniques and uses for underground storage
7
Improved irrigation practices
• Understand water movement in the soil
• Minimize irrigation loses incl. deep watering
• Calculating irrigation needs
• Applications for tower gardens
• Application of drip irrigation
• Understand pumping options that can be used

Icons

You will find that several different icons are used throughout the Chapter. These icons should assist you with navigation through the Chapter and orientation within the material. This is what these icons mean:



Facilitation tools

Processes that you can use in workshop situations, to support your work in the field.

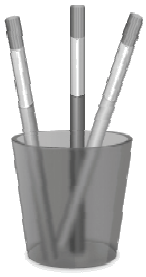


Research /Case study

The results of research or case studies that illustrate the ideas presented.



Looking at research, facts and figures to help contextualise things.



Activity

This indicates an exercise that you should do – either on your own (individual) or in a group.



Copy and handouts

These sections can be copied and used as handouts to learners / participants

5.1 Introduction

Water is everywhere on the surface of the earth. It is within all living organisms, soil and even in the air. Without drinking water, the bodies of animals and plants cannot be sustained. Without water there is no life; with too little water, life is very hard indeed.

Water is particularly precious to rural households, precisely because they so often have to make do with limited and/or unreliable supplies. Even in relatively higher rainfall areas, households often need to walk considerable distances to fetch water, either because the local supply system fails, or because it provides too little water for all their needs, including water for home food gardening.



Qumbu village in Eastern Cape is not remote – it lies quite close to the N2 freeway some 60km North of Mthatha, and has had municipal water supplies for a number of years. Yet it was still necessary for this lady to pay R10 per 200-litre drum of muddy water from the river whenever she couldn't cart it by wheelbarrow herself. A drum of 'clean' water (not purified, just not muddy) was twice the price. This amounts to R100/kl, while purified tap water in the cities was being charged at less than R5/kl.



Note the deep valleys people have to walk down to reach water in the streams around Lubala, Lusikisiki, and Eastern Cape. Despite this area's high annual rainfall of 1050 mm/a, the households experience water as a scarce and precious resource, because they have to spend so much time and effort daily to get it to their homesteads.



In drier areas, water is also physically scarce and many sources can dry up completely during drought periods. Lorraine village, Limpopo Province, 2003.

Key issues for homestead water management

Household water needs

Because water is so scarce, it needs to be used sparingly. A household has varied water needs, which includes the following main categories:

- Smallish quantities of water that is **safe for drinking**, cooking and doing the dishes;
- Larger quantities for **personal hygiene** and doing the washing – which need not be of the same quality as drinking water; and
- Even larger quantities of unpurified or **'raw' water for food gardening** and other productive purposes.

These differences in the quality of water required for different purposes also means that the household can re-use or recycle water quite successfully. For instance, water used for washing can be used to water the vegetables – provided the household is careful about how they deal with soap and detergents.



Here, water from household processes is being recycled for use in food production. Ash from the cooking fire is added to the water and left overnight to settle out the soap and impurities before it is used to water the plants. Also note the water storage containers behind the low wall.

Once the interest and awareness of the household members has been kindled, they can save and re-use water in almost every use they put it to! Two areas are of most interest, because here potentially larger quantities of water can be saved:

- **Recycling** saves a great deal of effort that would otherwise have been needed to fetch more water; and
- **Improved irrigation practices** can save a tremendous quantity of water, while assuring good and healthy crop yields.

Watering the garden: how much, how often?

One of the most common wasteful irrigation practices is to spread a small quantity of water across the whole garden every day or two. It is understandable that people tend to do this, because they reason that 'at least all the plants will get a little bit of water'. However, such shallow watering is in fact very wasteful, because most of the water simply evaporates out of the topsoil without doing much good at all.

A much better approach would be to divide the garden into imaginary 'blocks' or 'sections', and to provide a good deep watering to each section every four to seven days. Thereby the water can seep deep into the soil and less of it will be lost to evaporation.

Beware: deep watering can also be overdone. Then the water seeps down deeper into the soil than the plant roots can reach them – we call this deep percolation. (However, this is a less common mistake than the major water losses through too shallow and too frequent watering.)

How can one know how deep the water has gone? The simplest method is to push a steel peg into the soil a few hours after watering the bed, when the water has had time to infiltrate properly into the soil. The peg goes in quite easily until it reaches the dry soil below, which gives you a good idea of how deep the water had gone down. Combine this with knowledge about the typical rooting depth of the crop, and it becomes easier to strike a balance between over- and under-watering.

Saving water by paying attention to the soil

The food gardener can make much better use of rain by **channelling** more rainwater directly to the vegetable beds, and by **improving the soil** so that it can take and hold (store) more water.

- To channel rainfall run-off to the vegetable beds, the gardener needs to look at where water normally runs in his/her yard during a rainstorm, and then dig shallow ditches and bunds (earth ridges) where necessary so that from then on, water will flow directly to the vegetable beds. However, in heavy rainstorms the water can be too much, and may wash the vegetable beds away. To prevent this, she/he can shape special bunds to form 'escape routes' for the excess water.
- There are various ways to improve the garden soil to save water. The idea is to make the soil softer and deeper so that more water can sink into the soil (improved infiltration) and so that the soil can hold more water for longer (improved water holding capacity). A very effective way for a food gardener to create a permanent deeper layer of soft topsoil, is 'deep trenching', and this is discussed in Chapter 6 in considerable detail.

Saving water by using better watering methods

The water lost in irrigation, is all the water that is applied but can't be taken up by the plant roots. Therefore, good irrigation methods are those that minimise the main 'water loss culprits', namely:

- Evaporation;
- Deep percolation;
- Water applied where the plants are not growing; and
- Uneven distribution of water, meaning that some plants get too much, while others get too little.

Managing water applications better

It is impossible to irrigate without losing some water, but irrigation efficiencies can improve dramatically, just by taking some more care to avoid these 'culprits'.

In the case study below, we can see the range of possible water losses with a sprinkler irrigation system, and how we can avoid many of these losses.



Case study 1: Types of water losses in irrigation

Water losses in sprinkler irrigation systems

Sprinkler systems (*tjarra-tjarras*) spray water through the air (evaporation during application), and wets a large area (not only where the plants are actually growing). If the system is left running for too long at a time, water may soak beyond the depth of the plant roots (deep percolation), but if it is switched on only for a short while every day, only a thin top layer of soil will get wetted and will quickly dry out by sun and wind (more evaporation losses).

Some ideas to minimise irrigation losses

Without changing the irrigation system (sprinkler), irrigation efficiency can be improved dramatically by:

- Irrigating during cooler times of the day, and thereby reducing direct evaporation;
- Applying a deep irrigation, so that the evaporation from the soil surface is a smaller percentage of the total water applied; but
- Avoiding deep percolation by measuring how deep the water infiltrates into the soil; and
- Trying to still make best use of every rainstorm, so that irrigation is needed less often.

Using organic matter to save water

Soil structure plays a critical role in soil water management. The fact that organic materials and minerals are mixed together creates a kind of balance between the forces:

- In a sandy soil the presence of organic matter and humus promotes water retention, so that the soil will not dry out so quickly; and
- In a clayey soil the presence of organic matter is good for drainage, because it creates water channels in the soil.

Using the correct irrigation technology for the circumstances

Different irrigation methods perform better in different circumstances. Irrigation methods that are good at avoiding the 'water loss culprits' under specific conditions are the following:

Drip irrigation is good at reducing both direct evaporation as well as evaporation from the soil surface. However, be warned! Drip irrigation can be very bad on coarse sandy soils where water runs straight down without spreading sideways in the soil to reach the plant roots (deep percolation losses).

Drip systems also need careful management, because the drippers can easily become blocked without the gardener noticing it! Also, gardeners often find it hard to believe that the plants get enough water, because there could be just a small wet patch on the soil surface. More than with any other type of irrigation, with drip systems it is important to take a spade and dig to see where the water goes. Do this as often as you need to until you know your system well, and how it reacts on your soils.

Drip systems cost money and a food insecure family may not be able to afford the replacement costs.

Flood irrigation is generally believed to be wasteful, and this is true where this method is carelessly applied. However, with proper planning and care, efficiencies of 90% and higher are possible. Water can be lost to evaporation and percolation in the canals and ditches transporting water to the vegetable beds, and through deep percolation in the vegetable beds if too much water is given at a time. The common problem of water losses through too shallow watering does not occur with flood irrigation.

Efficiencies are greatly improved by levelling out the beds so that water can spread evenly across the entire bed. In deep trenched gardens, the ditches around the brim of each trench bed should be nice and level and the top surface of the trench bed should also be level, or shaped into small subdivisions to enable the gardener to share water evenly across the bed.

Similarly, making a basin around a tree helps to keep the water in place until it has infiltrated where most of the tree's roots are.

Chapter overview

In the introduction above, we have briefly summarised the key things that a rural household can do to get further with the water they can get hold of. We will give more detail on all of these later.

- You will remember that in Chapter 1, the water situation in the world and in South Africa was introduced, as well as some of the policies and laws that govern water use. In this Chapter we will take those thoughts a bit further, and develop a better understanding of the **actual day-to-day problems of water supply in rural villages.** We will also look at planning and facilitation methodologies that have been developed to address the problems (problem tree, SWELL, etc).
- **Looking at water from a rural household's perspective** we will look more closely at the quantities and qualities of water needed for different homestead uses, and potential water sources for these purposes. We will look deeper into how a food gardener in a rural village can make the best use of the water they can get hold of, in an affordable and effective way for their circumstances. Particularly, we will consider how garden layout and irrigation approaches can improve water availability for food gardening:

In section 5.4 we will look at the question of "how much"?

1. **How much** water does a rural household **need** for its different purposes? What are the quality requirements for different purposes? How much can be recycled from each of these uses?
    a. Safe water for drinking and cooking
    b. Water for hygiene and washing
    c. Raw water for production like food gardens, livestock (poultry, goats, sheep, cattle), brick-making, etc.
2. Water **sources**: Where can a rural household get water from, and **how much** can they hope to get from the different types of sources?(municipal water, recycled water, rainwater, local boreholes, springs, streams, rivers)
3. How can a household **balance** their available water with their different water needs across the seasons?

In Section 5.5 we will focus on making the best use of rainwater:

4. How can a household lay out their yard to capture and use **rainwater**?
    a. Principles for layout planning (to make the best of water, sun, wind, frost);
    b. Deep trenching to improve water infiltration and water holding properties of the soil;
    c. How to turn run-off into run-on (including the infield rainwater harvesting technique); and
    d. The "Helicopter Planning" technique to put it all together.

In Section 5.6 we will learn how to plan and manage water use in the home food garden:

5. **Applying** water sensibly: how to get the most from stored water. Answering questions like:
    a. How much and how often should one irrigate?
    b. How do you know how deep the water went into the soil? How do you

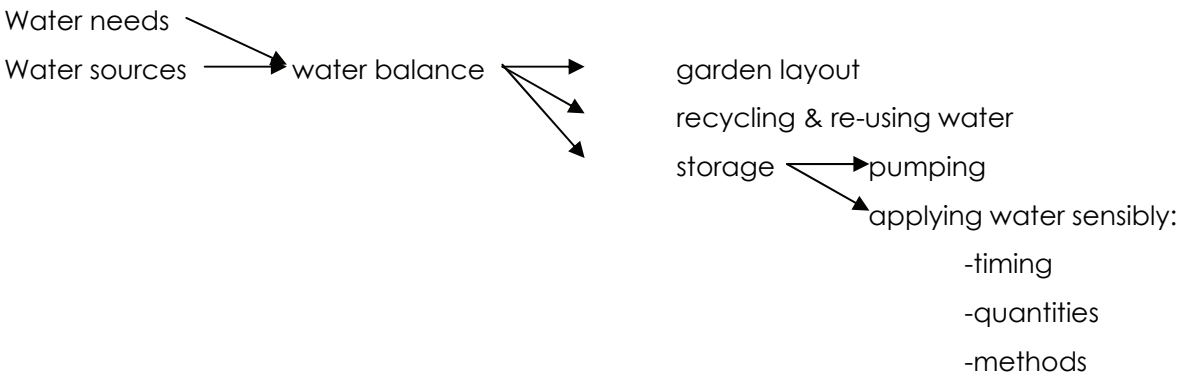
know when it is time to give the next irrigation?

c. What irrigation technology could you use in your circumstances (short furrows, basins, sprayers/sprinklers, micro sprayers, drippers)?

In Section 5.7 we will look at technologies which are suitable for use by rural households:

6. Water **storage** needs and options for rural households.
7. **Pumping** options.
8. **Operation, maintenance and self-monitoring** in homestead water management.

Below is a flow diagram that represents the logic for how this chapter is organised.



5.2 Day-to-day water problems in rural areas



We can keep water and manage it, but we cannot make water! Why are our boreholes running dry? Why is there less water now than before? Where did it go? Why are so many rivers silted up and contaminated? Why are so many of the water supply systems so unreliable: giving water only some days instead of continuously, as they were designed to do? What is happening?

To understand this better, we have to look at where South Africa is in its history, and think about our successes and failures as a country. Many of the problems we face will take many years to solve; therefore rural households are interested in what they themselves can do in the meantime to improve their own situation – and in some cases, just to survive.

The South African water governance context

Laws and policies

Soon after the 1994 democratic elections, the new government introduced major reform of water policies and law in South Africa. Water resources are now managed in terms of the National Water Act (Act 36 of 1998), which recognises basic human needs and water for the environment, calling this the Water Reserve, and commits South Africa to the honouring of water agreements with neighbouring states. All other water uses are subject to term-specific allocations.

A separate Water Services Act (Act 108 of 1997) governs water supply through Water Services Authorities (WSAs), which are mainly the 42 wall-to-wall District Municipalities covering the country, and Water Services Providers (WSPs), which may be local municipalities or other bodies authorised by the WSA. Municipalities are further subdivided into Municipal Wards (several villages grouped together), which is the normal unit for planning of municipal services and activities.

These municipal structures are in their infancy and have a very wide range of responsibilities, which places tremendous strain on their ability to develop and manage water supplies to vast underserviced areas (De Lange, 2009).

To make matters worse, there is a tremendous shortage of engineers (Lawless, 2007) and other technically-qualified people in South Africa. This is a very serious problem, because water supply (planning, design, installation and operation and maintenance) is a specialised technical matter! Further, managers of water supply divisions need excellent technical skills in water supply, as well as a thorough and sympathetic understanding of people's needs and realities on the ground.

Due to this shortage, government has established a list of 'scarce skills', which will be targeted to improve the situation.

Implementation programmes for water

Post 1994, the national Department of Water Affairs and Forestry set in motion a tremendous effort to reach unserviced populations with clean drinking water. This function was later devolved to the municipalities, as described above. In more recent years, a major focus on sanitation services was added.

In the drive to reach some 12 million unserviced people, several approaches were adopted that are of relevance to this study:

- Firstly, in an attempt to reach as many people as soon as possible, a policy was adopted to supply all people with 25 litres per person per day, within 200 m of the dwelling. At the same time, payment for services was introduced (there was no system of payment for water in the rural villages pre-1994). Later, the concept of Free Basic Water (a free lifeline supply of 6kl per household per month) and the 'water ladder' was introduced by Ronnie Kasrils, a former Minister of Water Affairs and Forestry, which signified that government was committed to ensure 'some, for all, forever', and would follow with improved services over time;
- Secondly, a decision was taken to pursue bulk supply and reticulated systems, since these were believed to be more affordable, and easier to implement and manage than smaller dispersed and stand-alone systems;
- Thirdly, in the drive for supply, there was little capacity to spare for the preparation of proper operation and maintenance of both existing and new systems. Today, there is growing pressure on water sector players to address this aspect as a matter of urgency, as many systems are falling into disrepair.

Changes in thinking: multiple water uses, sources and systems

There is now growing recognition that the RDP level of supply, namely 25 litres per day (ℓpd), is inadequate to enable the poorest of the poor to engage in a wide range of economic activities – should they have access to more water.

Also, it is being argued that it may be economically more advantageous to supply sufficient water from the start, instead of a 'water ladder' approach:

- Partly because this would avoid having to add onto system capacity later; and
- Partly because the increased amounts of water could enable economic activities that would enable payment for water services, thereby rendering the systems more economically viable from the start.

Several factors have also created a more favourable environment to move away from the singular focus on bulk and reticulated water supply systems, and to consider a range of alternative systems to augment bulk supplies:

- Problems with the reliability of supply due to inadequate operation and maintenance have created the need for 'fallback' supplies which are more easily within the control of rural communities; and
- The realization that most economic activities do not need a purified source of water means that a range of other systems can be reconsidered, such as roof and surface harvesting of rainwater, springs, stream diversions and boreholes fitted with handpumps and other manageable devices.

In this context, the concept of Multiple Use Systems (MUS) provides a focal point for a range of ideas in the current water supply context in South Africa, and can play a significant role in shifting and organising the thinking of players in the water sector.

Further, recent world events, especially the unprecedented rise in food and fuel prices, has helped South Africa move beyond the dangerous argument that alternative water supply options and uses are just veiled attempts 'to keep poor people poor.' Rather, we need to enable people to be as productive as they can be, whenever they may happen to be without formal employment and income.

Rural water supply, like poverty, needs multiple strategies to increase access and reduce risk.

What is the Multiple Use Systems (MUS) approach?

To understand the MUS approach to water supply, we need to realise that:

- Households have a range of water needs for different uses;
- Not all of these uses require purified water; and therefore
- A range of water sources can be used to help satisfy the different water needs if the household (not just purified water from normal municipal water supply systems).



Activity 1: Household water uses, users and sources

Aim:

To develop a better understanding of the range of water uses, users and water sources in a rural context.

Instructions:

Look at the pictures of water users, water uses and water sources on the next page.

Think of a household in a rural village that you know well (you may use your own homestead as an example, if you wish).

From the viewpoint of the household:

- Select from the pictures the water users, uses and sources that currently apply to them, and add further ones you can think of. Draw lines to link the household's current water uses with the water sources that currently supply water for these uses.
- Next, select further water sources that this household could possibly use in future. Link these sources to possible uses. Use different colours to link the current and future uses to their possible water sources.
- For each of the additional water sources, write down what a household would have to do to get access to these, including what permission they would need, physical work they would need to do to bring the water to where they need it, how they would need to collaborate with other households to get this water, etc.
- List the constraints they will have to overcome to get hold of this water (social, financial, legal, etc.) and ideas of how to overcome the constraints.



From: AWARD

Figure 1: Rural water users, uses and sources

SWELL – a new planning method to provide water for poverty reduction

In "chasing the backlogs", municipalities' planning of water supply have concentrated on trying to supply 25 litre of purified water per person per day, and have not attempted to supply water for other uses in rural homesteads.

In Chapter 1 we discussed the groundbreaking study in Bushbuckridge, where the Association for Water, Agriculture and Rural Development (AWARD) found that villages with more than RDP levels of water supply had **double the level of local economic activity** compared to villages where only 25 litres per person per day was available to households. This finding showed the importance of water as an enabler or catalyst, for development at these poorest levels of society.

This finding by AWARD has helped to change our thinking in South Africa about the importance of 'water for productive uses for the poor', and helped to change some of the policies of the Department of Water Affairs and Forestry to be more 'pro-poor'. AWARD's finding was also one of the cornerstones that lead to the new worldwide concept called Multiple Use Systems (MUS) for water supply planning.

But how can these findings be put into practice?

AWARD followed up on their work on water for productive uses, by developing a **planning method for municipalities to work with ordinary people on the ground** in villages, to identify their needs and possible sources for water for productive uses. This method follows the same planning steps as for Integrated Development Plans (IDPs) and is called **SWELL** for **"Securing Water to Enhance Local Livelihoods"** (Maluleke *et al.*, 2005).

SWELL is a participatory method, which draws the responsible people in the various government organisations and village groups together to analyse and plan how to solve the specific water problems in a specific area. The officials bring their expertise and knowledge about what government can and can't do, while village groups bring their knowledge about the day-to-day realities of water supply in their neighbourhood, as well as their vision for productive water uses so that these can be addressed in water supply planning.

Before the idea of 'multiple sources, systems and water qualities' became known, officials could not even consider listening to such requests for more water, because they could not even cope with supplying the RDP levels. Now there is new hope that households could get access to more water in a practical way.

The diagram **'What is SWELL'** shows (in the right-hand portion of the diagram) the organisations that take part in the participatory planning process. This means that together they develop a better understanding of the livelihoods and specific productive water needs of people in that village or ward (shown in the left-hand portion of the diagram). The quantities and qualities of these water needs and potential sources for that village can then be calculated, so that multiple, separate and integrated systems can be designed and implemented to address these needs over time.

The example on the next page shows a **problem tree** developed by SWELL participants for specific water problems in Ward 16 in Bushbuckridge.

Figure 2: What is SWELL?

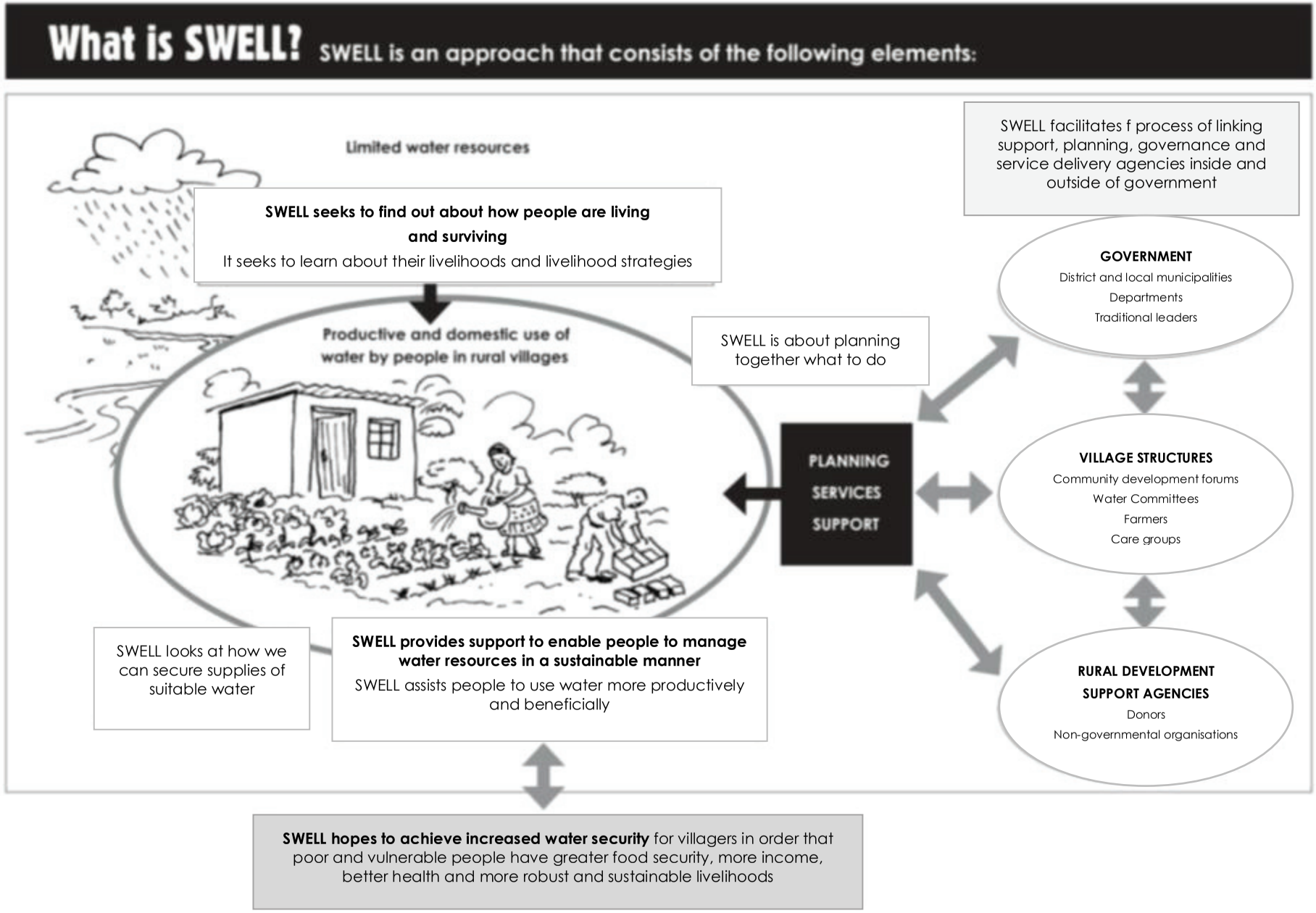


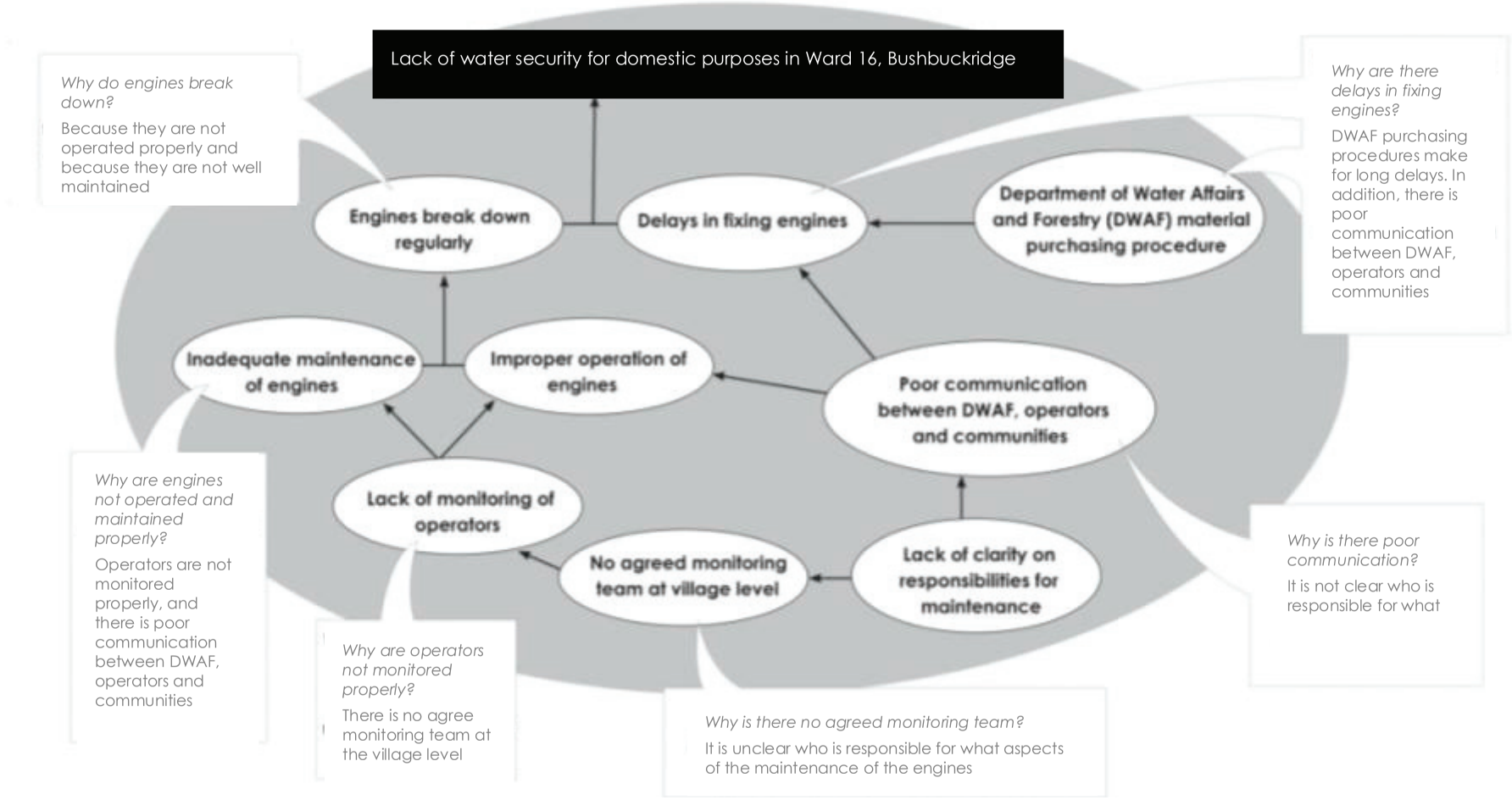
Figure 3: SWELL 'problem tree': water issues in Ward 16, Bushbuckridge



Participants in a SWELL workshop in Bushbuckridge identified the different causes of the lack of water security. These causes are shown in the form of a problem tree in the diagram below. A problem tree is useful to show linkages between the causes of a problem and to provide a holistic view of the problem

Problem tree (part of a problem tree designed by SWELL participants)

The problem tree below shows how the supply of water for domestic use in Ward 16 in Bushbuckridge is caused by the fact that engines frequently break down and that there are long delays in fixing them. Let's take a closer look at the problem tree to see how it works. The arrows indicate the causes of the problems experienced by the community, thus building a picture of the underlying or root causes and showing how they are connected. Each arrow raises a different question and leads us to a different interlinked cause



The steps in the SWELL methodology follow the IDP planning steps as follows:

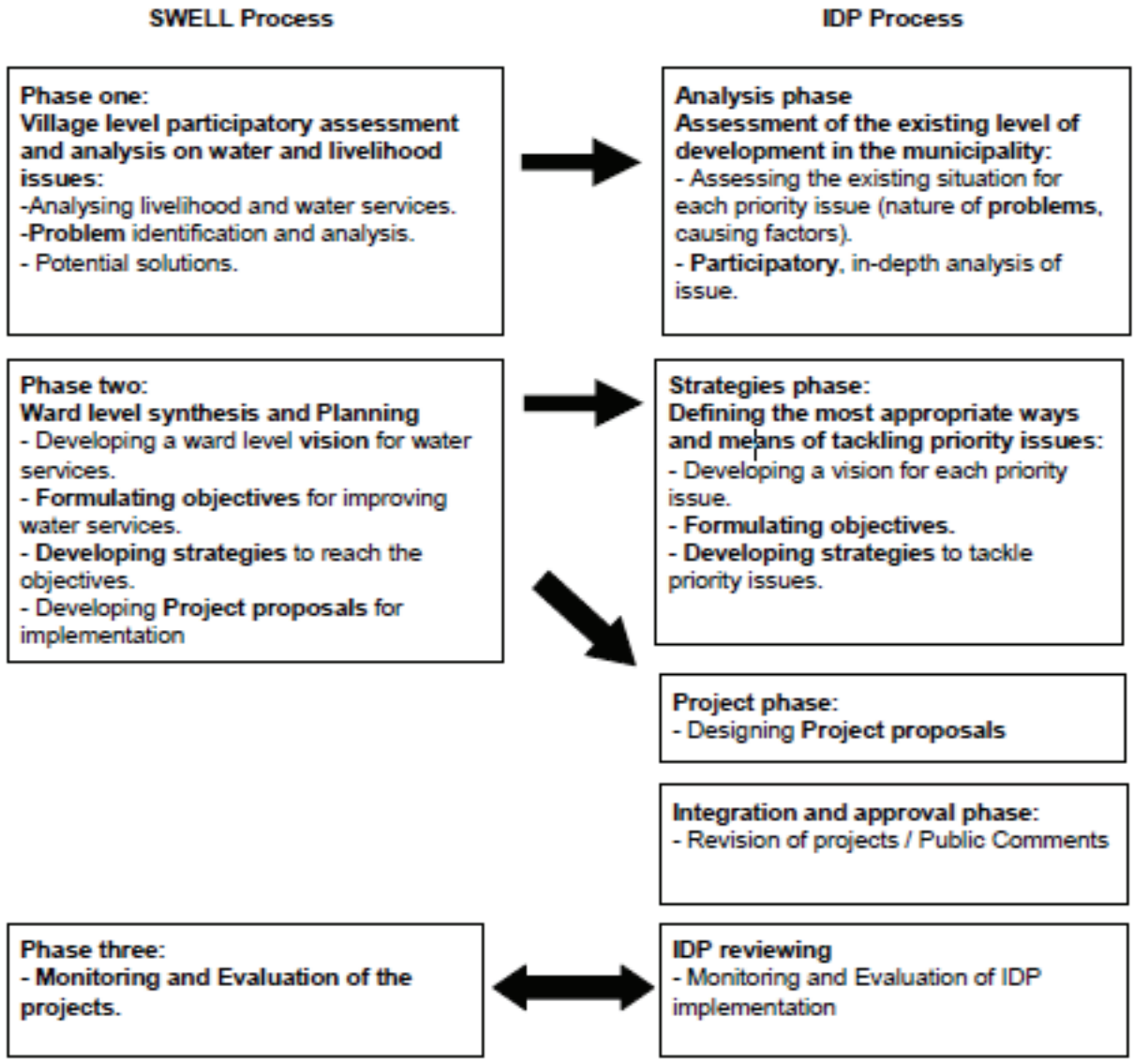


Figure 4: Steps in the SWELL planning method (Maluleke *et al.*, 2005

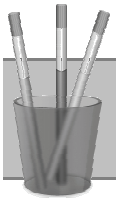
The SWELL steps in Figure 4 above, can be summarised as follows:

- **Phase 1** is at village level, looking in-depth at water and livelihoods issues.
- **Phase 2** is at Ward level, to synthesise findings, develop an integrated plan for the Ward and come up with project proposals for implementation.
- **Phase 3** is monitoring and evaluation of the projects.

5.3 What can individuals do?

Let us not be tempted to think that nothing can be done just because these processes take time. Individuals, households and farmers – every one of us – can help to save water, as we already have a major impact on water and our environment. Anyone can help to make a difference without even engaging the water committee! What can one do? All of us can use water sparingly, avoid polluting it, and use every opportunity to help protect water sources.

Individuals' impacts in the water cycle



Activity 2: How do I impact on water?

Aim:

To identify where the individual can intervene in the water cycle, and have both positive and negative impacts.

Instructions:

Study the picture of the water cycle below. Think about where you, as an individual, would be able to intervene, or manage our water.

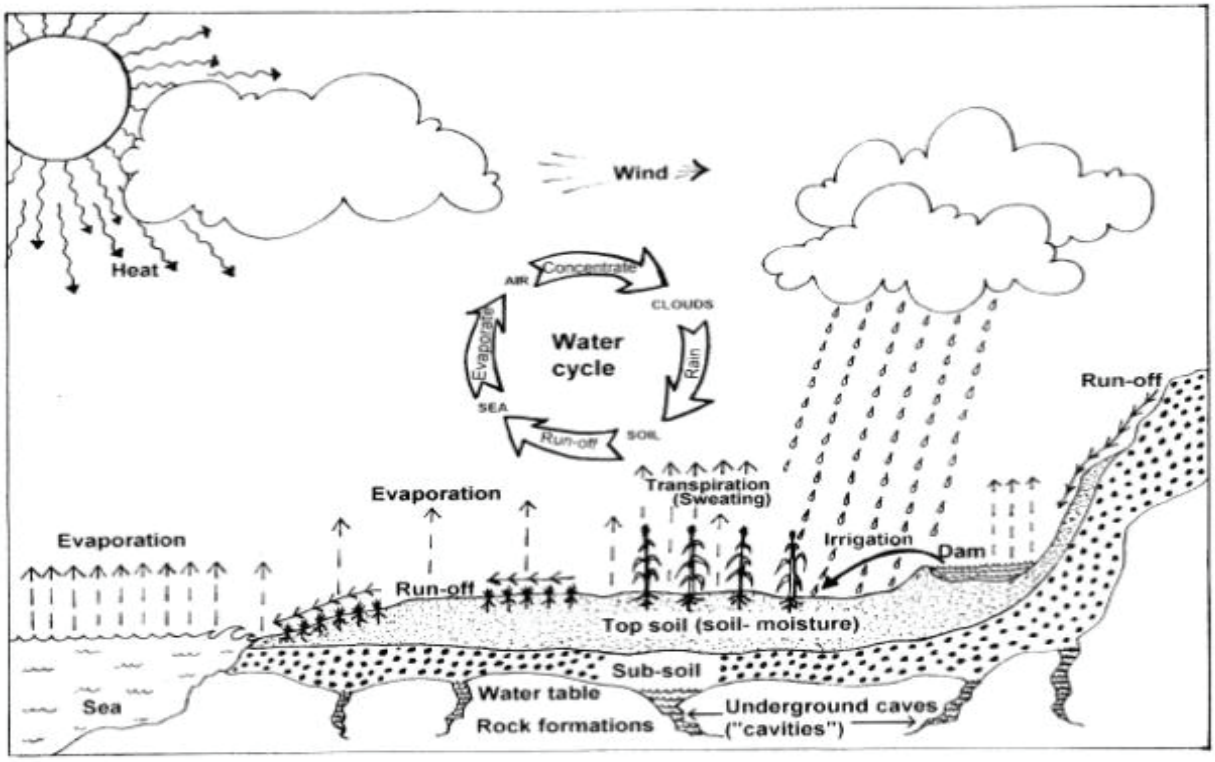


Figure 5: The Water Cycle

In the water cycle we see that water falls on an area through rain:

- In South Africa's dry climate, most of this rainwater evaporates immediately.
- The rest of it runs off towards lower-lying areas and eventually to the sea. From here it evaporates to, once again, form rain.
- On this downhill journey, some of the water infiltrates into the top- and subsoil, and some of it seeps even deeper until it joins the groundwater.
- Water in the top 10-15 cm of the soil can still be lost to evaporation when the air starts to dry out when the rain has passed. This happens much more quickly when the wind blows, and when the soil is bare (i.e. with no plants or mulch on it).
- Water in the 'root zone' (where roots grow) can be taken up by plant roots and used for transpiration (the plants 'sweat'). Without this process, we will have no grasslands, forests or crops – and no food!
- Evaporated and transpired water goes back into the air, to once more become rain.

Now think about the area where you live and work, and write down your answers to the following questions:

1. How are you and your household currently impacting on the water in your own area? Think of negative impacts (polluting water, overusing water, allowing water wastage, etc.) and about positive impacts (saving water, protecting it from getting polluted, preventing too much evaporation, etc.)
2. What more can you and your household do to use more water productively out of the whole water cycle? And to protect the water from evaporating unused? And to prevent water pollution? Write down all your ideas on how to impact positively on the water cycle.

Time: 2 hours

How individuals have improved our water resources

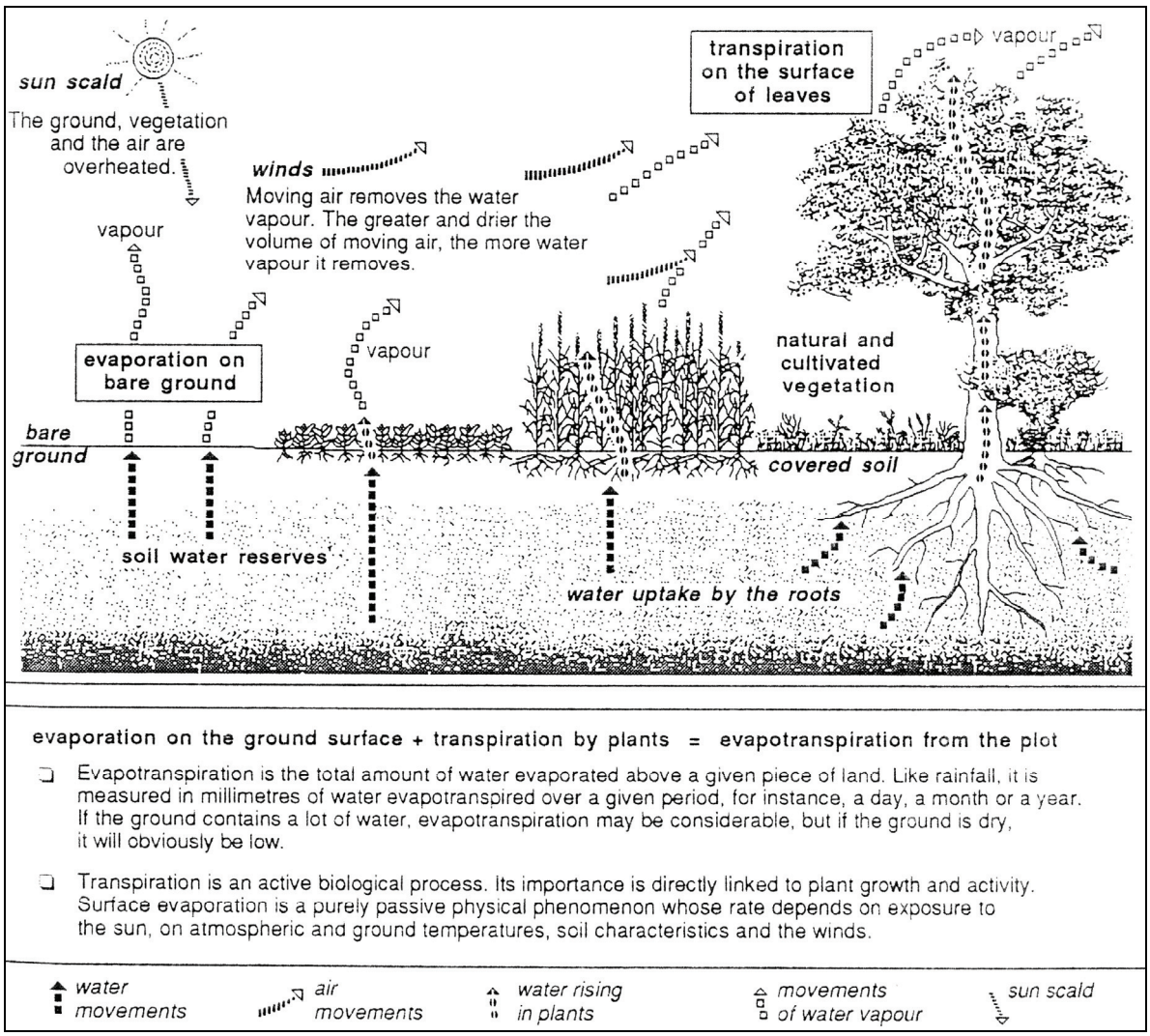
It is possible for a household, even in a dry area, to create a small oasis at home. In this Chapter you will find several examples of what individuals were able to achieve in the rural areas. There are examples of the following:

- Groundwater recharge (in this section)
- Spring protection
- 'Farming with water' – a case study of Mr Phiri's farm (in this section)
- 'Water for Food' – a case study of Mma Tshepo's home food garden
- Emily Masha's luscious garden in dry Sekhukhune (rainfall only 440 mm per year).

Groundwater recharge

Water that enters into the soil can take the following two possible routes:

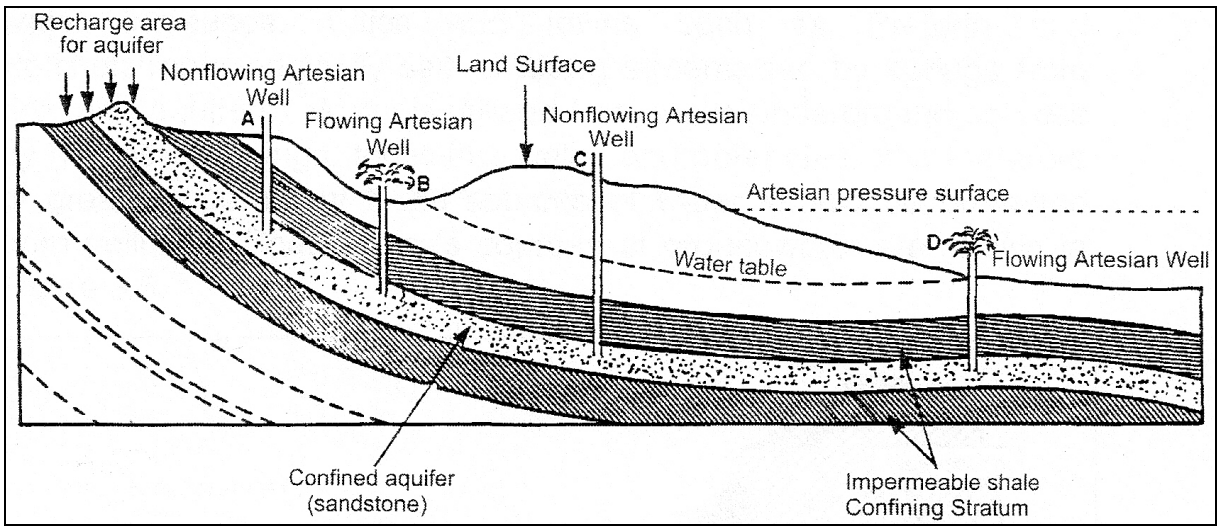
1. **Firstly**, water can be absorbed by plants and trees which transfer it back to the atmosphere/air through **evapotranspiration**. Plants wilt and become stressed if they transpire ('sweat') more water from their leaves than they can draw from the soil. Plant roots can only draw water from the soil within their 'root zone', that is where their roots are growing.



From: Ways of Water, CTA, 1990

Figure 6: How evapotranspiration works

2. **Secondly**, when there is enough rainfall, the water will seep deeper into the earth to be stored in aquifers. **Aquifers** are cavities and cracks in underground rock formations that store water – this water is called '**groundwater'** and the top of the groundwater 'surface' is called the **water table**. In high rainfall periods the groundwater increases, so the water table pushes up (rises), and in dry periods the water table drops down lower below the ground surface.



From: Vista University, 2003

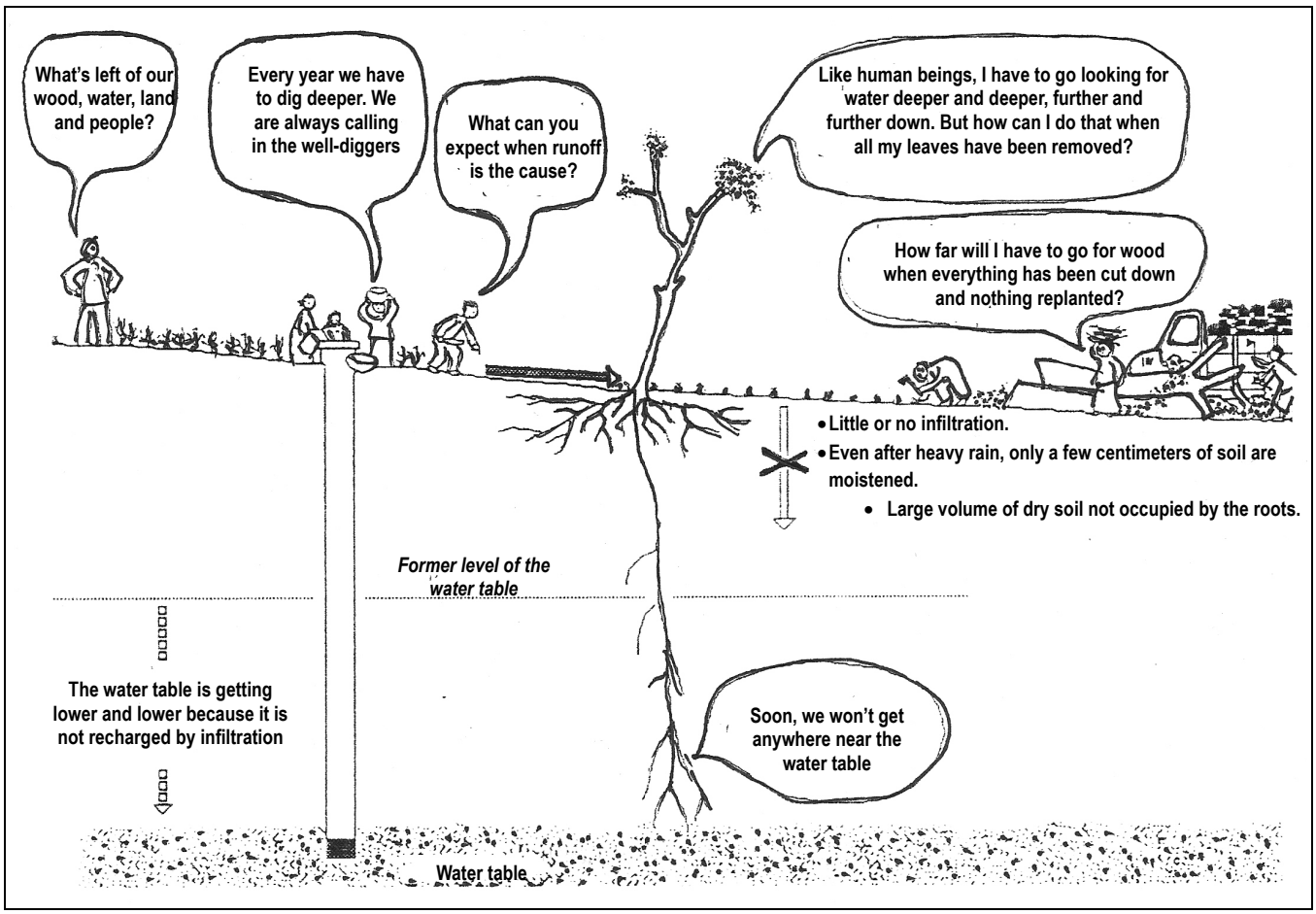
Figure 7: What happens to water under the ground

When the water reaches an *impermeable* layer of rock (e.g. shale or mudstone), it will follow the slope and can eventually emerge on the surface as a spring or the source of a stream or river.

Impermeable:
Doesn't let water through
Base flows:
Sustained low flow in a river during dry weather conditions

Aquifers are related to seepages, wetlands, spring flow and river base flows, but the relationships of flow and recharge are complex and not well understood. The springs and their related ecosystems may be vulnerable to large-scale groundwater abstraction. It is possible also that over-pumping can permanently deform aquifers, leading to the collapse or closure of water bearing fractures. Stressing of an aquifer by over-pumping can also increase the salinity of the water. The mean annual recharge of aquifers varies between 2-4% of the annual rainfall.

Groundwater recharge is also related to the vegetative cover of the land. The two pictures below give an indication of how it works.

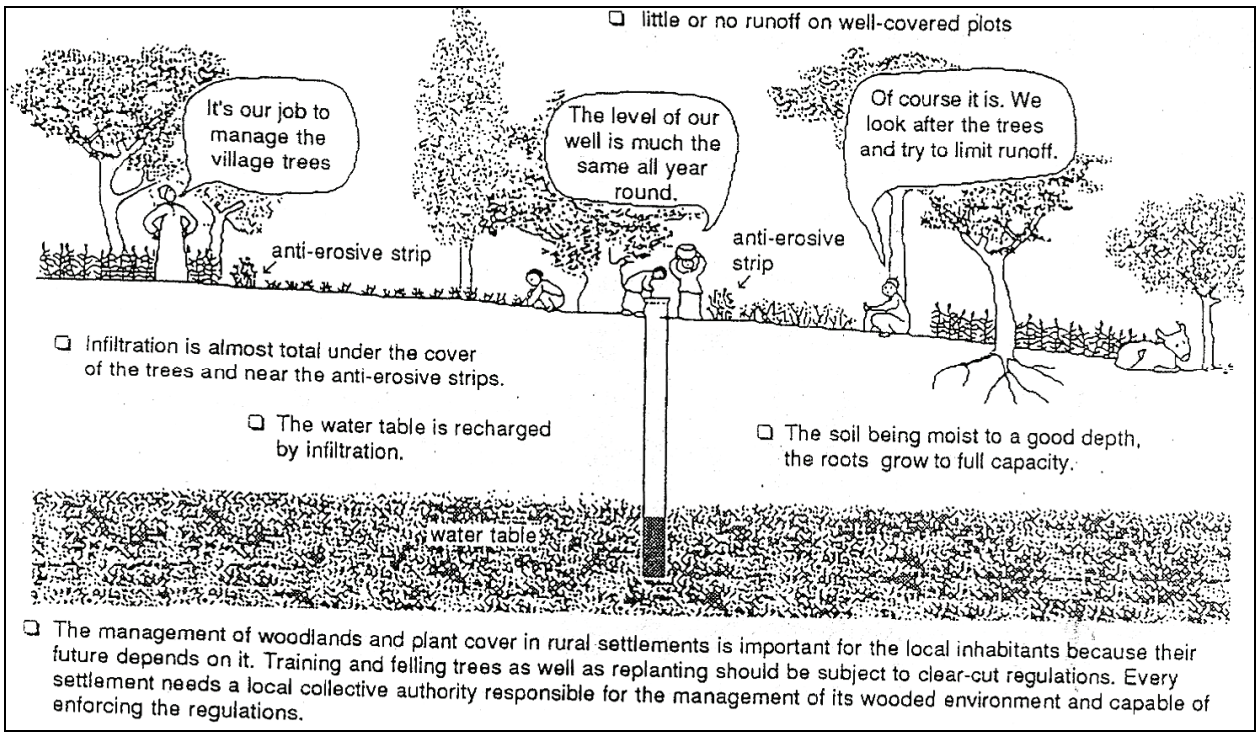


From: Ways of Water, CTA, 1990

Figure 8: A lack of vegetative cover reduces the water table

The picture illustrates what happens to the water table and groundwater when resources in the environment are extracted or taken away without replenishing them. We tend to think plants use all the water and that there should be more water if we remove them. This may be true of alien trees, which act like huge pumps that extract water from the soil every day. However, if we removed indigenous vegetation, groundcover reduces and the surface of the soil becomes hard. This results in higher runoff rates and there is little or no infiltration of water. The area becomes drier all the time and it is difficult for plants and trees to survive, resulting in even less vegetation, again causing less infiltration. Boreholes and wells dry up.

Other natural resource problems such as accelerated soil erosion, loss of fertile topsoil and the development of dongas are also results of this cyclical process – all initially caused by loss of vegetation. The picture below illustrates the outcome of management of groundcover (such as trees and crops) on an environment.



From: Ways of Water, CTA, 1990

Figure 9: Increasing infiltration to protect the water cycle

Rivers have a sustained flow, because most of the water is actually stored in the soil, where it slowly releases into the drainage or stream. In disturbed catchments ('watersheds'), this slow and sustained release of water is disrupted. Water runs rapidly off the ground's surface, rather than soaking in. This process creates floods followed by drought (Lancaster, 2008).



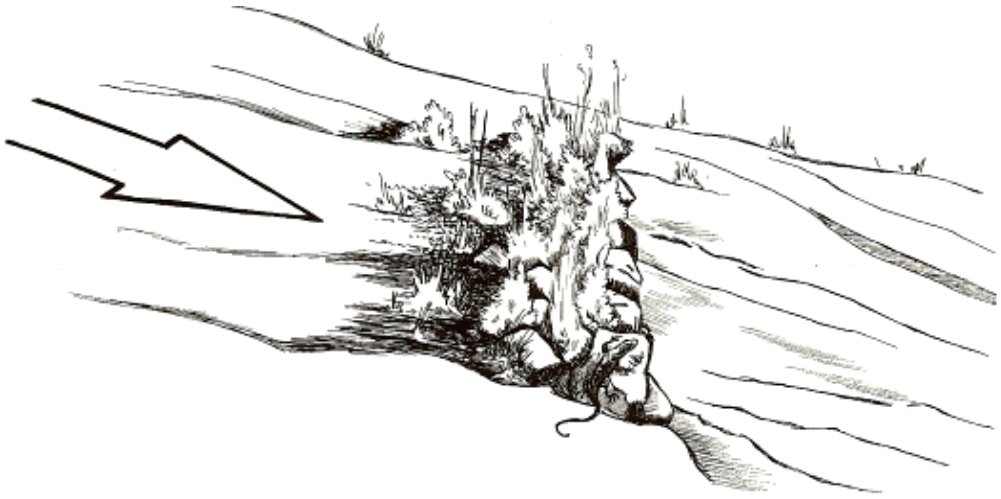
Case study 2: Farming with Water: Mr Phiri

Mr Zephaniah Phiri Maseko has lived and worked on his family land holding (3 hectares), in one of Zimbabwe's driest regions for over 30 years. He has created his "garden of Eden" and over the years has taught many others to do the same.

The farm is on a north to east sloping face of a hill (providing good winter sun). The top of the hill is a large, exposed rock (a granite dome) that creates a lot of storm water run-off. The average annual rainfall in the area is around 570 mm. Droughts occur often.

When Mr Phiri began, it was very difficult to grow crops successfully, let alone make a profit. He had no money for deep wells, pumps, fuel and other equipment. Mr Phiri started his farming with long and careful observation. He noticed that where the run-off from rain went unchecked (not slowed down) very little infiltration took place. He then noticed that the soil remained moist for longer in small hollows/depressions. This also happened up slope of rocks and plants (where the rainfall runoff is slowed down and can infiltrate between rocks and plants). He realised that he could mimic or copy this process and enhance areas of his land where soil was remaining moist for

longer. Thus began his water farming.



From: Lancaster, 2008

Figure 10: Trapping water creates fertile areas

More water, soil, seeds and life gather where their flow across the land is slowed down (here by the rocks packed on the contour). The arrow indicates the direction in which the water flows

Beginning at the top of his catchment, Mr Phiri built low stonewalls here and there on the contours. These 'check dam walls' slow down and spread the flow of storm run-off water. This controlled run-off from the large rock (at the top of the hill) is then directed to two earth dams just below (one large and one somewhat smaller). These dams were dug out by hand.

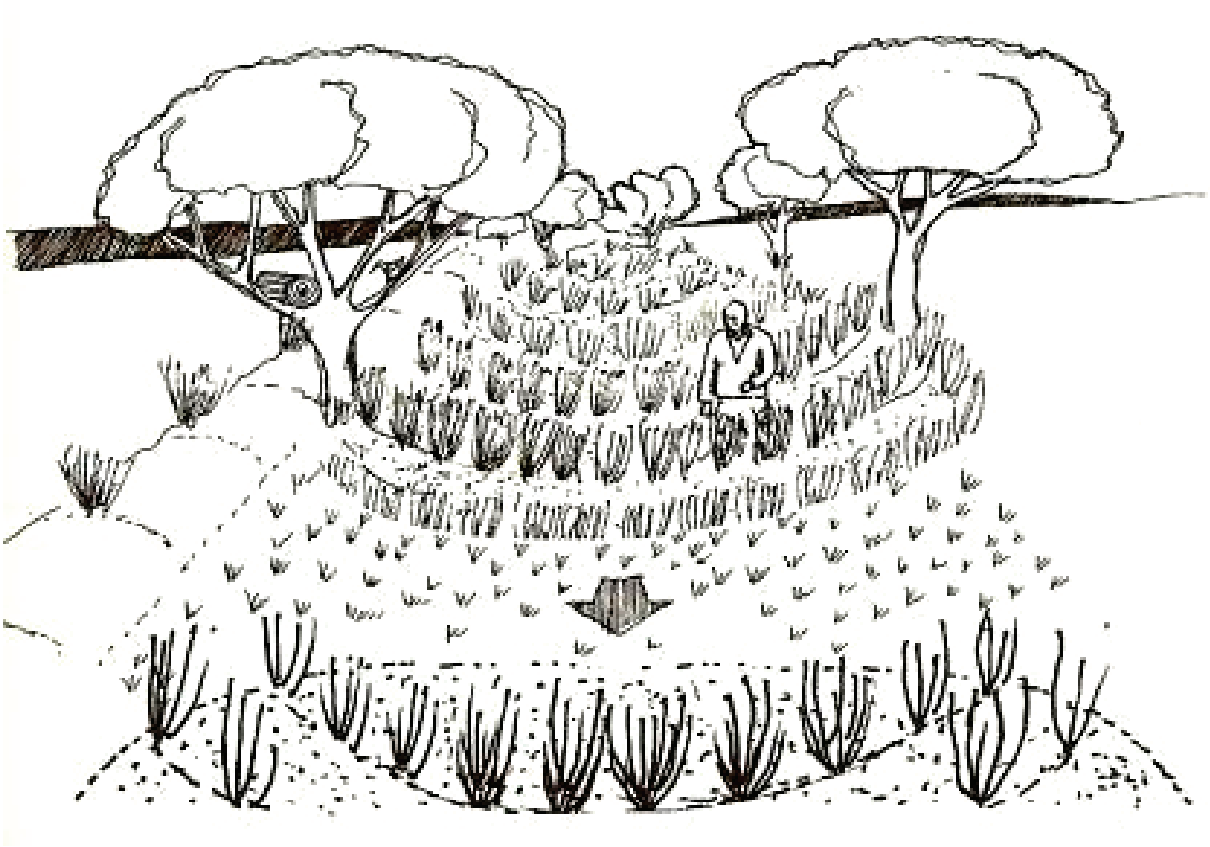
The water in the larger dams seeps straight into the ground over a period of time. The overflow from the smaller dam is directed via a short pipe to an above ground ferrocement (steel reinforced concrete) tank that feeds the family's vegetable garden during dry times. Another tank, shaded and cooled by a granadilla vine, captures drinking water from the roof of the house. Besides these two tanks, all water harvesting structures on the farm directly infiltrates water into the soil.

Numerous water harvesting structures act as 'nets' that capture the flow of the surface run-off and quickly infiltrate the water into the soil, before it can evaporate. These include:

- **Check dams** (small stone walls placed within drainages across the waters' flow);
- **Vegetation** planted on contours;
- **Terraces** (built-up level fields or beds);
- **Berm-n-basins** (dug out basins with earth and plant banks, laid out on contour);
- **Infiltration basins**; and
- **'Fruition pits'**. These are large basins dug out in the bottom of drainage lines (3 meters long, 2 meters wide and about 2 meters deep). When it rains, the pits fill up with water and the overflow fills one pit after another. Long after the rain stops, water remains in these pits, infiltrating into the soil. These fruition pits feed the groundwater table as well as the plants.

Thatch grass, fruit trees and timber trees have been planted in and around the fruition pits. Mr Phiri explains with a smile: "I am digging fruition pits and swales to

plant the water, so that it can germinate elsewhere. (See the explanation of swales and contour bunds below.)



From: Lancaster, 2008

Figure 11: Sketch of Mr Phiri standing in a "fruition pit" full of thatch grass

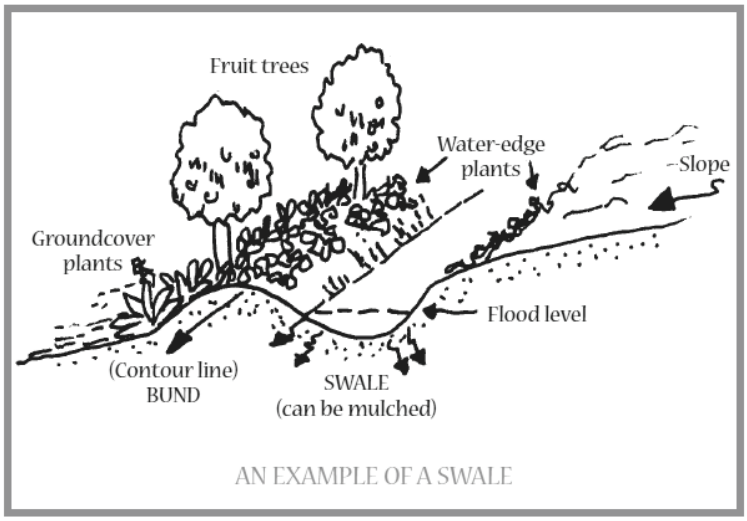


1. Granite dome
2. Unmortared stone walls
3. Reservoir
4. Fence with unmortared stone wall
5. Contour berm/terrace
6. Outdoor wash basin
7. Chickens and turkeys run freely in courtyard
8. Traditional round houses with thatched roofs
9. Main house with vine covered cistern
10. Open ferro-cement cistern
11. Kraal – cattle, goats
12. Courtyard garden
13. Contour berm
14. Dirt road
15. Thatch grass and thick vegetation
16. Fruition pits in large diversion swale
17. Crops
18. Dense grasses
19. Well and hand pump
20. Donkey pump
21. Open hand-dug well
22. Reeds and sugar cane
23. Dense banana grove

Figure 12: Layout of Mr Phiri's farm
From: Lancaster, 2008

Swales / contour bunds

Swales are earth banks/ bunds built along a contour line. Earth is piled below the ditch rather than above. This is a very good way to concentrate water on the land. In this way, you can keep double the amount of water in your soil. The banks are planted with water loving and long living plants. The ditches fill up with soil over time and need to be cleared out when this happens. The soil should be cleared out and placed below the swale to prevent it running back in when it rains again.

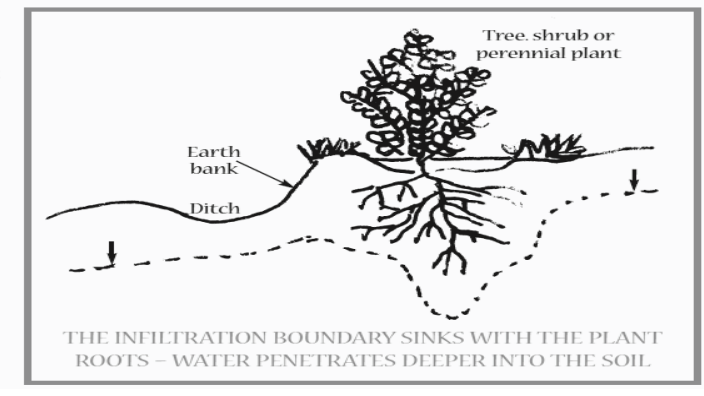


If this is not done, the trench fills up with soil and cannot serve the purpose of slowing water down so that it can infiltrate the soil. In addition, if the trench is filled with soil, then run-off water cannot be contained and will wash over the bund, possibly washing away plants and trees growing there.

Figure 13: Swales and contour bunds concentrate water on the land
From: Production without destruction, 1995

Earth Banks/ Bunds

Earth banks are built by digging a ditch across the slope, along a contour line. Whereas with a swale, the dug-out earth is placed below the trench, with a bund the dug out soil is placed above the ditch. Rainwater will accumulate above the earth bank/bund and in the ditch. This water will sink into the ground instead of running off your land. As soil is washed down the slope and accumulates behind the bank, a small flat terrace will be formed (LIRAPA, 2008).



Diversity of crops

Mr Phiri plants a diverse range of crops on his farm: basket reeds, pumpkin (squash), maize, peppers, eggplant, lettuce, spinach, peas, garlic, onions, beans, granadilla, mangoes, guavas and paw-paws, as well as a number of different types of indigenous trees.

Figure 14: Plant roots improve the infiltration boundary in the soil
From: Ways of water. CTA, 1990

Indigenous trees are those that occur naturally in the area. They are the best suited to dealing with the particular natural conditions. (Exotic trees come from other

places and may not grow as well. Sometimes exotic trees grow too well and compete with indigenous trees. They are then called invasive. This can be a big problem).

Mr Phiri's crops are planted on the terraces formed between the contour bunds and the swales. This diversity provides food security for his family: even if some crops fail, others will survive.

Open pollinated varieties

He only uses open pollinated varieties of crops and collects, keeps and plants his seed from one year to the next. Over time these crops become adapted to the drier conditions on the farm.

Adding organic matter to the soil

Mr Phiri has found that soils amended (improved) with local organic matter and nitrogen fixing plants (such as Pigeon Peas) infiltrate and hold water a lot better than those amended with synthetic/commercial fertilizers. He says: "You apply fertilizer one year but not the next and the plants die. Apply manure once and plant nitrogen fixing plants, and the plants continue to do well year after year". Note that another advantage of manure is that it is usually free, compared to the costs of synthetic, commercial fertilizers.

Hand dug wells

Towards the bottom (the lower lying areas) of the farm are hand-dug, unlined wells (except for one, which is lined and has a small hand pump, for household use). These wells are situated in the wetland in the low-lying area. The wetland helps to filter and clean the water. That is why it is good for household use as well. There is almost always water in these wells and even during a drought it is possible to pump water up from the wells for irrigation. Mr Phiri uses a donkey-driven pump for this purpose.

Wetland

A wetland lies below the wells at the lowest point. Here three aquaculture (fish-farming) ponds/dams are surrounded by a soil-stabilising grove of bananas, sugar cane and reeds. The fish are harvested for food and their manure enriches the water used to irrigate the fields. The taller vegetation creates a windbreak around the ponds (reducing evapotranspiration). The shorter grasses filter incoming run-off water into the ponds and feed his cows when in calf.

For years, Mr Phiri found himself in opposition to the international aid and government programs that were pushing for groundwater extraction and export crops as opposed to rainwater harvesting and local food production and distribution. As a response Mr Phiri formed a non-government organisation called the Zvishavane Water Resources Project that is spreading his techniques well beyond his area. He says: "It's a slow process. But that's life. Slowly implement these projects and as you begin to rhyme with nature, soon other lives will start to rhyme with yours".

5.4 How much? Water uses and sources for rural households

To **balance** water uses and sources to minimise periods of shortfall, one needs to know how much is **needed** at different times of the year, and how much is **available** from different sources throughout the year.

It is never possible to quantify needs or sources exactly, because in nature there are great differences from year-to-year, and people's activities and circumstances also change over time. However, it is possible to make good estimates!

The household can use their estimates to plan their own water supplies, and then, by keeping records of the actual situation over time, they can keep improving their planning from year-to-year.

This same basic approach applies at village, ward, municipal and national levels!

Rural household water needs

A rural household has a range of water needs, which includes:

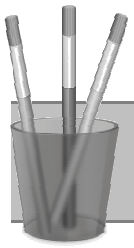
- Water that is **safe for drinking**;
- Water for **cleaning purposes**; and
- **'Raw' water for food gardening** and other productive purposes.

Next, one needs to estimate the quantities needed for each category before one can start one's planning. Table 1 provides typical values for water needs of rural households. Note that the cleanest water (potable water) can be used for anything, but is also the most expensive, and the scarcest water. Therefore, a household will get furthest with its water if it saves the high quality water for drinking and cooking. It goes even further if the household can reuse it for other purposes where possible.

Table 1: Typical values for rural household water needs, sources and recycling

Water use/water need	Typical quantities needed	Quality required	Suitable water sources	Recyclable portion and quality
Domestic water – safe for drinking				
Potable (drinking, cooking, dishwashing)	7 litre per person per day	Drinking standard	Treated municipal water; uncontaminated local springs, wells & boreholes; roof-harvested rainwater.	60% (mainly from dishwashing)

Water use/water need	Typical quantities needed	Quality required	Suitable water sources	Recyclable portion and quality
Domestic water – good for cleaning purposes				
Domestic non-potable (washing self, cleaning house, laundry)	65 litre per person per day	Clear water	All the above, plus surface-harvested rainwater (e.g. underground rainwater tank); local streams, rivers, dams.	70% (Good for raw water uses)
Water for production				
Vegetable gardening	Maximum 20 litre per m^2 per week (summer)	Raw water, but without toxins	All the above plus recycled water from above uses plus run-on and infield rainwater harvesting.	0%
Fruit trees	Minimum 20 litre per tree per week			
Poultry (Smith, 2006)	0.200 litre per adult chicken per day			
Small livestock	10 litre per adult goat per day (10% of bodyweight)			
	50 litre per adult cow per day (double for lactating animals)			
Cement-block making	20 litre per 20 large blocks or 40 maxi-blocks	Raw water (free from chemicals and silt)		



Activity 3: Estimating household water needs

Aim:

To quantify the needs of a rural household for water of different qualities.

Instructions:

Use the same homestead as for Activity 1 in Section 5.2 above.

Draw up a table similar to Table 2 below.

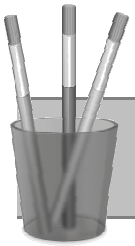
In the first column, list the household's current water uses.

In the second column (using the values in Table 1 above), calculate the weekly water needs for each use. Think carefully about the quality of water needed for each use.

Now estimate how much of the water used by the household can be reused, and add this up in the last column.

Table 2: Estimating the water quantities and qualities needed by a rural household

Water use/water need	Calculation	Maximum quantity needed (litre per week)	Recyclable portion (litre per week)
Drinking quality water (safe, potable water)			
Drinking, cooking & dishes (7 litre per person per day)	Number of people x 7 litre x 7 days		60%
Traditional beer making (30 litre water per 20 litre beer)	Litre of beer made per week x 1.5		0%
Cooking porridge to sell at market (3 litre water per kg of maize meal)	Kg maize meal cooked per week x 3 litre		0%
Traditional healer			0%
Other...			
Total drinking quality water needed per week		_____ litre/week	(___ Litre)[i]
Clear water (not purified)			
Bathing, washing & household cleaning (65 litre per person per day)	Number of people x 65 litre x 7 days		70%
Caring for the sick (including extra washing, 50 litre per day)	Number of sick people x 50 litre x 7 days		0%
Other...			
Total clear water needed per week		_____ litre/week	(___ litre)[ii]
Raw water (untreated)			
Vegetable gardening: backyard gardens, communal gardens. (Maximum 20 litre per week per m^2 planted area in summer; less 30% in winter)	Planted area (m2) x 20 litre		0%
Fruit trees (maximum 20 litre per tree per week	Number of fruit trees x 20 litre		0%
Poultry (200 milli litre per adult chicken per day)	Number of chickens x 0.2 litre		0%
Small livestock (10 litre per adult animal per day)	Number of goats + sheep x 10 litre		0%
Large livestock (50 litre per adult animal per day)	Number of cattle + donkeys + mules x 50 litre		0%
Cement-block making 20 litre per 20 large block or 40 maxi-blocks	(Number of large blocks) or (number of maxi-bricks/2) x 20 litre		0%
Other...			
Total raw water needed per week		_____ Litre/week	(0 litre)



Activity 4: Water for the garden – litres or millimetres?

Aim

To become comfortable with thinking about rainfall and watering the garden in terms of millimetres applied.

Instructions

We all know that rainfall is measured and reported in millimetres. You may hear on the radio or from a neighbour that a certain area had had 21 mm (or 2 mm or 120 mm) of rain the previous night. This means that a 'layer' of water, 21 mm deep, had fallen on the surface of the earth. (Part of this layer of water soaks into the ground, and part of it flows along the soil surface down to a river as 'run-off'. Quite a lot of it evaporates back into the air even before it reaches the river – mostly only about 10% ends up in the river.)

Rainfall:

In a 21 mm rain event, how many litres would have fallen?

1. On a roof of 10 m long by 6 m wide?

   Remember: Volume=length x width x depth

   21 mm=21 ÷ 1000 =0.021 m [because 1 m=1000 mm]

   Volume=length x width x depth=10 m x 60 m x 0.021 m=1.26 m^3

   1.26 m^3 = 1.26 x 1000 =1 260 litres [because 1 m^3 =1000 litres]

   You can simplify your calculation as follows:

   Volume=length x width x depth=10 m x 60 m x (21 mm ÷ 1000) x 1000 =1 260 litres
2. on a yard of 30 m x 20 m?
3. on a garden trench bed of 1 m wide by 4 m long?

How many large bucketsful (20 litre each) would that be?

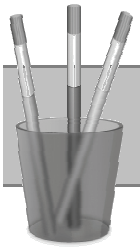
Watering the garden

Now think again about that trench bed of 1 m by 4 m:

4. If you would water this bed with four bucketsful (using a 20-litre bucket) how many millimetres would you have given your trench bed?
5. If you had planned to give 20 mm, and it had rained 15 mm the previous night, how many millimetres would you need to give? How many 20-litre buckets is that?

Answers:

1. *1 260 litres; 63 buckets of 20 litre size.*
2. *12 600 litres; 630 buckets.*
3. *84 litres; 4.2 buckets.*
4. *80 litres; 20 mm.*
5. *5 mm; 1 bucketful (=20 litres). NOTE: Spread this evenly across the whole bed!*



Activity 5: How much water does the garden need?

Aim

To develop useful 'Rules of Thumb' on how many buckets per week a food garden needs, and how much water we can get from rain.

Instructions

From the calculations we did in the Activity above, we can develop the following 'rules of thumb'. [Rules that are easy to remember that we can use to work things out quickly.]

1. Make sure you understand these two rules of thumb, and REMEMBER THEM.

Rainfall:

If 1 mm rain has fallen, then 1 litre has fallen on every area of 1 m x 1 m.

The rule of thumb is thus: Every 1 mm of rain gives 1 litre per m^2.

Watering the garden:

In most areas, a garden needs about 20 mm per week.

To give 20 mm per week, we need to give one 20-litre bucket of water per week for every 1 m x 1 m area of garden beds.

The rule of thumb is thus: One 20-litre bucket per week for every m^2 of garden beds.

2. Now use your rule of thumb to work out how many buckets per week a garden with 10 planting beds of 1 m x 6 m would need.
3. How many buckets is that per day if the gardener waters 6 days per week?
4. Should the gardener try to divide these buckets evenly between all the beds every day?

Answers:

2. *60 buckets (20 litre size) per week.*
3. *10 buckets per day, which is the same as one 200-litre drum per day.*
4. *No, definitely not! Every bed would just get a thin sprinkling and will dry out again almost immediately – all the hard work and precious water to waste. Much better: divide the garden into six parts and water one part per day, moving on to the next part the following day. In very hot periods, water one-third of the garden per day and increase the number of buckets per day if necessary.*

Water sources for rural households

Remember that all our water comes from the water cycle (review Figure 5 above).

Municipal water supply systems

To the majority of South Africans, the most easily available water source is the municipal supply, which is usually piped water – either at a public tap within 200 m of the yard, or a yard tap, or a house connection. The municipality is required by law to, at the very least, provide all households with a minimum lifeline amount of 6kl (6000 litre) per household per month. This is called Free Basic Water (FBW) and is free of charge. For water use beyond the FBW limit, households are expected to pay. While this is the policy position, the reality looks somewhat different:

- Not all municipalities have managed to supply all households with FBW. Some villages have not been reached with reticulated (piped) water supply systems, and are relying on local boreholes, springs, streams or rivers for their basic water requirements.
- In many other villages, the piped systems are no longer working or are regularly out of order, and may run dry for days in a row. This means that households have to store water to be ready for such 'dry' periods, and/or find other water sources to keep them going.
- In some villages the piped systems stop working properly because there are too many illegal connections, which draw so much water from the system that the water stops reaching the further and higher-lying areas.
- Many households don't pay for water they use beyond the FBW amount, for a variety of reasons: Some refuse to pay because the system is unreliable or inferior; some find it hard to accept that they now have to pay for water when it has always been free of charge; others don't pay because they expect to get away with non-payment; and so on.
- Non-payment means that the municipality has less money to repair and maintain their existing water supply systems, meaning that the systems deteriorate further, and non-payment escalates even further – a vicious downward spiral.
- Also, many municipalities don't have engineers and well-managed water supply divisions that can do the technical work properly (Lawless, 2007).

The use of municipal water for productive purposes may thus be limited due to any or all of the following factors: available quantity, reliability, allowable uses, and cost.

Therefore, rural households who want to use water for productive purposes (food gardening, animals, brick making) would usually need to find additional water from somewhere. Many of these possible additional sources would also be used by others, meaning that ways have to be found of sharing it fairly to avoid conflicts and tensions in the village.

Often the only potential sources that are fully under control of the household are:

- Water that the household can recycle from other uses; and
- Rainwater falling directly onto their yard. This is one of the reasons why rainwater harvesting (RWH) is such an attractive option.

In Activity 5 you calculated that one 200-litre drum per day is needed, 6 days a week, to give 20 mm per week to 60 m^2 of garden beds. When the household wants to think about getting water from other sources, like boreholes, wells, rivers, etc., you can help them think how it would be possible for them to get one 200-litre drum per day from the various possible sources – or more for a larger garden, and less for a smaller garden.

Let us consider how various possible sources could help a household to get together one 200-litre drum per day, 6 days a week (=ten 20-litre buckets/day, 6days/week).

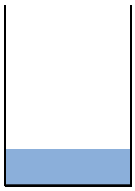
Recycled water

We often forget that it is possible to use water more than once. In Activity 3 above, you calculated how much water your example household could recycle per week from their present water uses.

You can now add together all the water that can be recycled per week. Then divide this by six to know how much of the 200-litre drum needed per day could be filled from grey water.

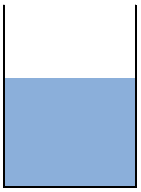
Example 1:

RDP supply of 25 litre per person per day, for a household of 4 people
*=25*4*7days=700 litre per week.*
If the household can manage to recycle one-third=233 litre per week
=39 litre per day for 6 days of irrigation
(i.e. the 200-litre drum can be filled to almost one-fifth [19%] from recycled water).



Example 2:

FBW supply of 6000 litre per household per month = 1500 litre per week
If the household can recycle half=750 litre per week
=125 litre per day for 6 days of irrigation
(i.e. the 200-litre drum can be filled to over half [62%] from recycled water).



Boreholes, wells, springs, streams, rivers

In the drier provinces, most villages are very far from any streams or rivers, and even in high rainfall areas people may have to walk up and down long steep slopes to reach the water. Therefore distance, cost, and the time and labour needed to collect the water, all affect households' access to these sources.

Boreholes

In the past, government drilled boreholes in and around rural villages and equipped them with hand pumps, or with diesel-powered pumps if the borehole was strong enough (could give a lot of water). As the electricity network is spreading to more areas, more and more electric submersible pumps are being used.

Some of these boreholes fell into disuse when municipalities started supplying piped water from bulk supply systems (large dams, reservoirs and pipelines). It could be possible for households to use water for gardening from such boreholes.

A hand pump typically pumps at 10 litres per minute. Therefore, it would take 2 minutes of pumping to fill a 20-litre bucket, or 20 minutes of pumping to fill a 200-litre drum.

To this, add the amount of time to get the water to the garden from the hand pump. Measure the time it takes to fetch one bucket, and multiply that by the number of times per day that the household would need to go to the hand pump to fetch water.

Similarly, you can calculate how much time it would take to collect water from other sources such as wells, springs, streams and rivers.

If the household is allowed to take as many bucketsful as they need, their available time and labour will determine how much water they can collect every day.

Otherwise, the limit may be on the number of 20-litre buckets they are allowed to fetch.

In many villages, water vendors fetch water from all types of sources and deliver it to people's houses, often by donkey cart. In that case, the amount of money that a household can afford to spend on such water would determine how much bought water they can afford to add to their daily 200-litre drum for irrigation.

Example:

In Qumbu village in 2009, the home food gardeners gave the following information: One 200-litre drum of clean water was costing R20. One 200-litre drum of muddy river water cost them R10 (=R50/kl). Most gardeners could not afford to pay R60 per week (R10/day for 6 days of irrigation per week) to water their gardens. They bought some water when it couldn't be helped, but tried to use as much as possible by recycling household water, fetching water themselves by wheelbarrow when they could, and were also taking some from the public tap stands when possible.

Springs

Springs are important sources of water in certain areas, but must be looked after. If cattle are allowed to trample the spring, its use can be impaired. The eyes of the spring can be damages or closed by the trampling, thus giving less water. Water can also be muddied and soiled, which can lead to health issues for people drinking and using this water. It is thus important to protect springs and keep them clean,

It is not recommended to build a low reservoir around the spring as this demands more pressure or head from the spring to yield its water. This could also impair the operation of the spring.

The following sketch provide a simple yet effective construction to 'harvest' the whole yield from a spring, and more importantly protect it from cattle and storm water damage.

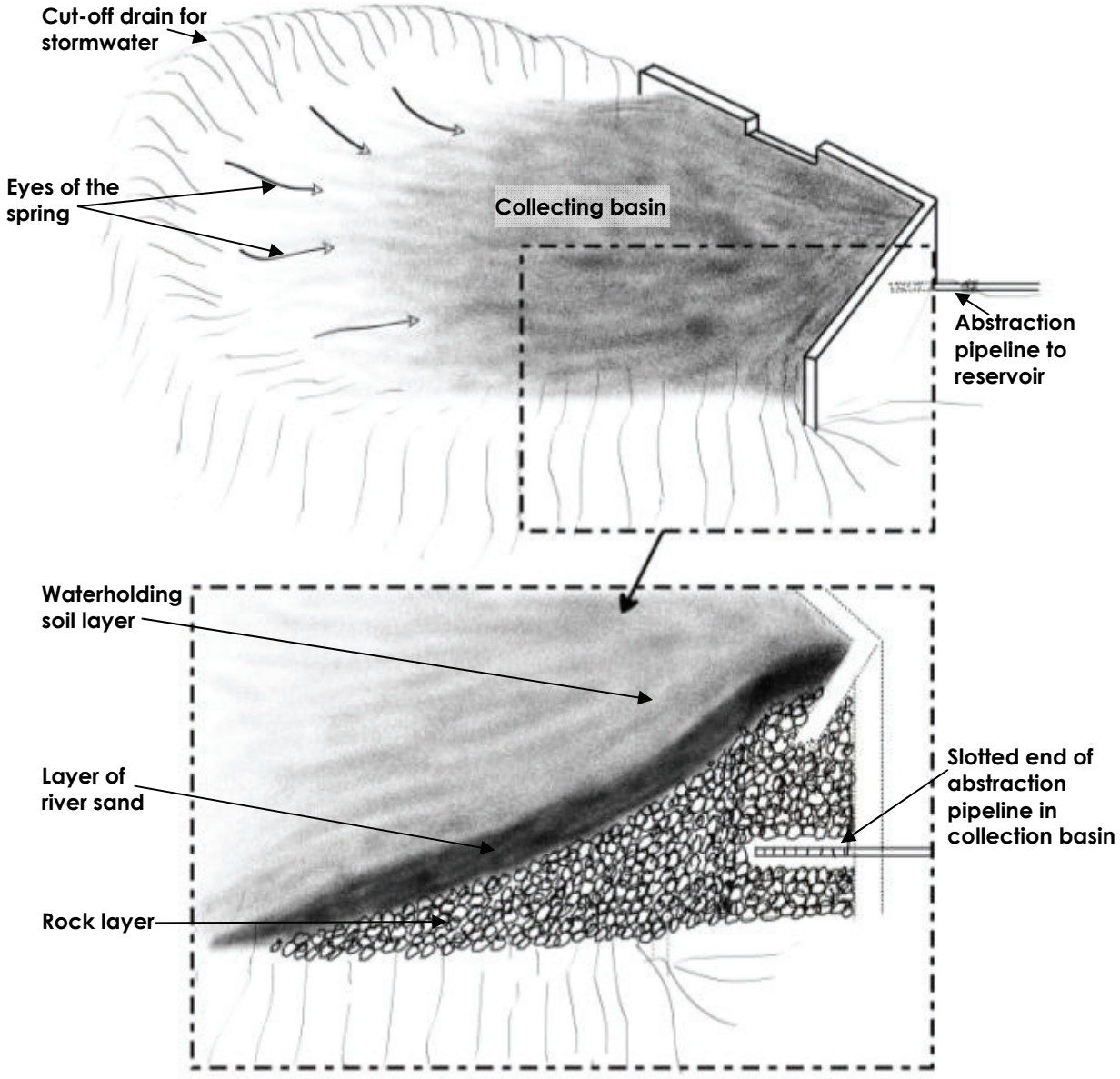


Figure 15: an effective method for spring protection

Rainwater harvesting

One of the main attractions of harvesting rainwater in the yard is that it falls where it is needed – or very close by – which reduces the time and effort needed to get the water to the garden.

With rainwater harvesting, we try to stop water falling on and running across our yard; from running away unutilised. There are two main strategies, which can be used together or separately:

→ One, to get more water to soak into our soil, so that the soil gets wet deep down and can sustain plants for much longer. In other words, we are storing more water in the soil itself; and

→ Two, to store water in containers and/or tanks for later use.

The amount of rainwater a household can capture and store depends on the following:

- The amount and pattern of rainfall – not only more rain is a factor, it is also the way in which rain falls: Light drizzle will soak deep into the soil, but will produce little run-off, while hard, intensive storms can produce a lot of runoff to channel to tanks, or to slow down and channel to the garden beds – care needs to be taken to prevent erosion with such hard rainfall..
- The soil conditions – rocky or clayey soils would give more run-off than sandy soils; there is more runoff from steeper than from flatter slopes; and wet soil would give higher runoff than dry soil.
- The available storage – storage is often the limiting factor with rainwater harvesting. One should not underestimate the storage capacity needed in order to make it meaningful.

The question does arise – how much water can a gardener gain through rainwater harvesting? And how much storage does a household need? This depends mainly on the intended use for the water.

We will go into more detail on this question in "How much water to store for food gardening" in section 5.7.

In section 5.5 we will first look at how to make the best of rainwater for food gardening through garden layout.

5.5 Making the best use of rainwater

Introduction

We have seen that one of the most important and under-utilised sources of water for a rural household is the rainwater that **falls on their yard**, and **flows past or through their yard** when it rains.

Rainwater is good for several uses by a rural household, depending on how clean one can keep it:

Water from the roof

The cleanest rainwater comes from the roof, and can be stored in tanks or drums for drinking and cooking. The roof is cleaned at the start of the rainy season by the first rains. This is called 'first flush' and is not allowed to go into the storage tank, to keep the tank clean. (First flush systems, gutters and roof water storage tanks will be discussed in more detail in the 'technology' section below).

Surface run-off

Water from the roof is just a very small portion of the available rainwater, compared to the rain that falls on the yard, and water that runs through or past the yard from the surrounding areas – this is called surface run-off. Surface run-off is not clean enough for drinking, cooking and dishwashing, but can be used for non-potable domestic uses like washing oneself, laundry and general cleaning. It is also a very important water source for productive uses, like food gardening, water for animals and poultry, and brick-making.

How can a household make best use of rainwater? Simply by laying out the yard in such a way that water is...

- ➔ **Intercepted** (captured), then…
- ➔ **Slowed down** so that it doesn't flush away everything in its path, then…
- ➔ **Channeled** to where it is needed, and then…
- ➔ **Stored** for use, in two ways:
  - i. Directly in the soil of the planting beds, and
  - ii. In tanks or containers.

- ❖ The process of channeling water directly to planting beds is called "run-on", and we will look closely at how to do this in the section called: "Turning run-off into run-on".
- ❖ Further, we will look at techniques to get more water into the soil (more infiltration), and to store more water in the soil (water holding capacity of the soil). Many of these techniques were discussed in detail in Chapter 6, namely deep trenching, mulching, double digging, etc.
- ❖ You can read more about how a rural household can store and pump water in section 5.6: "Technology and equipment".

"Helicopter planning" is a very useful method, developed over many many years in the field by Mma Tshepo Khumbane, which **enables ordinary rural households to plan the layout of their own yards** to capture and use every drop of rainfall they can.

First we will look at the **principles for garden layout and design**, and then learn how to help households to do their own **"Helicopter Plans".**

In summary, we will learn how a household can lay out their yard to capture and use **rainwater** by:

a. Understanding the principles for garden layout planning (to make the best of water, sun, wind, frost);
b. Applying deep trenching, mulching, etc. to improve water infiltration and water holding properties of the soil;
c. Turning run-off into run-on (including the infield rainwater harvesting technique); and
d. Using the "Helicopter Planning" technique to put it all together.

Principles for garden layout and design

What is garden layout all about?

Every homestead yard is exposed to the natural elements of **sun**, **wind**, **rain** and **frost**, in different ways, depending on where the homestead is situated in the surrounding landscape or the 'topography' of an area. All these elements affect how well plants can grow.

Normally, a household would not be able to move house to look for an 'ideal' yard for production! A better approach is to make the best of what they have, by laying out the garden to create the best possible conditions for plants to grow well.

We need to learn how we can work within the given topography (**altitude, aspect, ridges and valleys, slope or gradient**) affecting the yard to protect the plants so that we can improve our harvest. To do this, one has to understand what plants like and don't like.

In this section we will learn where to position the garden:

- We will have a brief look at topography, and then
- Think about how a gardener can manage sun, heat, cold, frost, wind and water better.

In the next section we will then go into more detail on how to lay out the beds across the slope in a garden to maximise the use of rainwater.

Topography

The amount of sun, heat, cold, frost, rainfall and run-off a household can expect, depends on the position of their homestead in the landscape, with topographical factors like altitude, aspect, ridges and valleys, and slope all playing a role. For instance:

- If you cultivate steep slopes, you could cause soil erosion;
- Valley bottoms are often not very favorable for gardening, as there may be a problem with frost or there may be a wetland. Wetlands are lowlands that are seasonally or permanently waterlogged (wet);
- If your crops are planted in a flood plain, your crops can wash away during heavy rainfalls; and
- If you are at a high altitude you may have cold winter temperatures.

Altitude

Higher-lying areas get **colder** in winter (like Lesotho, Drakensberg and other high-lying mountain areas).

Households can learn more about what types of crops grow well at their altitude.

Do you know how to find out where N, S, E and W are? If you are confused; just think where the sun comes up – that will be East. Where the sun goes down – is West.

Now if you stand with your left hand towards the West and your right hand towards East; you will be facing North, and South will be behind you.

Aspect

'Aspect' means which direction your land faces, and this influences the amount of **sunshine** your land can get.

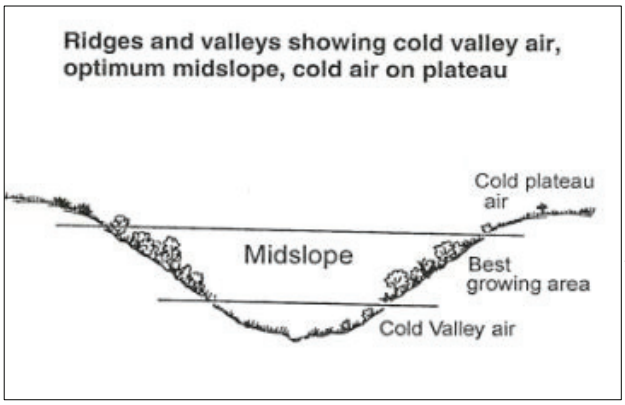
In the Southern hemisphere, North-facing slopes get the most sun, and can be hot and dry in summer, and pleasant in winter (you may find aloes on these slopes). South-facing slopes are cooler and wetter (you would find indigenous forests on these slopes).

Large gardens may slope in more than one direction (i.e. a choice of aspect), but mostly the entire garden will face in a certain direction. The gardener needs to make best use of the available sunshine, and create shade for plants that need this.

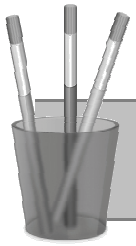
Ridges and valleys

Ridges are at the tops of hills or slopes and valleys are at the bottom. There can be a large difference in temperature between ridges and valleys. Valleys can become hot during the daytime and very cold at night. Frost is often found in the valley bottoms. Ridges can be cold and windy.

The best places for cultivating are generally mid- and lower slopes, but not on top of ridges or right in the bottom of valleys.



The mid-slope area is best for gardening or farming.



Activity 6:
Analyse a picture for aspect, ridges and valleys

Aim:

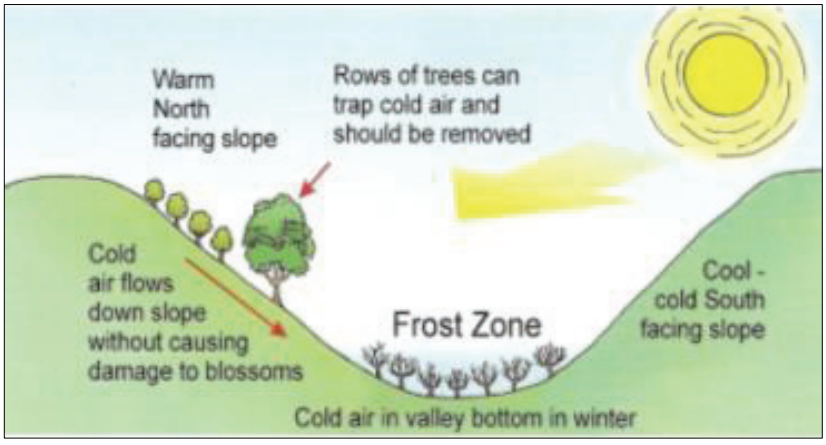
To analyse a given drawing in terms of aspect, ridges and valleys to give indications of land use options.

Instructions

Look at the picture below. The picture is meant to give an indication of planting of fruit trees related to the aspect, ridges and valleys. Note the aspect and the movement of air as shown in the drawing. Then answer the following questions

1. Where it the best place to plant trees and crops? Give two reasons for your answer.
2. Why have no fruit trees or other trees been planted on the cool, cold south-facing slope?
3. What is the difference between the fruit trees planted on the north-facing slope and the fruit trees planted in the valley bottom?
4. A comment on the drawing states: "rows of trees can trap cold air and should be removed". Try and work out what this statement means. Where is the cold air coming from and where is it going? Where will the cold air be trapped? If you would want to plant rows of trees to protect your fruit trees from cold air where would you plant them?

Time: 2.5 hours



From: Growing fruit in KwaZulu-Natal, 2006

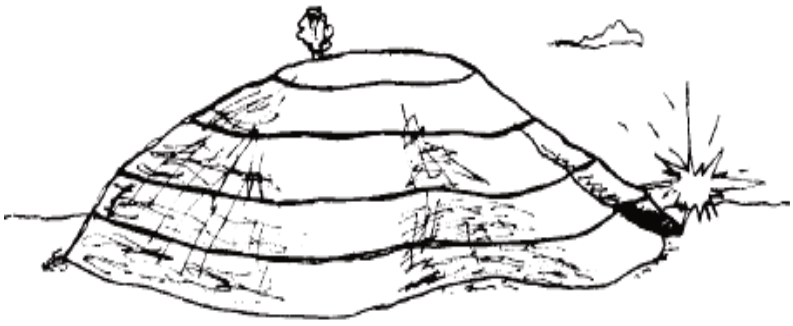
Slope or gradient

'Slope' tells us how steep or flat our land is. The steeper the land, the faster water runs down the slopes during rainstorms – and the more easily soil will be washed away (eroded). In other words, steep slopes are more vulnerable to erosion than flatter areas when used for cropping and grazing.

If we can prevent run-off water from gathering too much speed, we can prevent erosion. We do this by limiting the distance the water can run downhill before it gets slowed down – by creating contours (level ridges) or other erosion control structures (like terraces) along the hillside. The steeper the land, the closer the contours have to be spaced together to keep the speed of the water within safe limits.

On a map, contours are imaginary lines that are on the same level (at the same height or elevation), across a slope as indicated on the picture.

An understanding of slopes enables the gardener to take control of rainfall run-off and use it in the garden. This is called rainwater harvesting.



Water drainage, catchments and watersheds

All water that falls on land runs downhill until it reaches the sea – unless it evaporates or gets intercepted along the way. This is called surface **drainage**. Water that falls right at the very top ridge of a hill or mountain would 'shed' to one or the other side of the mountain, and then continue its journey down to the sea. This top line along the highest lying points of the landscape is called the **watershed line** (or sometimes simply the 'watershed').

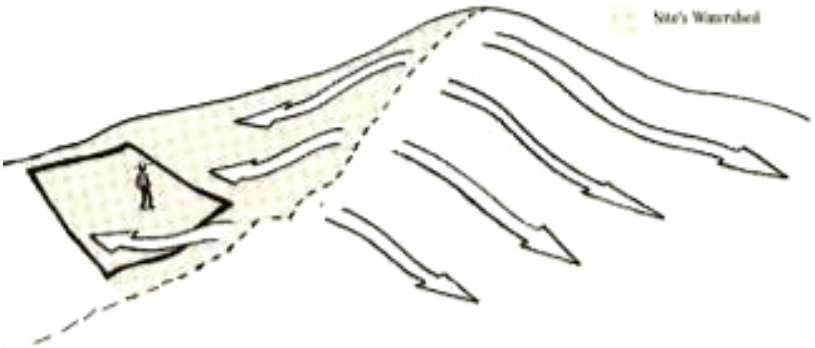


Figure16: A diagram depicting a watershed line and the direction water would flow in.
From: Lancaster, 2008

In South African water law, when we talk about '**catchments'**, we mean the whole area, right from the watershed line, that drains into the sea at the same point (this would of course be at the mouth of a river).

Some of these terms can become a little confusing when people use them in different ways. For instance:

- In some other countries such a 'catchment area' is also called a 'drainage basin' or a '**watershed'** (so the same name is used for the watershed line and for the whole basin!)

- Also, when water managers talk about 'catchment management', they mean managing all the water that runs from the watershed line to the river mouth.
- However, when environmentalists talk about 'catchment management', they mean managing all the interrelated natural processes in the catchment area.

This knowledge will help you to better understand the following definition of a watershed, by John Wesley Powell (1888):

According to him, a watershed (catchment) is
"that area of land, a bounded hydrological system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded they become part of a community."

Catchments can be subdivided into several sub-catchments, or smaller drainage basins, from where the water from the tributaries all run into the same river and eventually out to sea at a common point along the coast (the river mouth).

An understanding of catchments enables a gardener to be able to estimate how much potential run-off there is in and around their homestead. They can determine where water drains to and how much there is.

The natural elements

The general topography of an area influences the way in which the natural elements affect the garden (e.g. how much sun, wind and water reaches it). We combine our understanding of the topography with our knowledge of how different plants react to the natural elements to make decisions about garden layout.

Sun:

Plants mature once they have absorbed the required amount of 'heat units'. The more heat units they can absorb every day, the faster and larger they grow, and the sooner they can be harvested. However, if they are bombarded with too many heat units too soon, they get scorched! This is the value of a 'hothouse' or hydroponic system: plants are protected against the onslaughts of too much sunshine, wind, cold and even pests and diseases, while they receive enough heat units (warmth), water and nutrients to enable them to grow fast and strong.

In nature, some plants prefer full sun, while others grow better in the shade or semi-shade. Some, like apple trees, need enough 'cold units' in winter to enable them to form lots of fruit in the next season. That is why apples and cherries do so well in the high altitude, colder areas of the Free State, like Bethlehem area.

Remember, this does not mean that you cannot grow apples anywhere else, just that they may not grow quite as well as they would in areas with these ideal conditions.

Summary of garden layout factors for sunshine:

- Lay out the garden beds to get the maximum sunshine all day long. Beds that lie along an East-West direction will get the full benefit of both morning and afternoon sun.

[NOTE: If this clashes with the bed direction you need to catch water, you have to decide which factor is more important in your circumstances. If water is scarce, or you have heavy storms that can easily cause erosion damage, make sure you lay out your beds along the contour!]

- Plant fruit trees in your garden beds to create shade for plants that don't like full sun.
  [NOTE: In monoculture commercial farming trees and vegetables are not grown together, to prevent competition for water and nutrients. However, in homestead food gardens based on intensive production methods like deep trenching, companion planting and other organic production systems, this is one of the ways of working with natural processes to create synergy.]

Wind:

What is the prevailing wind direction for the area where you live? In other words, which direction does the wind most often blow from? How strong are these winds, how often and how continuous do they blow?

Wind dries out soil and plants very quickly, making them struggle for survival. Not many gardeners realise that a lot of the damage they see in their plants, is actually from wind! This topic is covered in more detail in Chapter 4 of this manual.

However, it is very easy to create small protected areas in the garden to avoid wind damage to the plants. The gardener's most effective weapon is awareness – once you take notice of what is happening, you can begin to take control of the situation. Households can make thatch fences to keep the wind out or establish hardy plants as windbreaks, etc. This is described in detail in Chapter 6.

Summary of garden layout factors for wind:

- Place windbreaks or shelter belts across the path of the prevailing (commonly occurring) damaging winds.
- It is in fact better if windbreaks are not solid lines of trees, but broken lines with plants of different types and heights. The taller species in the center of the windbreak help to lift the wind up and over your garden and crops.
- Design these windbreaks or shelter belts to also be 'heat sinks' for the sun in winter by creating semi-circles of vegetation along an East to West orientation. The openings of the semi circles point North and capture the sun to form a warm frost free environment within the half circle to grow cold sensitive crops.

Water:

We all know that plants cannot grow without water. If plants receive regular deep watering, they develop deep, strong roots, meaning that they can produce large, strong stems, leaves and fruit. If they get just a little water on the soil surface most of the time, the roots will be shallow and the plants will have very little resistance to dry periods.

Did you know that plants can also suffer if there is too much water around their roots all the time (water logging), so that the roots cannot 'breathe' (too little oxygen)? Therefore plants need well-drained soils to prevent the roots from rotting and dying.

Water can also damage the soil in the garden in several ways, for instance:

- We have seen above that fast-running water can wash away the topsoil, causing erosion. As in the surrounding landscape, the steeper the slopes in the yard, the faster the water will run downhill during rainstorms.

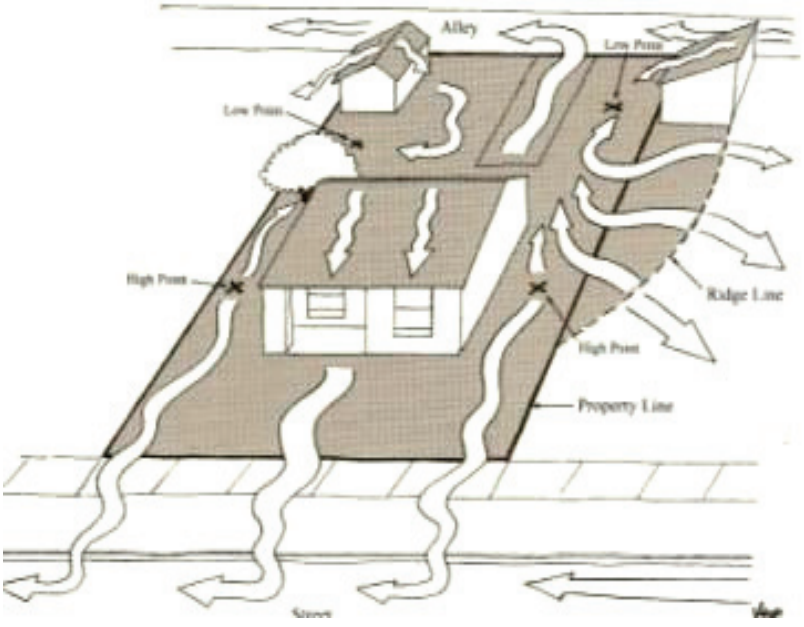
  A household can reduce erosion damage by finding ways to slow down the flow of the water in the yard: by making cut-off trenches, contours, terraces, stone barriers, and bunds or ridges, by creating flat areas to slow the water down, by building stepped furrows and infiltration basins, etc. Once the water is slowed down, it can be channeled anywhere the household needs it.
  In the section on "Making the most of rainwater" we will look in more detail at how a household can 'take control' of rainwater and use it to their advantage, instead of allowing it to do damage.
- Large water drops falling on the soil can compact the soil and create a hard crust on the soil surface which can keep water and nutrients from getting to the plant roots.
  Households can protect their soils from crusting by breaking the impact of such large water drops: with mulching, by letting the water break its fall on flat stones, or by breaking large drops into finer spray before it hits the plants or soil.

Summary of garden layout factors for water:

- Notice where the water runs through the yard during rainstorms. This will always be from higher-lying areas to lower-lying areas. The steeper the slopes in the garden, the faster the water will run. The best way to understand how the water flows in your garden is to walk your land in the rain!
- Plan how to take control of the water (slow it down) and channel it to where it is needed (in the garden beds and/or in dams or storage tanks).
- Lay out long, level garden beds along the contour (i.e. across the slope) to more easily intercept and spread out the water along each bed.

An urban example

From: Lancaster, 2008



In the next section you will learn in detail how to lay out the garden to maximise water benefits.

Applying the elements of layout to the home garden

Stepwise process for garden layout planning

This is a stepwise process: Step 1 to 3. Work from the big picture to the detail.

Step 1: Where does your homestead lie in the landscape, and how will this affect what you can do in your garden?

Think of altitude, aspect, ridges/valleys, slope and natural drainage routes. Include sun, wind, frost and water. Keep these factors in mind when you choose your garden site, when you think about how to compensate for 'not-ideal aspects, and when you decide what crops to plant.

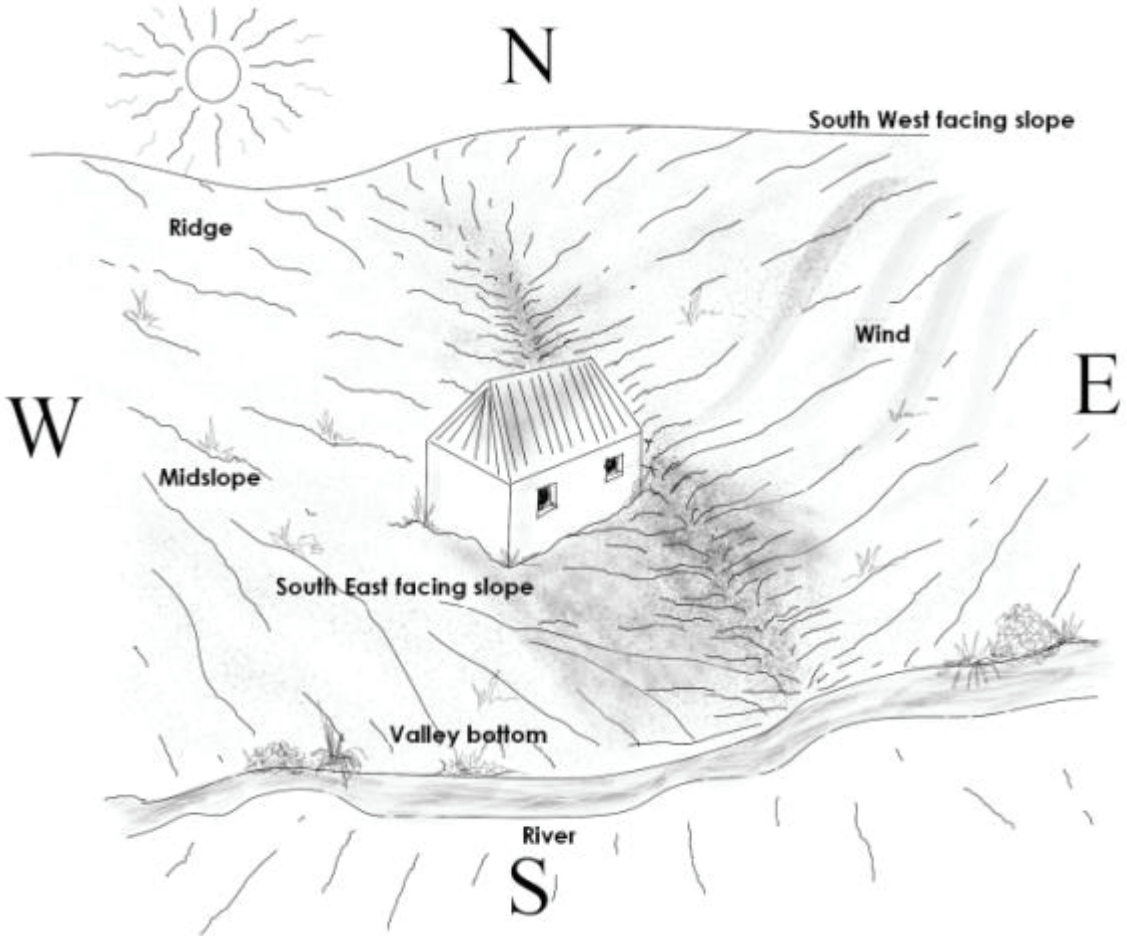


Figure 17: Step 1 – Considering the location of the homestead in the landscape

In Figure 17, the homestead is situated on the mid-slope, which is better than on the ridge (exposed to wind) or in the valley bottom (tendency for frost). However, it is on a South-facing slope, which tends to be colder as the sunshine cannot warm it as effectively as slopes that face North[1]. This gardener would have to take care to

make the most of the available sunshine. A natural drainage route passes by the Eastern side of the house. Rainfall runoff would run towards and down this shallow area during rainstorms, down to the river. The prevailing wind direction is East.

Step 2: Where would you like to have your garden?

Choose an area to make your garden, then test your choice: is it the best place for you? No site is ever perfect, but the ideal would be: Fertile soil. Easy to get water to it. North side of the house or buildings. North-facing slope. Protected (or can be protected) against wind, and against animals. Close to your house so that you can easily spend lots of time there. Others in the family are satisfied that you use this area.

Weigh the positive and negative points of your choice, and make a final decision on where to make the garden.

Plan how you will compensate for the 'not-ideal' aspects of your garden site, such as exposure to wind, etc.

The most important thing is to MAKE A DECISION and to MAKE A START!

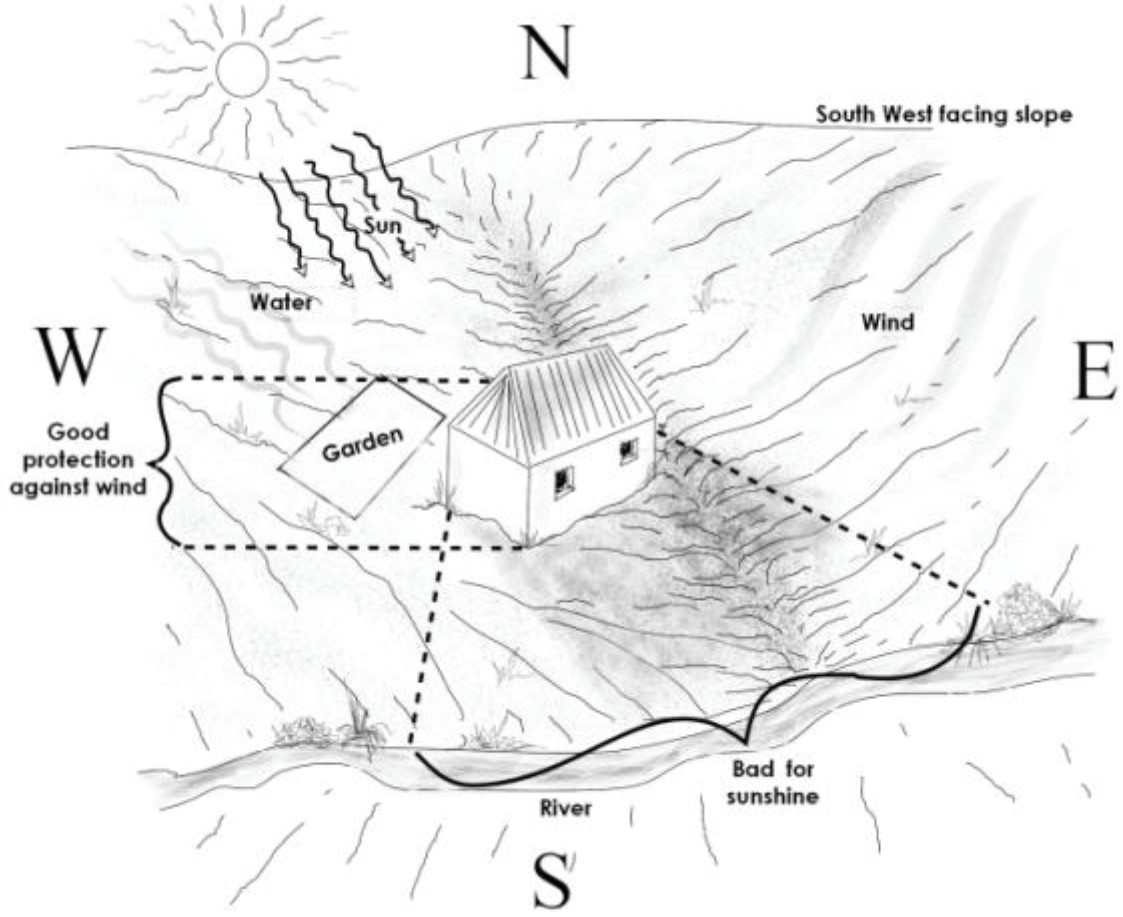


Figure 18: Step 2 – Selecting a suitable area for the garden

This gardener has selected a garden area on the north-western side of the house. It makes the best use of sunshine by avoiding the areas south of the house which would be in the shade for parts of the day. The chosen area is half-hidden from the regular easterly winds, although further protective hedges would be advantageous.

Water running down the SE-facing slope towards the drainage route could be intercepted and spread through the garden. It should also be possible to make some low earth ridges (berms) to divert extra water from higher up in the drainage route towards the garden. The selected garden area is also nice and close to the house, making it easier to keep stray animals away and to spend lots of time there. The Northern wall of the house warms up during the day and will add further heat to the garden. Grey water can easily be taken from the kitchen to the garden.

Step 3: How will you lay out the planting beds in your garden?

Usually, one would start by thinking about water when you decide how to lay out your garden beds. You will first decide where to place your long narrow planting beds across the slope, and then how to shape the earth into rainwater flow paths and ditches so that runoff will flow to your plants during every rain event (see next section: 'Turning runoff into run-on').

Water factors affecting garden layout

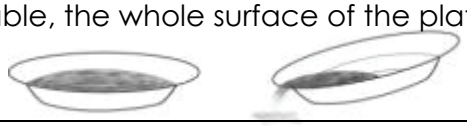
We all know that water always flows downhill, and that the steeper the slope, the faster the water will run. Fast-running water has lots of energy, and drags everything in its path along with it – this is why soil erosion happens.

Runoff running through our garden must be slowed down to prevent soil erosion.

Fast-running water also has very little time to infiltrate into the ground, so despite lots of rain, the soil underneath can remain dry (in the root zone of the plants).

Runoff must be slowed down and even dammed up to have lots of time to seep into the soil – into the root zone of our plants.

We also know that water in a plate will all collect at the lower end if we hold the plate at an angle, but if we put it on a level table, the whole surface of the plate will be covered equally with water.



Our planting beds and ditches must be as level as possible, so that the water can reach everywhere equally. In that way we'll make best use of the water we have.

Other layout factors

In Step 2 you have already considered sunshine, wind and frost protection when you selected your garden area. Now, as soon as you have decided the basic positioning of the beds to maximise the use of rainwater in your garden, you can make further adjustments to create the best possible conditions for your plants, for instance:

- In which beds will you plant fruit trees to create some shade for your vegetables during the worst heat of the day?
- What barriers will you plant/erect on the windward side of your beds to protect the garden soil and plants against drying out from wind exposure?
- How will you prevent animals and birds from eating all your hard work?

These strategies are some of the most interesting aspects of gardening, and gardeners can spend hours in happy conversation sharing their latest creative ideas with each other!

But now, let us get into the detail of how to turn runoff into run-on, so that your plants can benefit much more from every rainstorm.Turning runoff into 'run-on'

This innovative technology is based on the work and experimentation of Mma Tshepo Khumbane, who has a beautiful working system at her present homestead near Cullinan. The remnants of a similar system in her former homestead plot near Tzaneen of some 20 years ago, still nourishes the fruit trees there, even though the present owners are unaware that there is a system at all! This system is the product of years of experimentation with practises in rainwater harvesting and storage. Mma Tshepo's run-on system has been studied and documented, so that it could be used as an innovation that could be introduced to other householders in their circumstances.

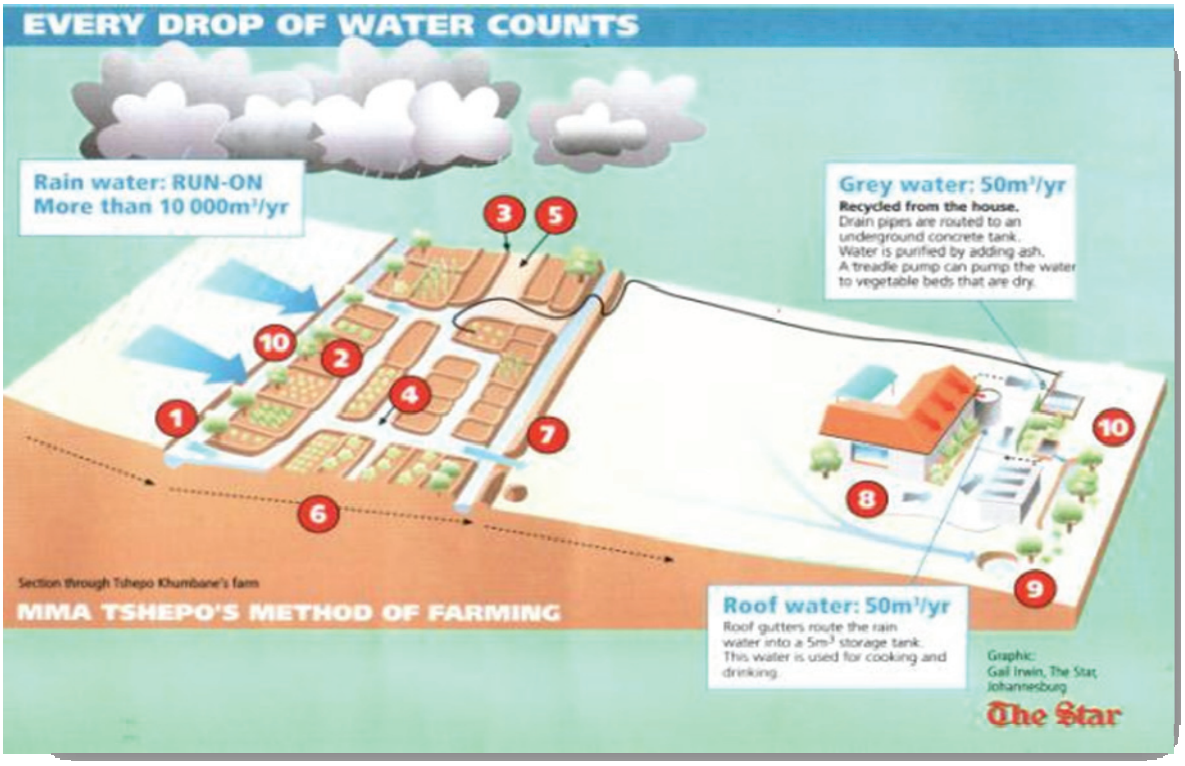


Compare this photo to the diagram overleaf.

Run-on is 'automatic irrigation when it rains.' The soil in the garden is shaped to catch rainwater runoff, slow it down and lead it gently to where it is needed. The water dams up in pathways between deep-trenched planting beds, giving it time to seep into the planting soil. The layout allows excess water to escape before it can erode the planting beds or the pathways themselves. Such excess water can either run further down-slope to a storage structure (tank or dam) for future use, or be released into the veld to continue on its natural course downstream to the river.

Interestingly, the run-on system works with water flows above and below ground.

- In its simplest form, the run-on system concentrates surface runoff from adjacent areas into the root zone of the planting beds. This in itself dramatically increases the effectiveness of rainfall – even in high rainfall areas, where a large percentage of rainfall may run off unutilised once the top soil layers are wet.
- Further, as people's understanding deepens on what happens to water below the soil surface in their own conditions, they can start manipulating these flows – with cut-off trenches and by creating strategically placed impermeable layers in their deep-trenched beds.



1. A trench (the top ditch) is dug across the runoff slope of the land to catch rainwater.
2. Below the top ditch, the vegetable beds are dug 1 m deep and filled with organic matter – grass, leaves, manure, and ash – and mixed well with topsoil. These trench beds are fertile and absorb and retain moisture.
3. The trench beds are edged with ridges. Some are re-enforced with stone to stop the soil washing away and to reduce evaporation.
4. Between the trench beds a network of depressions (rainwater flowpaths) connect the top ditch to a second one at the bottom edge of the garden. The rainwater flows and pools in these channels/depressions during rain.
5. These rainwater flowpaths are also the footpaths to access the trench beds.
6. In the rainwater flowpaths the gradient is flat so that the water has more time to soak into the trench beds.
7. If it rains too much, the bottom ditch is breached to avoid flooding of the trench beds.
8. A water catchment area: concrete paving around the house is lipped and slopes down to pipes which lead to further ditches and deep trenches downhill of the house.
9. Lower down a 2 x1 m hole (open pond) catches and stores more run-off.
10. Fruit trees are planted along the lower edge of a ditch so that their deep roots can benefit from the extra soaking.

Further, as peoples' understanding deepens of what happens to the water below the soil surface in their own conditions, they can start manipulating these flows – with cut-off ditches and by creating strategically placed impermeable layers in their deep trenched beds.

'We call this system "**double-double**" – now we can grow double as much food (higher yields), and we can grow food double the time (summer and winter)!"

Andile, Upper Nqumeya, Eastern Cape

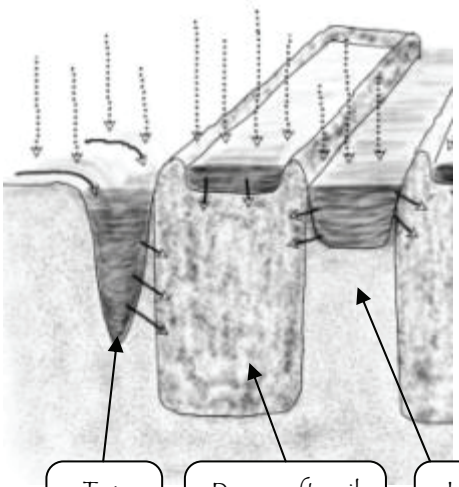
The challenge with run-on systems is to explain them in the simplest possible way, so that people will be encouraged to start experimenting with them. Further learning can then be built on their own experience.

For this reason we will take you through the run-on system in steps – starting with 'baby steps' and taking you right through to 'mature steps'; slowly progressing from little secrets to deeper secrets.

'Baby' steps – preparing deep-trenched beds to soak up the water:

In Chapter 2 – on "facilitation" you learned how deep trenching is introduced to enable gardeners to achieve early successes with gardening. In Chapter 6 – on "soil fertility management" you will learn in detail how to make a trench bed. You will also discover how deep trenching creates ideal soil conditions for plant growth. Here in Chapter 5 – on "water management" we will look at how deep trenching helps the soil inside your planting beds to absorb and hold more water. You will also learn how to lay out your garden so that water can pool around your deep trenched beds to maximise infiltration.

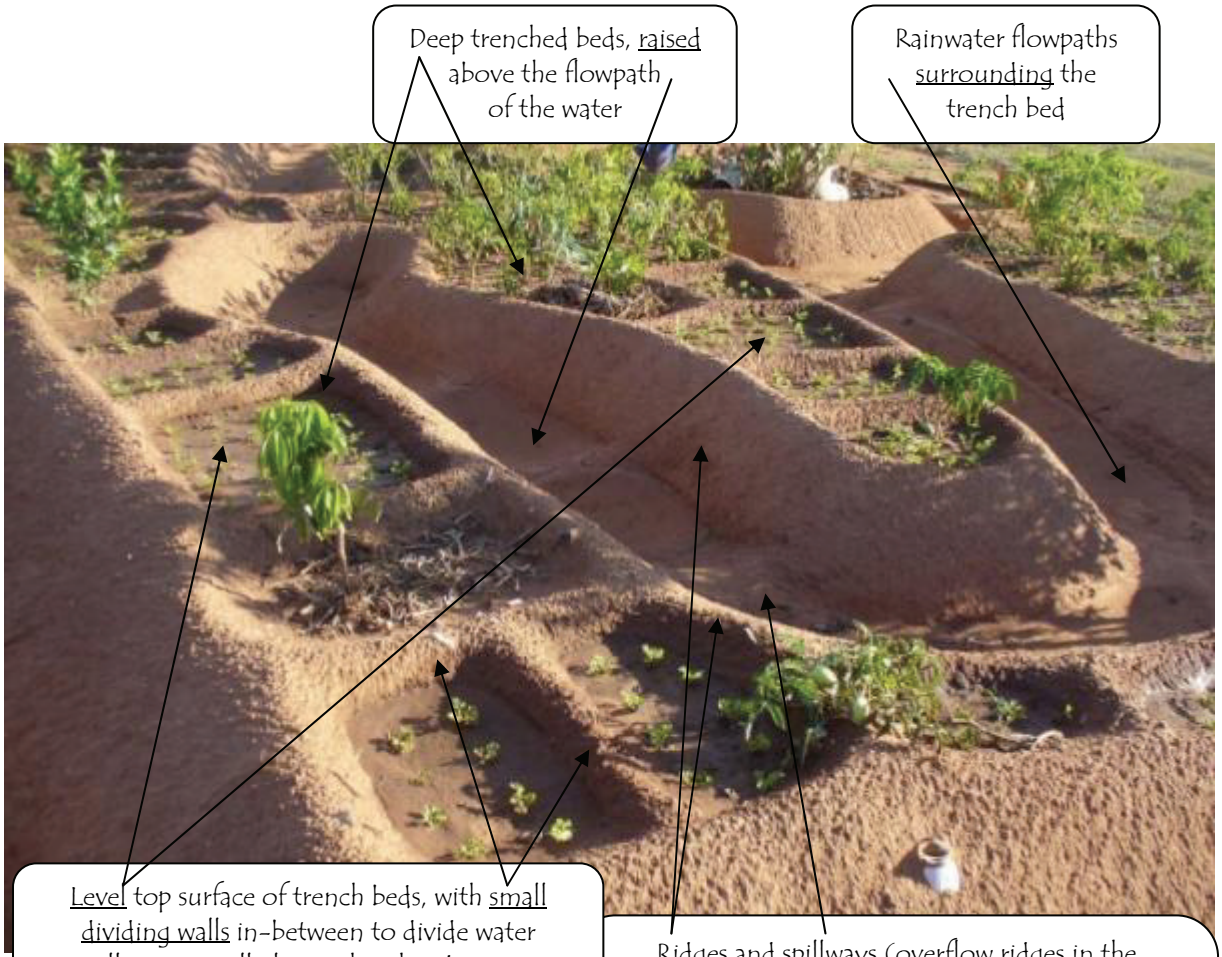
Let us first have a look at how the water moves from being pooled around your trenched planting bed into the root zone of your plants.



During a rainstorm, water pooling in the top ditch (left on this drawing) and in the rainwater flowpaths (right on this drawing) infiltrates (soaks) sideways into the deep soft soil of the trench bed. This all happens underground, so you cannot see it unless you dig and look! Very little water soaks into the soil beneath the footpath/rainwater flowpath, because this soil is very hard, while the ridges and deep soil in the trench beds are very soft and absorbent from all the organic matter that has been mixed into it.

Note that each bed is trenched, raised, ridged and surrounded by footpaths which double as rainwater flow paths during rain:

- TRENCHED to create a deep fertile root zone;
- RAISED to elevate it above the flow path of the water and make the soil even deeper;
- RIDGED to keep the water on the bed when you irrigate. The ridges also absorb lots of extra warmth for the roots, and creates ideal space to grow sweet potatoes and other crops that need ridging ; and
- SURROUNDED by rainwater flowpaths so that water can pool all around the trench bed during a rainstorm to give maximum time for water to infiltrate into subsoil of the trench beds through the soft porous ridges. The footpaths are on hard, undisturbed soil; therefore the pooled water absorbs mostly sideways into the ridges, and then soaks down into the deep trench.



Note that **all hand watering or irrigation is applied on top of the trench bed** – NOT in the rainwater flowpaths between the trench beds! Evaporation losses are tremendous if one tries to apply irrigation water via the rainwater flowpaths!!

'Toddler' steps – making a furrow for runoff to flow to the garden:

Look at where water runs across (and adjacent to) the yard during a rainstorm.
Often, you can see evidence of where water has flowed, even when it isn't raining, for instance, low-lying flow areas with small pebbles where the fine soil had been washed out; or fine soil that had been deposited in wavy patterns.

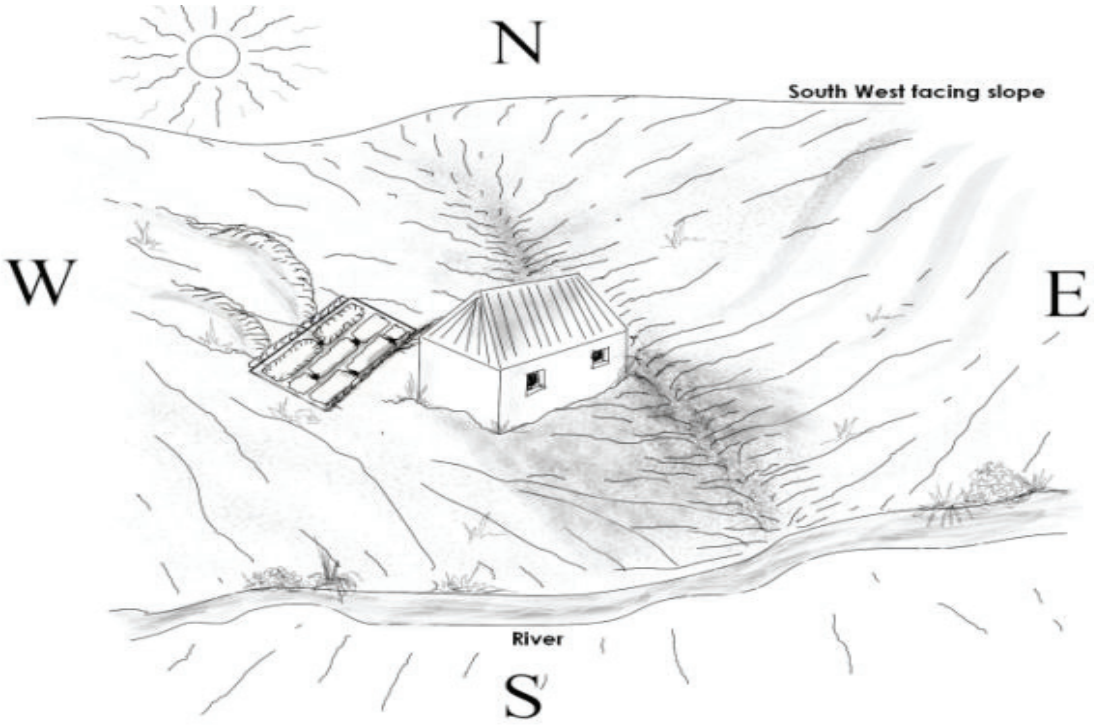
Think of how you can dig a furrow and make some soil berms (ridges) to direct this water to flow towards your garden every time it rains. This is your runoff supply furrow.

In the words of Zanele Semane[2], your **runoff supply furrow** is:
"a furrow that your planting beds can drink from".



This simple runoff supply furrow brings water to the planted trench bed in MaTonisi's new garden.
Photo: J Denison, Upper Nqumeya, Eastern Cape.

Figure 19: A depiction of run-off supply furrows leading to a garden



[2] Zanele Semane, facilitator working with Border Rural Committee, East London, South Africa

'Child' steps – making escape routes for excess surface flows:

One of the first challenges you may experience once you have created a runoff supply furrow to your garden, is what may happen in a heavy rainstorm – the water could be too much, and wash out your planting beds!



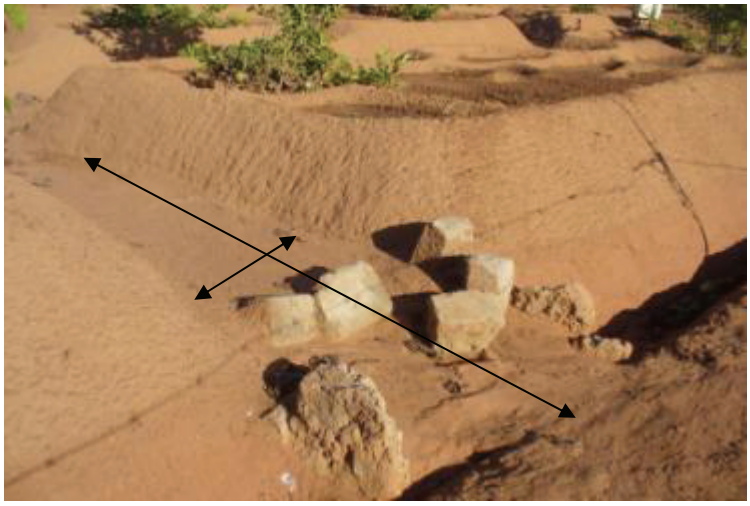
Therefore, before we discuss how to lay out the rainwater flowpaths inside the garden, we will first learn how to take control of how water flows into and out of the garden:

- The best way to prevent flooding and erosion damage is to create an escape route for excess water at the bottom of your garden.
- Another way is to block the water in the runoff supply furrow from entering your garden once it is wet enough. The disadvantage of this is: what happens if you are not at home at the time? This WILL happen sooner or later!

Water always flow down-slope, therefore it will start overflowing out of your garden at the lowest point it can find (think again of the plateful of water you are holding at an angle). Therefore, you should build a safe escape route at the lowest point in your garden – this is like a 'dam spillway' or overflow section, made of earth across the exit point of your last rainwater flowpath (see drawing below).

Here are some tips on how to make an **escape spillway** that would achieve its purpose without itself breaking up against the flow of the water:

- Make the top edge of your spillway **low enough** (lower than the ridges around your trench beds) so that the water can get out of the garden before it overtops your ridges and washes into the soft soil of the planting beds. Make it slightly higher than the bottom of the flowpath, so that water can dam up behind it to soak through the ridges.
- **Widen the rainwater flowpath** (i.e. where the water flows) before it reaches your spillway, so that the water can slow down even further. Your spillway could be **600 mm to 1 m wide**, but you can adjust this until you are satisfied, depending on how it holds up over time. The wider it is, the slower will be the flow of water over the spillway, and the better protected it is against eroding away.



- Make the **top** of your

spillway at least **300 mm from the back to the front** (i.e. like a normal 30 cm school ruler), so that it won't wash away easily. It is 2 m in this photo!

- ❖ You can pack stones on the escape spillway to help slow down the flow of the water.
- ❖ Water from this escape spillway can flow into the bottom ditch at the lower edge of your garden.
- ❖ The **bottom ditch** acts like a long overflow section. Look at the watermark on the photo below to understand how this works. Water spilled sideways out of the bottom ditch before the ridge could be overtopped.



'Young adult' steps – spreading runoff through the garden:

Your **runoff supply furrow** brings water to your garden, and your **escape spillway** and **bottom ditch** ensures that excess water will flow out of the garden before it starts eroding your planting beds. But how can you spread the water from the runoff supply furrow throughout the garden so that it reaches all your plants?

To achieve this, you will continue to apply the same principles:

-Water always flows downhill and must be slowed down; and

-Water is distributed evenly when the soil surface is level, i.e.

-Flat (not sloping/at an angle); and

-With an **even** surface (without hollows and bumps).



In this section we will go step-by-step through the process of marking out and constructing the network of ditches and rainwater flowpaths in your run-on garden.

How does one lay out the run-on system in practice?

This is the easiest to do if it is a new garden, which can be laid out on the contour. If it is an existing garden in which none of its edges follow the contour, or other restrictions prevent you from following the contour, it can still be done, but your long beds may get shorter!

Follow these steps to lay out a new garden:

1. Bring the water to the garden – make a runoff supply furrow

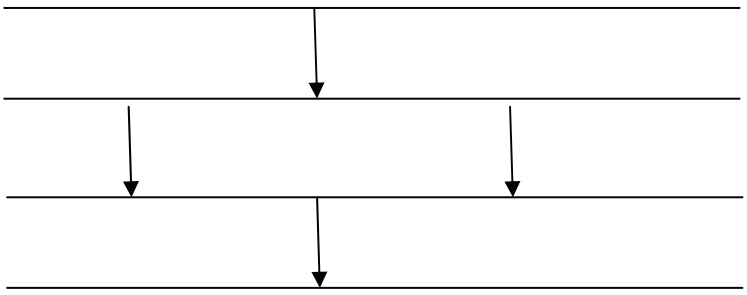
1.1 Find the highest point along the garden perimeter.
1.2 Make berms and a runoff supply furrow so that runoff from higher areas will collect at (be channeled to) the garden's highest point or edge.
1.3 You can also make a stone 'check dam' to slow the water down and to remove excess silt before it enters the garden.

At the end of this runoff supply furrow from a nearby road, the small stone 'check dam' slows down the water and removes silt before the water enters the garden. (Photo: Prof. B. Mati, Kenya.)



2. Mark out the top and bottom cut-off ditches and rainwater flowpaths in the garden

2.1 Draw a line on the ground along the contour (i.e. level) where the top edge of the garden will be (this is where you will dig your top cut-off ditch).
2.2 Draw further lines parallel to the top edge, not more than 1.5 m apart, where the long flowpaths will be. Continue until you reach the bottom edge of the garden, where you will mark the bottom ditch.
2.3 Now draw the position of the connecting pathways, staggering them to prevent long uninterrupted downhill pathways.
2.4 If you have already made your first trench bed earlier, incorporate it into your overall design. Your layout could look something like this:



3. Dig the top ditch

3.1 Dig out the **top cut-off ditch**. Dig this deep enough to contain the amount of runoff you would expect to run into the garden via the runoff furrow.
3.2 Heap the topsoil all along the lower edge of the cut-off ditch, thereby creating a **sidewall** for the ditch.
3.3 If you have too much, place the excess topsoil all along the lower edges of the long flowpaths.

3.4 Do not use 'dead' subsoil for the planting beds or ridges, but you can use it in the bottom of your hard rainwater flowpaths/footpaths.

3.5 Make sure that the bottom of the top ditch is **level**, so that water will spread and stand evenly along its full length during a rainstorm.

3.6 Create an **inflow spillway** out of the top ditch (i.e. a section where the sidewall is slightly lower than the rest of the sidewall of the top ditch) to lead water into the network of rainwater flowpaths in the garden.

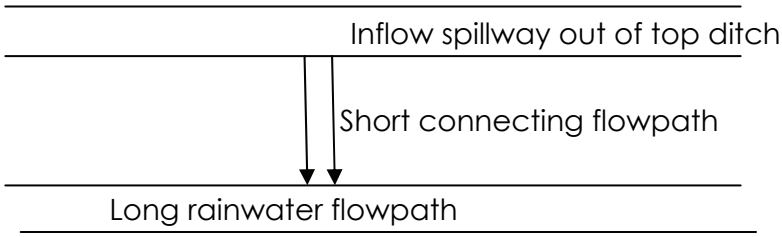
Remember that because you are just shaping the soil, you can always reshape it later once you have observed how your system responds during a rainstorm.

- *Your priority now is to create the water flows to your existing beds, and to expand the water distribution system to reach your beds as you add them later.*
- *If you have already made your first trench bed earlier, you would now want to create the flowpaths and spillways to pool water around the trench bed – always ensuring that excess water can overflow and escape down-slope without damaging your garden.*
- *You may want to lay out the run-on system for the whole garden, and deep trench your planting beds one-by-one over time.*

4. Make rainwater flowpaths that will pool the runoff between the trench beds

4.1 Make sure that your first **long rainwater flowpath** (which runs parallel to the top ditch above it) is level and even, and wide enough to walk in (not less than 300 mm). Form **ridges of topsoil** along the edges of the flowpath/footpath to hold the water.

4.2 Find the point where the **connecting flowpath** from the **inflow spillway** out of the top ditch joins the **first long flowpath**.



4.3 From this point, dig out the connecting flowpath, working back upslope towards the inflow spillway. Make sure the flowpath comes out level and even!

4.4 If the garden slopes very steeply, in other words the connecting flowpath will become very deep when you try to dig it out until it is level, you can construct another spillway at its connecting point with the long flowpath, and level out the connecting flowpath at a slightly higher elevation.

4.5 You can now continue this process of digging out long flowpaths and level connecting flowpaths with spillways in-between, until you reach the bottom edge of the garden.

5. Dig the bottom ditch

5.1 Dig out the **bottom cut-off ditch** along the lower edge of your garden. Make sure that its bottom is level.
5.2 This is a deeper ditch, but not a pathway, because no-one will need to walk in it.
5.3 Plant grass or pack stones along the down-slope edge of the ditch, or wherever water will overflow out of the ditch, to protect the area against soil erosion.

6. Secure the escape spillway

6.1 Make sure that the top of your escape spillway is lower than any other spillway in the garden, so that all excess water will find its way out of the garden via the escape spillway.
6.2 You can pack flat stones wherever you want to protect the soil against flushing out and eroding.
6.3 Channel the water that overflows the escape spillway and the bottom ditch to where you need it: this could be an open pond, an underground tank, or another garden further down.

'Mature' steps – working with subsurface flows:

We have mentioned before that a lot of the action with run-on systems and trench beds happen underground, which makes it harder to understand what is happening.

Research supervised by Professor Leon van Rensburg of the University of the Free State at Mma Tshepo's garden, revealed that there is a waxy layer about 50-60 cm underground, which helps water to flow underground, all the way to the river. This means that by helping more water to infiltrate into the soil, Mma Tshepo is actually also helping to reduce flood peaks and improve the baseflow of the river.

Mma Tshepo's soils are also sandy, meaning that deep percolation happens more easily. She has come up with a plan to reduce deep percolation without waterlogging her beds (drowning them from below). By placing a layer of plastic sheeting or green cow dung in the bottom of her trench bed and about 10 cm up the sides before filling it, she creates an underground pool of water which can spill over the edges of the plastic once it gets any deeper than 10 cm. Ingenious!

Case study 3: Implementation of run-on ditches

In Potshini in 2006, the run-on ditches combined with trench beds were introduced in Potshini through their learning groups. In a way, it is not surprising that the uptake of the run-on ditches was lower than other new ideas, as it is a *very* new idea and it is in fact difficult to observe the difference in one's garden directly, without some way of measuring the increased water.

Only one volunteer, Thabani Dladla, took on the run-on ditches as an experiment. This meant that he observed closely what happened and the supporting research team also placed water measurement instruments in the soil in his garden.



Above is a picture of one of the small trench beds in the Dladla homestead (there are 3) laid out with the run-on ditches, just before planting an autumn crop. Photo: E. Kruger, Potshini 2007.

Participants in the learning workshops felt that they would need guidance and assistance in their gardens to set up a run-on system at their homes. A few did go home and dug a ditch or two to lead water to some of the beds in their gardens. A complete run-on system was not attempted by anyone.

Table 3: Extract from a survey on significant innovations in Potshini

Innovation	Yes	No	Tried but no longer in use or did not try (why not?)	Adaptations made/ comments
Run-on ditches	9	9	Did not know about it – 4 My garden is too small – 2 New garden – 1 Could not make it work – 1	I did not have t o water in summer – 1 Retains moisture and saves water – 1 Perfect – *1* Good results –1 Easy way to water the garden – 1 You do not need to water when it rains – 1



Facilitation Tool 1: Garden layout for run-on: outline and process

Desired outcomes for the workshop

Participants can analyse where water flows in their yards and can dig a ditch/water supply furrow to lead water to their gardens;

Participants can construct a network of level flowpaths/ channels that can feed the beds in their gardens with the run-on water;

Participants can mark out the contours in their gardens to decide where to make their long beds across the slope, mark out the bottom cut-off ditch and

Participants understand that this is a process of observation and trial and error. They know that they can adjust their system over time until it works well.

The learning process

a. Introduce rainwater harvesting concepts: channel, slow down and spread out, sink in and lead off the excess.

b. Using photos of Mma Tshepo's garden, do small-group work to analyse where water flows, how it can be channeled, where it would sink in, and how and where excess water could be lead off to (see Visual Aids section for these photos).

c. Then the small groups do a practical, looking at the same elements in the homestead where the workshop is being held.

d. Then dig the main ditch leading water to the garden and dig a ditch across the top-end of the garden. In an existing small garden (5 m x 5 m on average) this ditch will follow the top fence line and be level or in level sections with spillways in-between. In a larger garden (10 m x 10 m and larger) this ditch is made on the contour using a line level.

e. Then level the run-on ditches around the trench beds, and make the ridges along their sides (i.e. around the trench beds) and the spillways in-between so that water can dam up in the pathways during rain.

Encourage participants to try it and see what it does during rain.

Facilitation process

Introduction to Garden layout and design:

The facilitator will introduce the workshop by explaining that how the garden is laid out can affect how well plants grow. How much sun there is (aspect), wind, cold and using rainwater can all be planned for. The facilitator can make a small presentation using the information provided in this Chapter to give the participants an idea of how weather and topography affects their gardening and some ideas of what can be done. The facilitator then specifically introduces rainwater harvesting through run-on, using the following process:

Group discussions on photographs showing a run-on gardening system:



A small group discussion using one of the run-on photographs, in Phuthadjithaba, Free State. (Photo: E Kruger, WRC, 2006)



A small group using the other photo in their discussion (each group must have a look at both!!) in Bergville. (Photo: E. Kruger, World Vision, 2007)

Divide the participants into small groups, hand out the two photos of Mma Tshepo's system and ask the groups to discuss what they can see happening in the photos. Participants in the small groups need to report back to plenary what they have discussed.

The facilitator then summarises and explains what is happening in the photos.

Assessing the run-on of a garden:

The small groups then to walk around the homestead (we are assuming the workshop is happening at the homestead of one of the participants!) and think through where water runs and where ditches can be placed to channel water to the garden. They report-back to each other and then dig a ditch in the agreed upon place, (where a trench bed can be dug below the ditch to "drink" from it).



A participant in a garden layout workshop in Emmaus, KwaZulu-Natal, presents her run-off map and shows where she will put her main run-on ditch and trench beds. (from Erna Kruger, World Vision Workshop, Bergville, 2008)



Here is an example of a garden where run-on ditches were being prepared during a workshop. It is possible to see the run-on ditches clearly. The raised garden beds are also leveled on their surface to ensure even water distribution of rain of irrigation that is applied directly to the beds. (Photo: E Kruger, Potshini, Bergville, WRC, 2006)

The small groups also look at slope, aspect and wind and make some comments about what interventions are possible.

Individual garden layout plans:

Then, each individual takes the present situation drawing of their own homestead (or makes one if they do not have one already) and fills in on there where the run-off is in their homestead and where they can make a ditch to provide run-on in their garden and place their first trench bed. They give indications of slope, aspect and wind direction as well as an idea of what they are going to do.

Once they have completed these drawings, a few volunteers are asked to present their garden layout plans to the group.

NOTE: It is possible to send the participants home to do this exercise while they are looking at their own homestead and garden (as this is easier than imagining it). They then come together again later to present their drawings to each other.

The facilitator should not prescribe at this point!
Rather let them try! Nothing beats experience.

What to do in a larger garden

Here, as mentioned in the instructions, a contour supply furrow will have to be laid out at the top-end of the garden.

Slope is measured or estimated, so that it is possible to work out how far apart to make contours or erosion control structures on the slope or hillside, so that slopes may be cultivated without being eroded. Contour lines are imaginary lines across a slope that is at the same level (height, elevation). It is possible to mark out contours using a line level. The process of making and using a line level is shown below. You can copy this section as a handout for gardeners when you introduce line levels and how to make them.

Copy & Hand Out 1

Make a line level to measure contours and slope

A line level is an instrument that can be used to measure contours (the levels across a slope) as well as the slope itself.

To make a line level you will need the following materials:

-20 m of line (fish line works well);

-A line level (an inline spirit level is a small plastic tube that you can buy from the hardware and is often used by builders);

-Two lengths of wood about 2 m long; and

-A measuring tape.

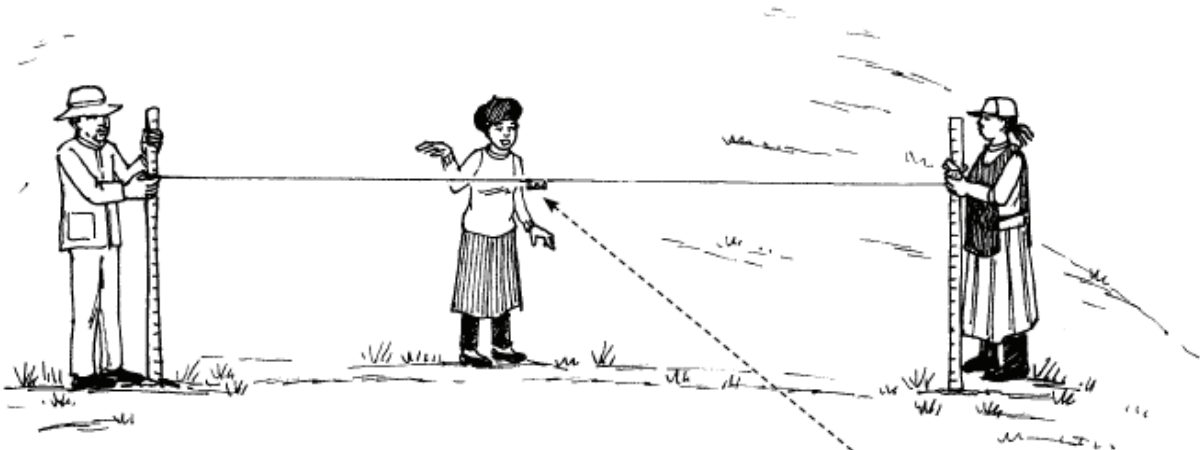
Making the line level

1. Using a measuring tape and a pencil or a fine koki pen mark each pole carefully along its length in 10 cm marks. Number these marks from the bottom.

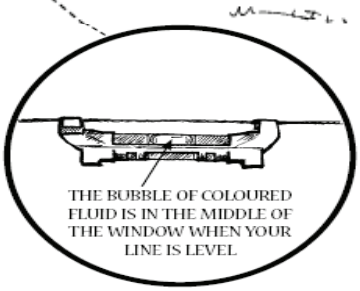
2. The two poles are then linked by exactly 10 meters of string (after you have tied the string to the poles), which should be tied to each pole with a knot that can be slid up and down the pole.

3. Hang the inline spirit level in the middle between the poles. When the string is horizontal, the spirit level is also horizontal or level and the air bubble will be in the middle of the window.

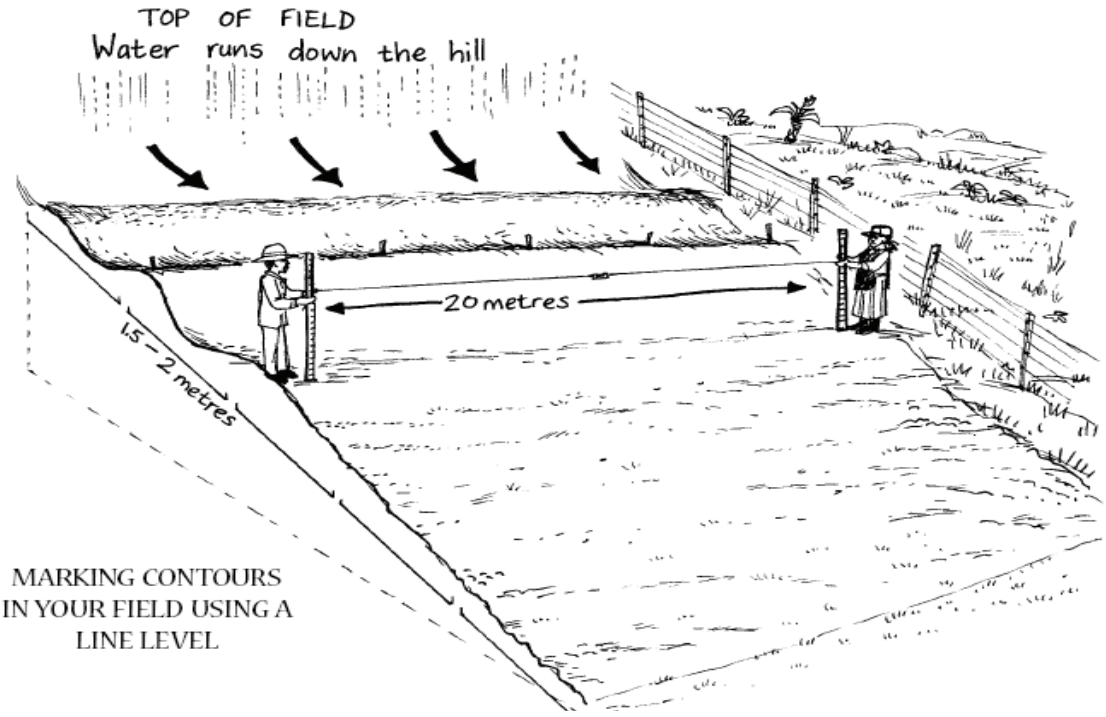
When you have assembled your line level it should look like the picture below. To use the line level to mark contours the string is placed at the SAME HEIGHT (on the same mark) on both poles.



Using a line level to mark contours. Note that the string is tied at the same height on each pole. The bubble of coloured liquid in the line level is in the middle when the poles are at the same height The spirit level itself has to be exactly half way (in the middle) between the two poles.



It is normal to start marking contours at the top of the slope where you are working. You start by marking the first contour. Once you have done that, you need to move down to where you will make the second contour. For a run-on garden, mark them about 1.5 m apart: this gives enough space for a 1 m-wide trench bed and a water/pathway, as well as the ridge that separates the bed from the pathway.



MARKING CONTOURS IN YOUR FIELD USING A LINE LEVEL



Here is an example of a garden in Hlabisa where a contour was made at the top end of the garden – the banana trees with the tall grass (Napier fodder growing behind them) give an indication where the contour ditch was made. From the contour ditch a number of other furrows have been dug as run-on ditches for the trench beds (left and right in the foreground of the photo) (Photo: E. Kruger, Hlabisa, ARC, 2007)

Some notes to the facilitator

The following recommendations can be made for run-on learning processes:

1. Introduce, as a minimum, the idea of water flow and ditches leading water to specific beds (especially if there is an existing garden). Do not be tempted to design a whole run-on system when introducing the concepts.
2. Check what is happening underneath the soil surface – where is the ground wet and how deep is the "wetness"? This is important! Show how sticks or metal rods can be pushed into the soft soil of the trench beds to see how deep it is wet. Otherwise, dig to see how deep the wetness goes. [NOTE: This is best done the day after an irrigation, when the water has had time to seep deep into the soil.] Promote these observations among participants. They should go home and do this on a regular basis.
3. Experiment, try it! And don't give up if it does not seem to work first time.

Basically, as a facilitator:

Do not get too technical; the concept of contours can be left out.....

Don't just talk, also do it;

Assist participants to do this in as many gardens as possible; not just one. The system looks different in each garden and people need to get used to this; and

Don't be tempted to leave it out as a concept because people do not immediately get the hang of it.

Case study 4: Run-on and deep trenching: From nothing to abundance









Photos: Paul Scherzer, Empangeni, KZN.







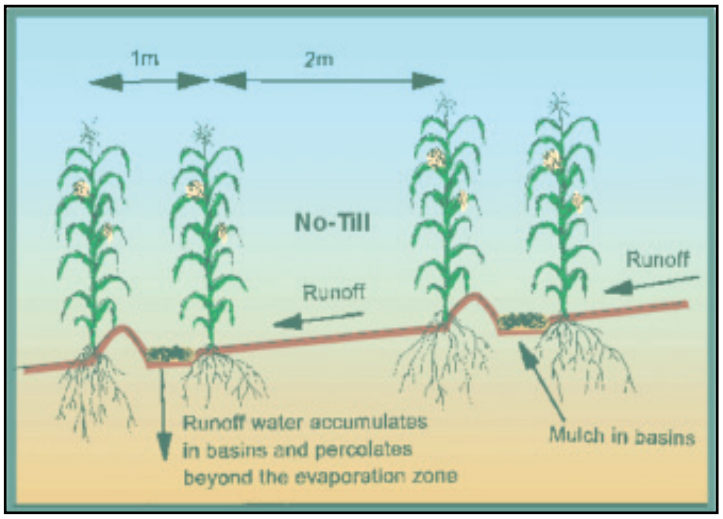
Infield Rainwater Harvesting (IRWH) technique: Turning 'run-off' into 'run-on' in shallow basins on the contour (Botha *et al.*, 2007).

The Infield Rainwater Harvesting (IRWH) technique was developed by the Agricultural Research Council and the Water Research Commission. The initial work was done at the Glen Research Station near Bloemfontein, and then the results were implemented in villages in the ThabaNchu area in the Free State, and later taken to more provinces.

To be able to use this technique:

- The slope must not exceed 7% on non-erodible soils
- The effective soil depth should be 700 mm-1000 mm
- The annual rainfall should be between 400 mm-700 mm
- You should preferably have clay or duplex soils (not sand).

In this technique, rainfall is harvested into basins that catch the run-off water. These basins also help to prevent soil erosion. Run-off water harvested from the un-tilled (unploughed and unplanted) 'run-off area' is concentrated into the planting basins just below them, thus promoting infiltration of water into the soil. Mulch in the basins helps to minimise evaporation. Below is a diagrammatic representation of how the system works and a photograph that gives another view.



'No-till' in the picture means that with this planting system, there is no need to plough.

In the 'runoff area' the soil is quite hard and the rainwater runs off this soil into the basins where the crop (in this case maize) is planted.

Water percolates beyond the evaporation zone in the soil. This means that water infiltrates deeply into the soil.

Figure 20: The Infield Rainwater Harvesting (IRWH) technique
From: Botha, JJ, 2007



Infield Rainwater Harvesting plots planted with cabbage. Water runs off the bare area (called the 'run-off area') and collects in the basins. Crops are planted in rows above and below these basins.

Figure 21: Run-off plots and infiltration basins in a garden situation

5.6 Irrigation planning and management

So far, you have learnt more about several aspects of home water management, including the following:

- Things that individuals can do to save and protect water;
- How much water a household needs and how to work out how much additional water they can get from different water sources in their area; and
- How to lay out a garden to absorb and retain much more rainwater through run-on and deep trenching.

Before we look at different technologies and types of irrigation equipment in the next section, let us now look at two very important aspects of water management, namely:

1. How to PLAN for how much water you would need throughout the growing season; and
2. How to MANAGE your water day-to-day to get the most out of it (stretch it as far as possible).

Planning ahead for the season's irrigation

In Activity 3 we made an assumption that our plants would need 20 mm/week throughout the growing season. This worked out at one 200-litre drum of water per day to irrigate a 60 m^2 garden 6 days per week, and then rest for one day.

20 mm/week is a good assumption to start our planning on, but of course, our plants would not need exactly the same quantity of water week after week!

- When it rains, they need less irrigation (we know how to calculate this (see Activity 4).
- When the plants are still very small, they need less water, but just like human babies, they need it more often. Human babies drink every two or three hours after birth; your seeds/seedlings must never dry out, so check them several times a day in the beginning.
- When plants are making fruit, like nursing mothers, they need extra food and water!
- This often coincides with peak season, when all the plants need extra water because it is extra hot. In cooler periods, plants would need less.
- Towards the end of their life, like older people, plants need less.
- The plants in your garden will be at different growth stages, and of different types – all having their own level water needs from week to week.
- And finally, in different parts of our country, the rainfall, sunshine, wind and other factors are all different, meaning that the water needs of the plants will also vary from place to place.

This sounds too complex to try and predict how much water we would need from week to week, and to try to add up what we would need for a whole growing season to help us plan ahead. But we have to have some idea, because it is very

disheartening to see your plants grow beautifully almost up to harvest time, and to then run out of water and see your hard work die before your eyes.

To solve this complex problem, the Water Research Commission has developed a computer program called SAPWAT for South Africa. There is a similar program that was developed by the Food and Agriculture Organisation (FAO) of the United Nations, which is more general for the whole world, called CROPWAT. The developers of CROPWAT and SAPWAT have shared ideas to improve both programs.

Using SAPWAT to work out the water needs for a garden in different parts of the country and with different crops, we know that there can be large differences in crop water needs. Even if one irrigates plants earlier or later in the day, the water needs are different.

Therefore, we have selected a 'typical' garden situation, with one-third each planted to crops with a high, medium and low water requirement. We then tested the crop water needs for such a garden in a high, medium and low rainfall area to see how great the differences could be. We did such an example for the summer rainfall areas and for the winter rainfall areas, and for summer crops and winter crops for each. From this, we developed a summary recommendation for you to use as a starting point in your area. We worked this out for 10 m^2 of garden so that it would be easy for you to multiply this to work out the needs of your size garden.

Table 4: Average water needs for vegetables in different rainfall areas per 10 m^2 deep trenched garden beds

Types of crops	Summer rainfall area		Winter rainfall area	
	Summer	Winter	Summer	Winter
Spinach (High demand)	2 800 ℓ	3 900 ℓ	6 600 ℓ	900 ℓ
Mixed (Medium demand)	2 500 ℓ	2 900 ℓ	5 400 ℓ	1 000 ℓ
Cabbage (Low demand)	1 000 ℓ	1 900 ℓ	2 600 ℓ	200 ℓ

Note: This is only a guideline based on 70% crop cover.



Activity 7: Estimating garden water needs

Aim

To make an estimate of the water needs of a typical food garden according to the rainfall area.

Instructions

Using Table 4 above, work out how much water your 60 m^2 garden would need for your summer crops, and for your winter crops in your area.

Managing irrigation water: get more 'crop per drop'

Golden rules

Day-to-day, how and when you irrigate your plants has a big influence on how much water you use in the end. Here are a few golden rules:

- Start the growing season with your soil thoroughly wet to at least one meter deep – especially for the dry season crop when there will be very little rain for a few months. At first, the young roots won't reach this water, but the water will stay there and the plants will draw on it later in the season when they may need more than you can give. Wetness in these deeper soil layers also encourages your plant to develop deep roots, which makes it stronger overall, and more resistant to drought.
- Deep wetting, once a week. In very hot periods you can shorten this to once every three days, but give enough water to make sure that it will seep deep into the ground, and not all just evaporate out of the top 10-15 cm of your soil. You can also mulch to help reduce evaporation losses. But NEVER give shallow daily wettings to mature plants – besides the evaporation losses; you are also encouraging your plants to make only very shallow roots.
- Try to give soft, fine showerings rather than big hard drops (which will compact your soil), or gentle flows rather than rapidly running water (which will wash out your soil and expose the plant roots).
- Distribute water evenly across the planting bed. If all the plants get equal amounts of water, you will be getting the most 'crop per drop'. With uneven water sharing between the plants, those plants that get too much water, use too much 'drop'; while those that get too little water, will give you too little 'crop'. In the next section you will learn how to choose an irrigation system to ensure good, even water distribution between your plants, e.g. by making LEVEL planting beds and furrows; by making sure your drippers are never clogged; and by spacing sprayers so that their sprays overlap enough to create equal watering across the whole area. All pressurised systems must at all time work at the pressure they were designed for, otherwise their distribution patterns get distorted and again – some plants will be over-watered while others will be too dry.
- Measure! Monitor! Keep a record of how much water you are giving; how much rain you are getting; and how the level changes in your rainwater tank(s). Every year you will get better at stretching your water to get the most 'crop per drop'. Always dig the day after you have given water to see how deep the wetness goes. Do these until you have developed a feel for how your soil reacts to irrigation and rain; and check again whenever you are uncertain whether the deeper soil layers are beginning to dry out.

How water moves underground

It is so important to understand what happens to water once it enters the soil, that we will look at two exercises to explain this well, namely:

- The sponge demo; and
- 'Water balloons' in different soil types.



Activity 8: Sponge demonstration: Water movement below the soil surface

Aim

To develop an understanding of how water moves under the soil surface.

To observe lateral water movement, uneven movement of water through the soil, and deep percolation beyond the reach of plant roots.

Instructions

Take three hard flat kitchen sponges, and hold them upright, one above the other as shown in the photo below. These three sponges represent the top soil, subsoil and the soil below (deeper than) the root zone.

Now 'irrigate' along the top edge of the top sponge. You can use a syringe or a small jug, moving it to-and-fro to apply water evenly along the whole top length of the sponge. Stop irrigating from time to time to show that the water keeps moving down into the soil even after irrigation has stopped.

Observe how the water (wetting front) moves down through the sponges – unevenly even when the irrigation along the top is applied evenly.

Notice what happens when water starts 'dripping out the bottom' of the second sponge – this is deep percolation; this water is beyond the reach of the plant roots.

In discussion, build the links between soil water deficit, and the way wetting fronts move through the soil. Irrigation can be improved by knowing when the wetting front has passed each of the depths.



Dr Richard Stirzaker (CSIRO, Australia) doing his sponge demonstration with the help of two SADC participants at the 2007 SARIA workshop in Pretoria (WRC Water Wheel, April 2007).

'Water balloons' under the soil surface

Water moves differently in sandy soils than in clayey soils.

- In coarse sandy soils, the water tends to go straight down with little sideways spreading. One needs to be careful not to give too much water at a time in these soils, because it may run down too deep even for mature plant roots to reach. Drip systems may not work well on these soils – better to use irrigation systems that spread the water better across the soil surface, like sprayers.
- In clayey soils, the water does not easily go deep, but tends to spread laterally (sideways). One needs to ensure that water is applied slowly (e.g. with drippers), or can pool on the soil surface (e.g. run-on and flood systems) to give enough time for the water to infiltrate into the soil.

Below are pictures of how the underground 'water balloons' form in different kinds of soil, when drip irrigation is used:

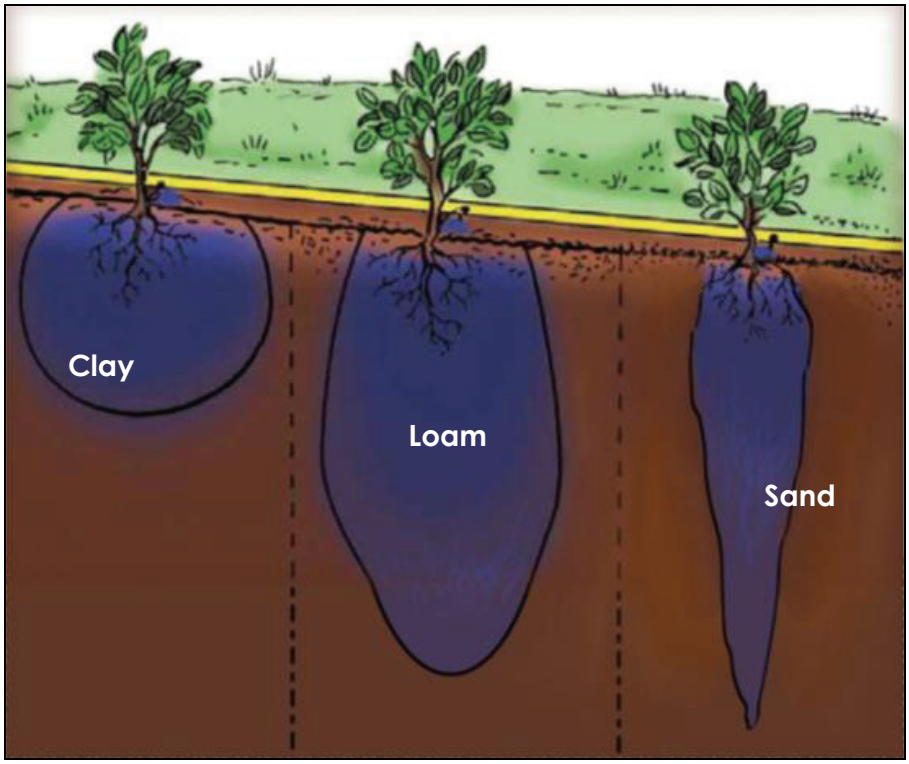


Figure 22: Water distribution underground

When you use drip irrigation, you will see little circles of wetness above ground, on top of the soil. These wet circles may be close together or more spread out and further apart.

Under the ground they may flow into each other.

You will need to check what is happening under the ground to know what the water is doing. You can press a stick or a rod into the ground as far as it will easily go – close to the drippers and then further away – to get an idea of how even the distribution of water is underground.

There may be some dry patches inside the soil, which is why it is more difficult to use drip irrigation with row crops. People usually put one plant next to a dripper, but this is not necessary if the soil has good lateral (sideways) distribution of water underground.

How fast the water comes out of the small hole or dripper will also change how the water moves. The systems that use large holes in the pipes, like the sponge and thread systems are more like a controlled flood irrigation system than a dripping system, as the water pours out rather than drips.

The secret to good irrigation is to check what is happening in the soil!

Take the time!!!



Facilitation Tool 2: Irrigation practices

Desired outcomes for the workshop

Participants can analyze how they water their plants and how water moves in the soil.

Participants can make decisions around how often to water their beds and how much water to apply.

Participants can make informed decisions around the use of drip irrigation, foot pumps or other irrigation technology. NOTE: demonstration of these technologies is required for this part of the

The learning process

a) Participants discuss their irrigation practices, their knowledge of water distribution in soil and different irrigation requirements according to seasons and types of crops grown.

b. Concepts and principles of good irrigation practice are presented and discussed.

c. A practical demonstration is done of water distribution in the soil

d. Further demonstrations of irrigation technology; such as drip irrigation using drip kits, or pumping of water from a stored source to the garden using foot or hand pumps is then given. These technologies are discussed by the participants to gauge their potential application in their situations .

Discussion on irrigation practises.

The facilitator will introduce the workshop and prompt discussion using the following questions. These questions can be discussed by the group as a whole, but it is always a good idea to break participants into smaller groups and have them report their discussion the larger group.

Questions to answer:

What happens to water once you have poured it on your plants?

Can you show with your hands how deep the roots of your plants go into the ground?

Can you then show how deep the water goes?

How do you tell how deep the water has gone into the soil?

NOTE: Here participants generally showed depths of between 10-15 cm for the roots of their plants and the same for the water. It was discussed whether water can go deeper and whether this will affect the depth of the roots.



Recap of concepts and principles of good irrigation:

* The water moves down into the soil over time. The best time to check is just after watering and then a day later. The water should then have moved down as far as it will go.
* How deep the water goes depends on the type of soil, how much water was given and how wet the soil was before watering.
* If you irrigate too little only the soil on top will be wet and most of the roots of the plant will still be dry. This leads to shallow roots developing.
* if you over irrigate the water will either sit on top of the soil and or move down past the root zone and into the groundwater. It will not be available to plants.
* Irrigation needs to be done so that the water will move down to the deepest roots
* If water goes down deep, it will pull the roots down. This strengthens the plants
* Deep watering less often is more efficient than shallow watering more often.
* The way we tend to water by pouring a little water around each plant is shallow watering; our roots are shallow and plants get easily stressed

Practical demonstration

Here, it may be necessary to wet an area the day before, and come back to it for the workshop the next day. This gives the water time to distribute inside the soil. The other option is to wet the area at the beginning of the workshop and come to it, once the discussions are done.

Participants are asked how they would know how deep the water has moved.

NOTE:
The only way that participants said that they could tell whether water was going to the roots of the plant was whether it died or not.

Here it was suggested that people could look how deep their irrigation was going, instead of seeing whether their plants died or not! You could dig with your finger, with a stick, a metal rod like a fence dropper, with a spade even, or with an auger to see what was happening and how deep the water is going.

This was then undertaken in Thabani Dladla's garden (Potshini, KwaZulu-Natal, 2007).
- The roots of vegetables were generally quite shallow (10-15 cm)
- The top 60-80 cm of the soil was dry and then deeper down it was wet. (We had to dig out an area with a spade to find this out!)

NOTE: Here we discussed that the deep water in the soil was due to rain earlier in the week, that Mr Dladla does not manage to keep his soil from 0-80 cm moist for his plants to grow well and that his shallow watering practices have led to shallow roots and plants that are stressed.
On the right, they are observing Thabani's garden, listening and discussing ideas around where the water is or is not!

Participants look at soil in an auger to see whether it is wet or dry



If there are drip kits operating in the area where the workshop is being held, the facilitator can also do the demonstration here. It will show how the water is distributed evenly under the surface of the soil, even though the wetting circles on the soil surface do not touch.





The wetting circles are clearly visible for a drip irrigated cabbage plot, directly after watering. An auger is being used to check the depth of infiltration (in this case more than 15 cm). Then the auger was used to check the infiltration in between the dripper rows, shown by the little holes in the soil (left). This soil was also wet to a depth of more than 15 cm. It demonstrated that the water covers the whole area under the ground, even though it does not look like that on the top and thus the possibility to put another line of plants in between the dripper rows.

On the right is a view of the wetted soil inside the auger. It is easy to see whether the soil is wet and to which depth it has been wetted.



Further demonstration of irrigation technologies.

In the case of Potshini, underground water tanks had already been constructed and people were keen to find ways to get the water out of these tanks that is easier than using buckets. Foot pumps (treadle pumps) were demonstrated.

Below are a few illustrative pictures





Above left; Sizakele has a go on the foot pump to pump water out of the underground tank behind her. On the right Thabani waters the garden using the nozzle fitted to the end of the pipe, while someone else pumps the water.



Left: Job Rotich (SSI) demonstrates how high the water can be pushed by the foot pump.

The foot pump is able to pump water up to a height of about 9 meters, so here is it pumped from the underground tank into the header tank for a drip kit which is about one meter above the ground.

How much water to store for food gardening

How much water should and could a household store for gardening? Again, one needs to PLAN for the season, and then MANAGE the stored water well to get as much 'crop per drop' as possible. The situation is different for winter and summer, and we cannot work it out exactly, because our rainfall differs every year – but we can make good estimates.

Planning water storage

A gardener stores water **in the soil** and in **containers and tanks**.

- The water stored in the soil reduces the quantity that the gardener needs to store in tanks – that is why run-on and deep trenching is so important. Run-on can bring two to three times as much water to the garden than what falls directly from above onto the plants, and deep trenching means that the soil can absorb and store more water than 'normal' soil.

Our calculation here for the required storage assumes that this is for a gardener who **practices run-on and deep trenching**. A gardener not practicing run-on and deep trenching will be able to grow a smaller area with this amount of water storage.

Now we are beginning to think about the three main factors that influence our choices about water storage for gardening; we need to work out the relationship between:

1. Size of garden
2. Size of storage
3. Size of runoff capture area (also called the 'collection area')

To work out this relationship, we need to know

- How much water your garden will need per month in summer, and in winter; and
- The average rainfall for the area in summer, and in winter. Most areas have rainfall records of at least the past 50 years

Water needs:

20 mm/week is the maximum your garden would need in peak season. This is 200 litre per day for a 60 m^2 garden (see Activity x), and a total of about 5 000 litre per month (this is 250 buckets of 20 litres each).

Water needs=5 000 litre per month

Storage size:

If your area often gets no rain in the dry season for 3 months in a row, you will have to store enough water for three months. That is, 3x5 000=15 000 litre.

Storage size=15 000 litre for winter=15 m^3

Capture area:

Now, you will have to make sure that your tank is full when the dry season starts. The

larger the area that you are capturing water from, the more your tank will fill back up during a rainstorm. Here is how you calculate this:

Volume (in m^3 or l) you can capture = rainfall (in m) x capture area (in m^2) x loss factor

We multiply by a 'run off factor' (RF) because some of the water that falls on our capture area does not reach the storage tank. The RF gives an indication of what you can harvest from the rain event. When the area is a roof, some water splashes away; when it is a yard or a field, some of the water soaks into the ground before it can reach our tank. Hard areas work the best to capture water!

Less water runs off when it is raining softly than when it rains hard; and less water runs off when the soil is still dry, than when it has already rained for a day or more and everything is wet. Less water runs off from vegetated areas than from bare areas, but the runoff from vegetated areas will carry less silt which will need to be cleaned out of your tank from time to time.

Select a run off factor (RF) from the table below that best describes your conditions:

Table 5: Loss against the run off factor

Roofs – estimated 15% loss or a RF =0.85
Hard roads or areas – estimated 50% loss or a RF=0.5
Soft soil – estimated loss 90% or a RF= 0.1
Loamy soils – estimated loss 70% or a RF = 0.3

These losses will depend on specific situations and can only be taken as guidelines

Let us assume that your last summer month is March, and that on average, 100 mm falls in March. Water is picked up from a hard road. What area do you need to capture 15 000 litres in that month.

Minimum capture area (in m^2)

= Volume (in l) you want to capture /(rainfall of last summer month (in m) x run off factor)

=15 000 litres/ (100 mm x (0.5))

=300 m^2

Capture area= at least =300 m^2

This is an area of only

(1) 20 m x 25 m (a loamy soil in a yard); or
(2) 60 m x 5 m (a short stretch of street)

NOTE: The larger the capture area, the better!

Gardeners must be encouraged to become very creative with channelling available runoff to their storage tanks, because this greatly reduces their vulnerability to dry periods!

Managing stored water

In our calculations above, we have already seen that it would be a good idea to start the dry season with a full rainwater tank, and with a full soil profile. Our strategies differ for dry and wet seasons.

Irrigation strategy in the dry season

This would be **winter**, in most parts of South Africa. There is no rain, and thus no crops. Or, in some parts, there is some rain, but not enough to see crops through to harvest, so crops may grow well initially, but die before we can benefit from them.

Dry season strategy: START FULL, END EMPTY

1. Start the dry season with the trench beds thoroughly wet, and the water tank full. You will try to use as much water from the tank as you need to get through the winter, and should end the dry season with the tank nearly empty.
2. If you are worried that your water may run out before the end of the season, plant a smaller portion of your garden in the dry season.
3. Decide how many days per week you will irrigate your garden. Divide the garden in equal parts to be watered every day (e.g. if you are planning to irrigate five days per week, divide the garden into five parts).
4. IRRIGATE ONE PART OF THE GARDEN PER DAY, do not try to give a little bit of water to every bed in the garden every day. (The exception is for seeds and seedlings, which need a small sprinkling once or twice a day until their roots area strong and deep enough to cope with less frequent watering).
5. Keep an eye on how much water remains in the tank, and how long before the next rain is expected. Write this down every day, so that next winter you can try to benefit from this year's experience.
6. If it looks as if your water will run short, decide which crops are most valuable to you, and keep them going with the water you have left. It is better to lose a few beds than to harvest hardly anything from all your beds. Keep in mind that some types of plants need less water than others; e.g. cabbage uses less water than spinach. So in a crisis you may decide to save fewer spinach plants and more cabbage plants.

Irrigation strategy in the wet season (Points 2-5 above also apply here)

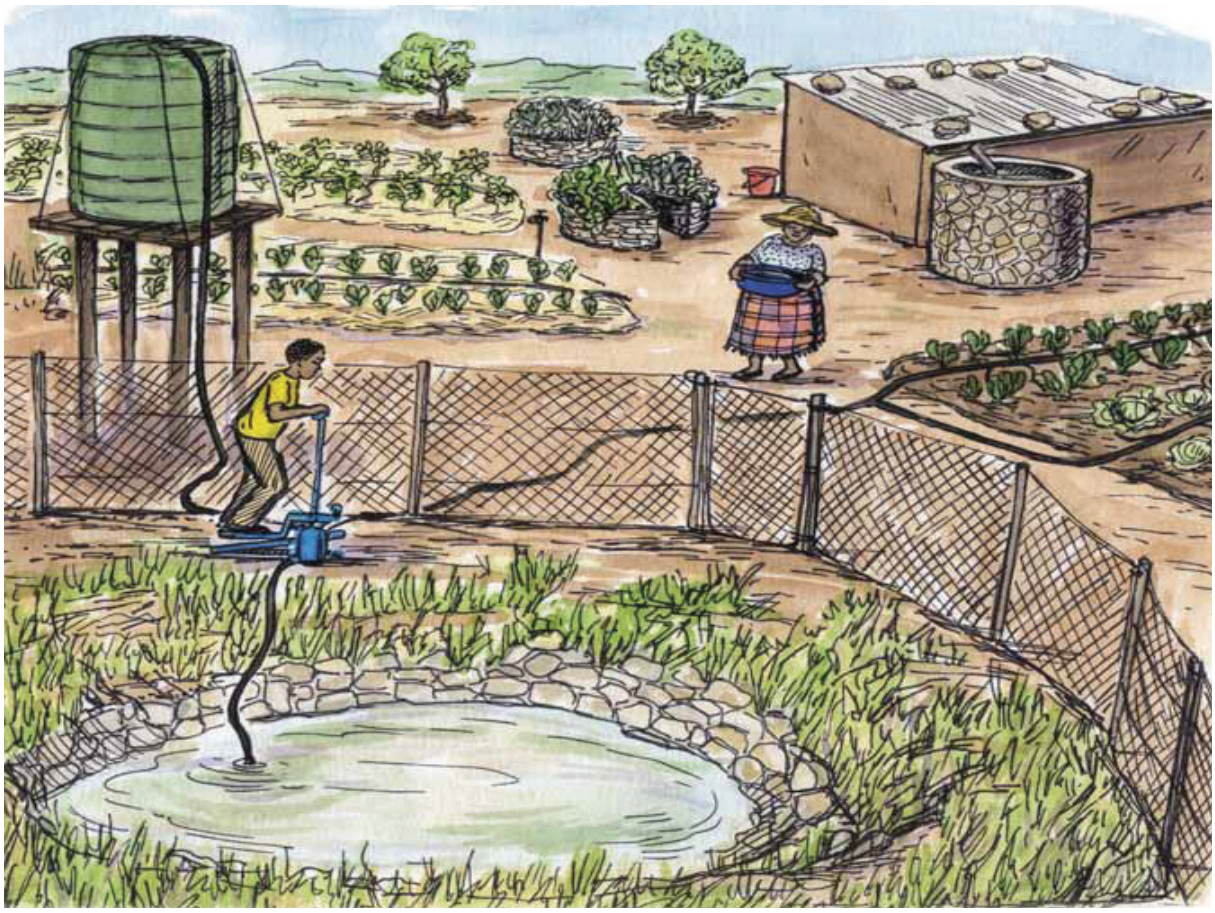
This would be **summer** in most parts of South Africa. Some years there is an abundance of rain, but some years can be very dry. A very difficult problem is when there are long dry stretches in an otherwise good rainy year, and this is where stored water will help you to save your plants. It is hard to predict when to expect a good or bad rainy year; therefore we have to plan for the worst, or 'almost the worst'.

Wet season strategy: START EMPTY, END FULL

1. If you can wet your beds thoroughly at planting, this is always a good strategy. Your rainwater tank will be nearly empty if you have made good use of it during the dry season, but should fill up quickly with the first few rainstorms.
2. You will then need to balance your irrigation with the amount of rain that has fallen, so that you do not irrigate unnecessarily. Remember the calculations in the sections above

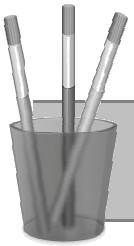
During really hot dry weather you will need to irrigate more, but by now your tanks should be full and you can empty it dealing with these "dry spells" so that it can refill. The assumption is that your tank should be able to fill up at least twice during the summer season and should be full for the start of the winter season.

5.7 Technology and equipment



In this section we will get practical about technology and equipment that the rural household can use in their yard to manage their water effectively. This includes the following:

- Water storage options for rural households
- Pumping options
- Applying water sensibly
- Irrigation technology
- Operation, maintenance and self-monitoring



Activity 9: Household water technologies

Aim:

To recognise technology and equipment for use by rural households.

Instructions:

See how many technologies you can recognise in the picture above.

How a rural household can store water

Raw water storage for home food production captures run-off from the soil surface during rainstorms, and stores it for use during dry periods, usually in underground tanks, now often called Rainwater Harvesting (RWH) Dams.



Left: This RWH Dam fills from surface run-off, and has a safe overflow structure in the foreground. Notice the good quality roofing material with a sturdy trap door back right.

The concept of raw water storage for home food production follows on from, and is best used in conjunction with the practices of deep trenching and run-on:

- As described in the sections above, deep trenching and run-on enables considerable **intensification** by concentrating water and plant nutrients in the plant-rooting zone in the soil – in an affordable manner.
- Raw water storage is an **additional strategy** which provides **water security** as follows:

– In *dry spells during the rainy season*, thereby providing security against food losses for the family; and

– By enabling production during the *dry season*, thereby providing a source of food to the household during the off-season period when production was traditionally not possible.

In most parts of South Africa, storage of roof run-off in above-ground tanks does not contribute to food production, for two main reasons:

- Roof run-off provides very much less water than surface water, meaning that the tank does not fill up regularly enough to enable sufficient water for food production; and
- Roof run-off is generally clean enough for drinking. In rural areas, drinking water remains scarce and unreliable, meaning that most households would nurture the water in such above-ground tanks for that purpose, and would not readily use it for production.



Gogela, EC. (DWAF, 2007) Roof run-off tanks provide too little water for food production. This household, like most others with roof run-off tanks, save this water for drinking and cooking.



Another example in Potshini (KZN) (DWAF, 2009) that has a flexible gutter attached to the tank. This makes it a lot easier to install the system and get the water from the roof gutters into the above ground tank

Raw water storage for home food production therefore focuses on the storage of relatively large volumes of water (typically 20 000-30 000 litre) in underground tanks; whereas roof run-off is stored for drinking purposes in above-ground tanks (typically 2 000-5 000 litre). The underground RWH Dams are thus typically six times the size of roof run-off tanks for drinking water.

Siting of underground storage tanks/ RWH dams

The RWH dam will be a dominant feature in the household's yard for many years into the future, therefore its positioning is important to the household. The household captures its garden and RWH layout planning in their own 'helicopter plan', which is simultaneously a household food security visioning and a five-year food gardening action plan.

The most critical consideration in positioning the RWH dam is to ensure that adequate rainfall run-off will enter the RWH dam during rainstorms. Where hard impermeable surfaces are available, the opportunity to capture occasional showers in the long dry season would increase the effectiveness of the RWH dam dramatically.

Other considerations include ground conditions, surrounding structures, and how close the RWH dam is situated to the garden. The labour involved in extracting and carting water also needs to be taken into account.

Some principles of siting RWH Dams for home food production are briefly summarized here:

a. To start with, make a careful evaluation of the site in terms of which way the ground slopes, the location of all existing structures, the existing vegetable garden, any adjacent roads or fields that may be at a higher elevation, which areas are hard and which are soft, possible roof run-off and surface run-off from hard areas.

b. If the site has a steep gradient, then the dam can be constructed with an additional 'outlet' pipe at its floor level that leads out and through the downside embankment at which point there should be a valve. In this case, if possible, the garden should be situated below this point. This means that the RWH Dam may sacrifice some catchment so that the garden may be gravity fed. This is shown in the contour and run on map in the figure below

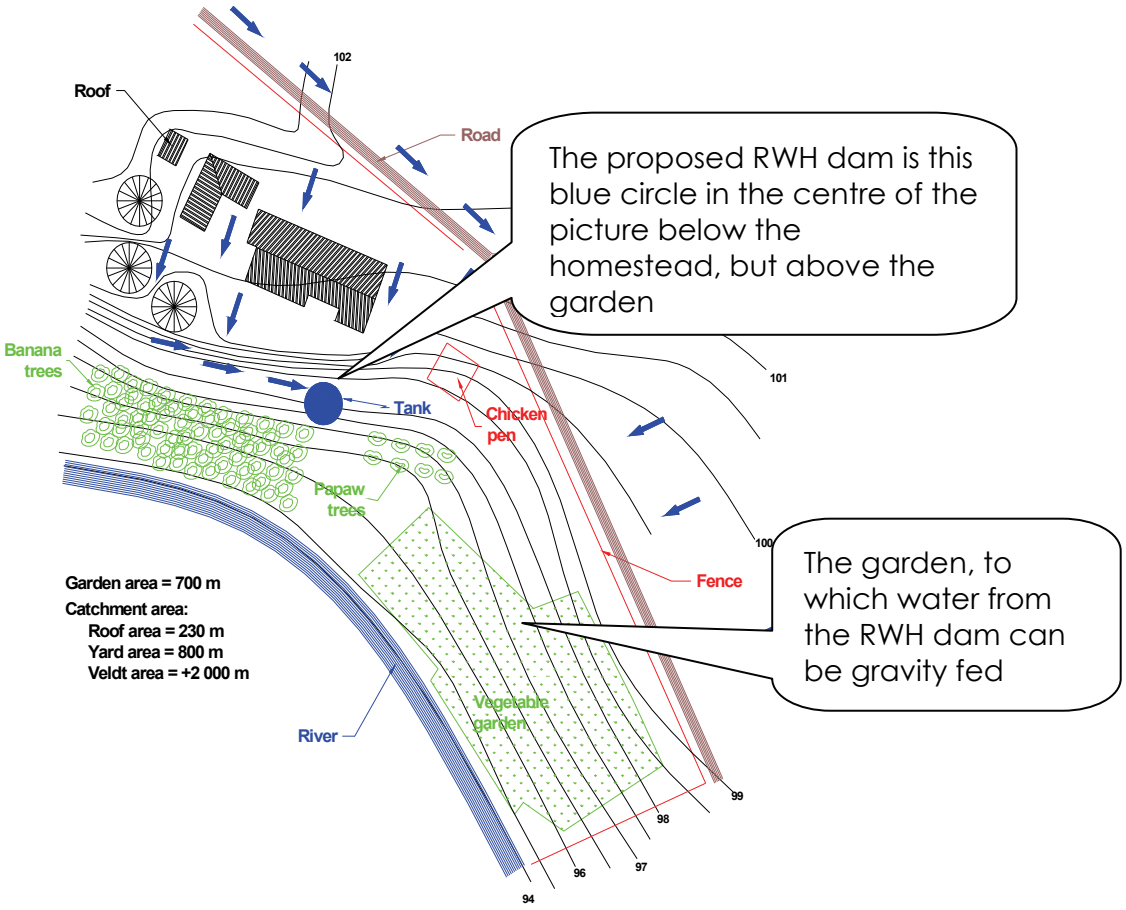


Figure 23: Run-off (blue arrows) and contour map (black lines) of a homestead in Umbumbulu (KZN) (DWAF, 2007).



This photograph depicts the same homestead shown in the map above. You can see the homestead at the top of the ridge, the RWH dam diagonally below that and here a visitor is standing in the vegetable garden below. Water from the dam is gravity fed here

c. If the site has a substantial catchment from an adjacent field or road that is at a higher elevation, then the garden could be sited so that the flow from these areas would flood the run-on collector-pathways around the trenches first, and only then lead onto the RWH Dam, which would then be situated at an elevation lower relative to the garden. Likewise, if the garden is above the dam, it should ideally be sited downhill of any hard ground such as court yards, driveways, or other impermeable surfaces, such as steel sheeted roofs.

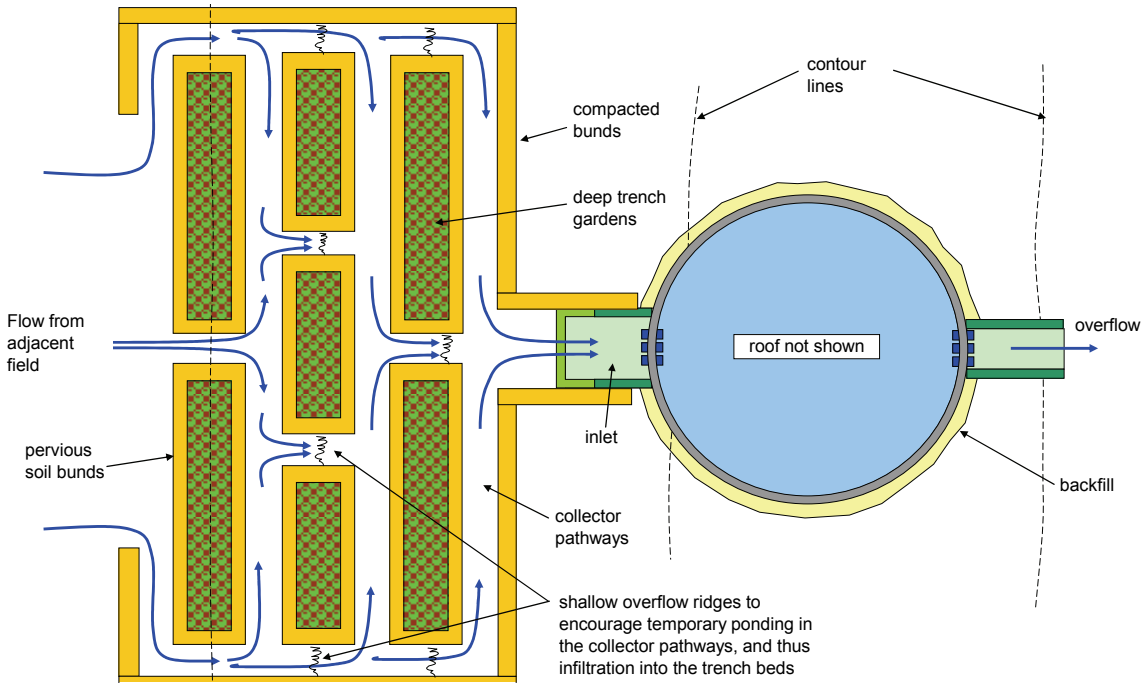


Figure 24: A schematic diagram of a garden with trench beds (yellow and green blocks) situated above a RWH dam (blue circle), showing that the run-off water first flows through the garden and then into the RWH dam below

d. Where irrigation is going to be via buckets, the garden and RWH Dam should be situated as close to one another as possible.



Here is a RWH dam constructed in Umzimkulu EC, (DWAF, 2009) showing that the dam is on the same level as the garden and is situated in one corner of the garden. Water is carried with buckets to crops.

e. If the ground is very soft and porous and unlikely to have much runoff, or if the yard is situated on the watershed and thus unlikely to produce much run-off, it may be necessary to opt to harvest roof run-off into an underground or above-ground dam. The RWH Dam (and thus the production area) should then be downsized to the amount of run-off expected to be available, considering the size and type of roof and the amount and frequency of rainfall typical to the area. An outlet valve at the floor level of the dam would allow gravity feeding to the garden, which should ideally be placed down-slope of the RWH Dam.

Please note: This option should be viewed as an exception to the rule, as surface run-off is the preferred source for production, as explained before.

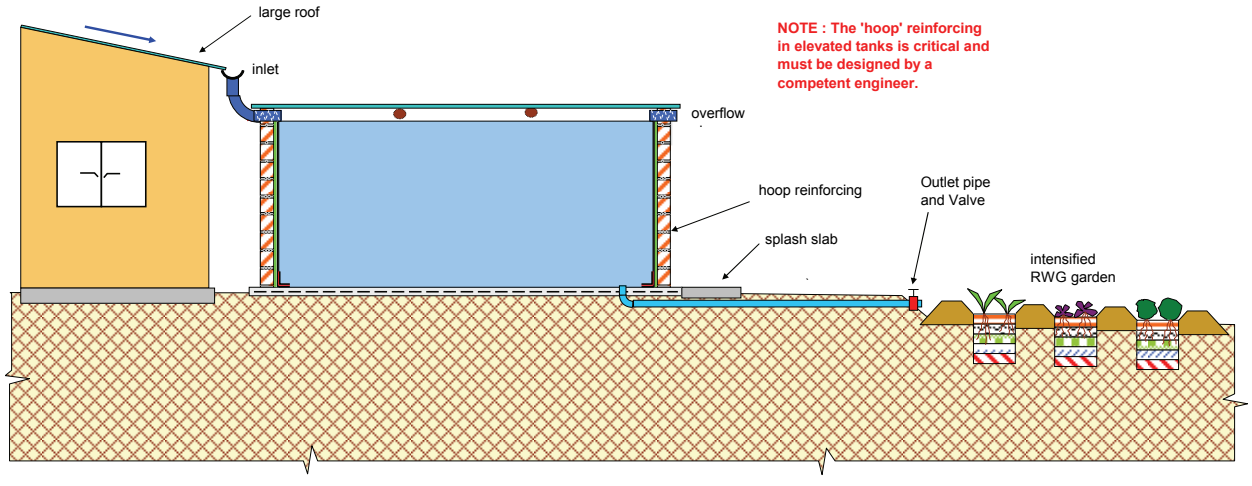


Figure 25: A schematic diagram of a RWH Dam built above ground when it is not possible to construct the dam underground.

f. It may be advantageous to construct berms or trenches to redirect runoff towards the RWH Dam's inlet rather than allow it to run past.

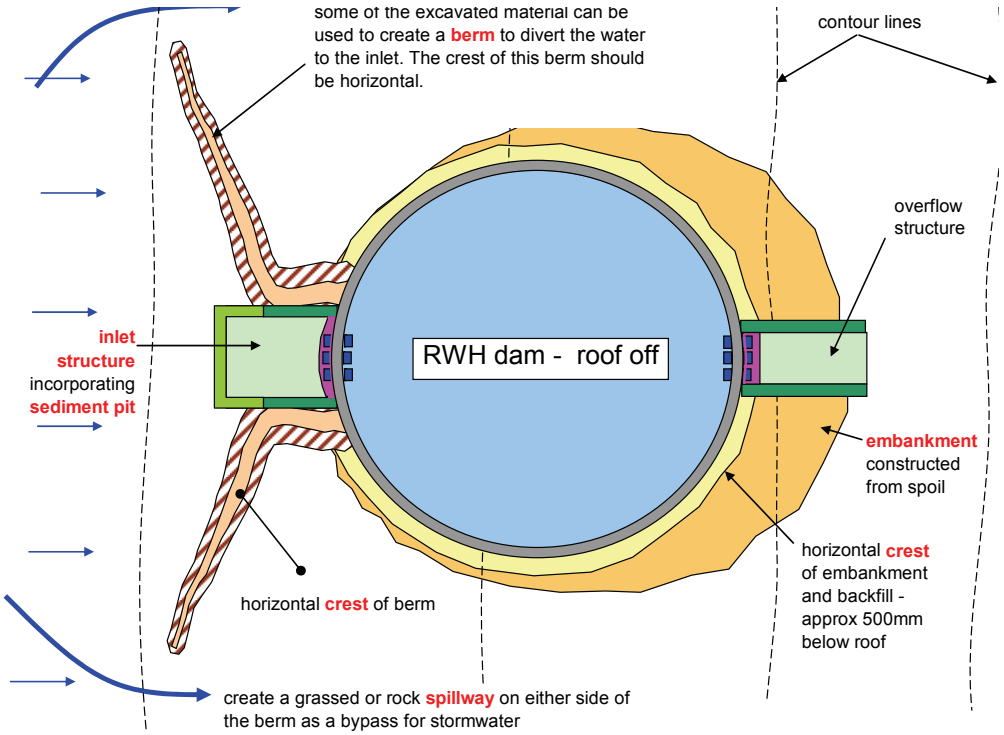


Figure 26: a schematic diagram of a berm or ridge (cross hatched brown structures) constructed to redirect run-off into an underground RWH dam (blue circle).

Construction of RWH dams

RWH Dam structure

During the Demonstration Phase of the Department of Water Affairs and Forestry (DWAF) RWH Pilot Programme, more than sixty experimental RWH Dams were constructed in 26 villages in four provinces. Five different implementing agents tried out several shapes, elevations, building materials and construction methods, with design assistance and construction advice provided by the Core Team.

From the lessons of experience during this experimental phase, a number of recommendations were derived. These are summarised in the table below.

Table 6: Recommended size, shape and elevation

- **Standard size: 30 000 litre**

– This provides enough water for year-round vegetable and fruit production of 100-200 m^2 in the yard (when combined with run-on RWH). This enables a constant year-round flow of micro-nutrients in the household to prevent malnutrition and stunting.

- **Shape: Round** [walls: cylindrical; floor: flat]

– A round shape is geometrically stronger, and less prone to cracking and leaking than square or rectangular tanks. A flat floor helps the household to leave a few centimetres of water to protect the floor and wall/floor joint from drying out and cracking.

- **Elevation: Underground**

– Tanks are built underground to catch both roof run-off AND surface run-off. In sloping areas, half-buried dams can still catch those all-important large quantities of surface run-off.

How a rural household can pump water

Treadle Pumps

One person can mostly operate a treadle pump and because they depend on human power, they pump relatively small amounts of water when compared to motor pumps/ engines.

They are therefore suitable for users who do not need too much water at a time, such as homestead gardeners and small commercial market gardens.



A treadle pump in use (Limpopo, 2007). And a close up view of the treadle pump showing its two cylinders, the inlet (yellow) pipe from the RWH dam and the outlet (black) pipe to an irrigation fitting or tank. (Lesotho, 2005)



A standard treadle pump can generally lift water 20 meters vertically, or drive it at least 200 meters horizontally, depending on the pipe diameter (See also Facilitation Tool 2 above some indication of how treadle pumps are operated and how high they can lift water). The number of litres that a treadle pump can pump depends on the strength, age, fitness and gender of the person operating the pump, and on the height to which the water must be raised. It averages out at about 1400 litres per hour. It takes much less time and effort to pump the water than to collect it in another way, such as carrying it in buckets.

It is possible for an average person to pump around 500 litres of water in 10 minutes. This is the same as 25 x 20-litre buckets of water!

The table below shows how long it would take to pump the water required for a household of five people, or for irrigating various sizes of land.

Table 7: Pumping times for household and irrigation water requirements

Household water, 25 ℓpd for 8 people = 6 kl/month	**Volume litre (ℓ)**		**Number of 10-litre buckets**	**Pumping time (hh:mm) at various pumping rates**		
				0.4 litre/s	**0.8 litre/s**	**1 litre/s**
Daily Weekly	125 875		12.5 87.5	00:05 00:36	00:03 00:18	00:02 00:15
Weekly irrigation requirement (mm)	**Area (m^2)**	**Volume (litre)ℓ**	**Number of 10-litre buckets**	**Pumping time (hh:mm) at various pumping rates**		
				0.4 litre/s	**0.8 litre/s**	**1 litre/s**
1 mm	1	1	0.1	2 sec	1 sec	1 sec
Baseline (above): One litre of water is needed to put 1 mm irrigation on 1 square meter. *This would take 5 seconds with a treadle pump at 0.2 litre (ℓ) /second pumping rate.*						
25 mm	1	25	2.5	00:01	00:01	00:01
	10	250	25	00:10	00:05	00:04
	50	1250	125	00:52	00:26	00:20
	100	2500	250	1:44	00:52	00:41
	150	3750	375	2:36	1:18	1:02
	250	6250	625	4:20	2:10	1:44
	500	12500	1250	8:40	4:20	3:28
	1000	25000	2500	17:21	8:40	6:56
Highlighted example (above): *A person would need to pump 52 minutes per week (e.g. **10 minutes per day** for 5 days out of a week) to supply 25 mm of irrigation to a **100 m^2 home food garden**, using a 0.8 litre/second pump.*						

Applications and Specifications

Generally pumps have certain design specifications which determine how much water they can lift, how far and for how long. Buying a generalised pump that does not have the correct specifications for a specific situation, the pump could be inappropriate

The following questions need to be considered to form a picture of what households in a particular community are presently doing and what types of pump (and their

specifications) will be required:

- *Are people watering gardens now, when, what with, how much, how frequently?* If the people do not water their gardens now, there is probably either no water available, or people in the area feel irrigation is out of their reach, or irrigation is not considered because it had not been practiced in the area before.
- *What is the water source, access to potable water (the first priority), distance, suction height, and pumping height?* If the water source is not accessible by treadle pump, there is no point in promoting it.
- *Will attention have to be given to water sources, spring protection, small dams, wells in dry stream beds, wetland protection, household rainwater harvesting dams, etc?* If the water source is accessible by treadle pump, the water source may need to be modified in order to make it suitable for pumping.
- *What limits irrigation – fenced land, or water, or time and effort to get the water distributed?* If the limits to irrigation cannot be overcome, there is no point in promoting treadle pumps or food gardening.
- *Will the pump be communally owned or shared or individually owned; must it be locked up at night?* If the pump must be shared or locked up at night, it must be portable.
- *Who will be doing the pumping, and when, and will this vary?* For example, if the pumping will be done by children on Saturdays, the pump must be light to operate and there must be storage for the water so that other people can use the water during the week.
- *What irrigation method/s is envisaged: furrow, basin, bucket from drum storage, mini sprinkle, drum/drip etc?* The answer to this question affects the flow rate of the pump that must be recommended, the length of hosepipe that is necessary, and how the water should be stored.
- *How would the pumps be distributed and sold – through local stores, hardware channels, NGOs, etc?* This affects planning and costing for warehousing, advertising, training and representatives.
- *Price, credit, spares back-up?* These also affect planning and costing for warehousing, advertising, training and follow-up.

It would be difficult to fit an existing pump to all the requirements specified above; ideally, an appropriate pump should be designed according to local requirements.

This raises three other very interesting and important questions.

The first question is: *What are the actual crop irrigation requirements?* When one studies this from research results and field observations and from using the simulations available from SAPWAT, it becomes evident that there is probably a tendency to over-estimate the water that is required, and that probably most people give far more water than is really necessary, which can be detrimental. In this case, it means that the capacity of the standard pump is may be too high.

The second question is: *Is it necessary to have a two-cylinder pump?* There are good reasons for having two cylinders, such as getting a uniform flow and evening out the treadling action, but if smaller flows are required, a single-cylinder unit may suffice. This has been developed in Kenya recently and, because of the fewer components

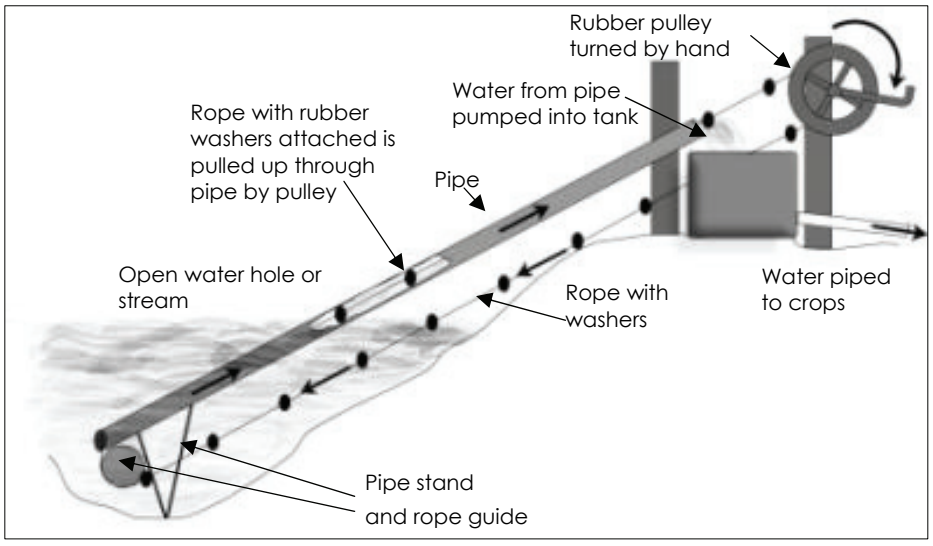
that it uses, particularly valves and pistons, it cuts the cost very significantly.

Taking it further, one starts to wonder: *Is it really necessary to have a treadle pump at all?* Possibly a more conventional hand-operated pump, stirrup pump with a single cylinder or hand-operated diaphragm pump would be adequate for most of the purposes for which the pump is likely to be used. In some cases this may bring the cost down considerably.

The treadle pump market in South Africa is still relatively undeveloped, which dampens possibilities for new designs. Good quality units imported from Kenya are currently more affordable than locally manufactured units (See Farmers handouts for Chapter 5 for further details regarding buying treadle pumps).

Rope and washer pumps

This type of pump can also be used although it is not common in South Africa. The advantage of these types of pumps is that the technology is fairly simple and can be maintained by the local 'mechanic'. Below is a schematic drawing of how a rope and washer pump works



What types of irrigation a rural household can use

In this section we will focus on drip irrigation, as a technology that has been promoted in South Africa and as a technique that saves water, time and labour.

Drip irrigation

Small-scale drip irrigation has been around in Africa for at least 30 years. It is usually called bucket-drip irrigation or drum-drip irrigation, depending on which water storage container is used. Water poured into the bucket or drum, slowly trickles into the soil around the plants via dripper pipes that run from the bucket or drum, which is placed with its bottom at least 1 m above ground level to provide pressure for the water to drip out. The water passes through a small filter to prevent that the drippers get blocked. Small-scale drip irrigation is often supplied as a kit, with all the components packaged in the drum itself – from there the term 'drip kit'.

A bucket- or drum-drip system is operated on a volume basis – the container is filled to a fixed level, and allowed to drain completely. Despite the fact that the drippers operate at only about 10 to 15% of their design pressure, sufficiently uniform water distribution is still achieved because the dripper lines are very short.

Drip irrigation enables the farmer to make use of limited amounts of water and fertiliser, and allows precise application of the water and fertiliser, directly to the root zone. Completely dissolved fertiliser can be administered through the drip kit – either inorganic fertiliser, or home made liquid fertiliser, made from kraal manure or plant extracts.

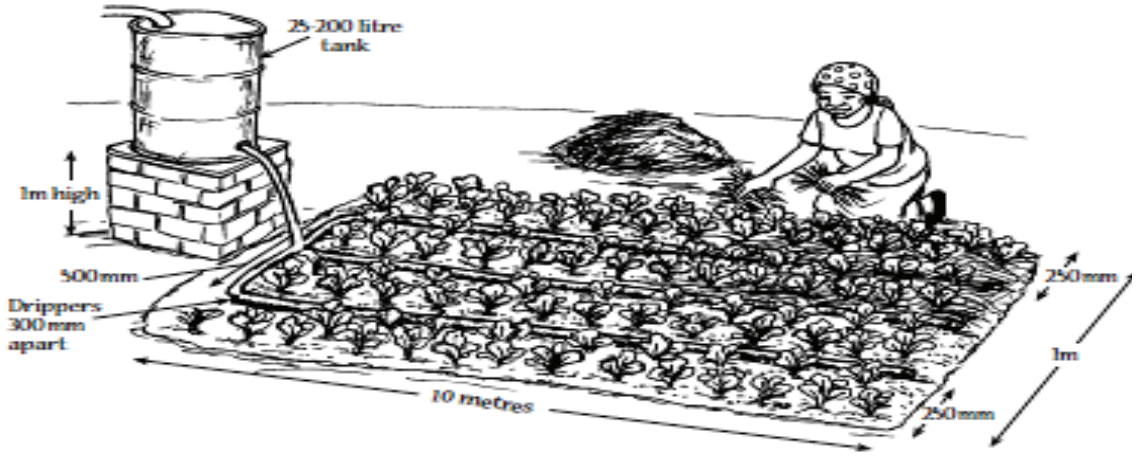


Figure 27: Drum-drip irrigation system in a home food garden

Drip systems require clean water to avoid blockages; therefore surface water needs to be filtered before it can be used. A simple in-line garden filter can be used in most applications. The drip lines must also be flushed weekly to prevent soil particles from building up in the pipes.

By not wetting the full surface, drip irrigation reduces weed growth, and minimises losses due to evaporation, runoff and percolation. Thus the system reduces the labour required to irrigate and weed the crops. This is seen as potentially important for vulnerable people, whether they are aged, disabled or weakened by the effects of HIV/AIDS.

However, although it is popularly viewed as one of the most water-efficient types of irrigation, the soils in large parts of SADC are not suitable for drip irrigation, notably coarse sands and severely crusting soils. Drip kits are somewhat more flexible and can be used in more difficult soils than conventional drip irrigation, since drip kits can give very small amounts of water on very short cycle times, even twice a day.

The drip kits are generally viewed as low-cost and easy to assemble and manage. There have been high returns in an arid part of Kenya by combining RWH into farm ponds with bucket or drum drip irrigation kits.

In summary, drip irrigation allows precise application of small amounts of water directly to the root zone. It is thus believed to save water and is seen as an appropriate intervention in areas where water is scarce.

The table below provides a summary of some of the main features of drip kits. The table expresses the general assumptions that water is saved, greater productivity is achieved and yields are increased.

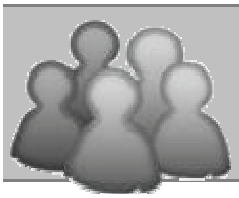
Table8: Summary of main features of bucket and drum drip irrigation kits (IWMI, 2006)

Uses	Precise application of irrigation water to plant root zones
Necessary conditions	Dry area or growing season, and relatively small amount of water available; perception of water scarcity Reliable source of clean water within carting distance Wheelbarrow, treadle pump or similar, to enable transport of water for distances up to 300 metres Soils suitable for drip irrigation (for example not too coarsely sandy) Access to good output markets may increase the returns, but the kit can be used to produce own-use vegetables Reliable supply of spare parts. A local trader should be identified who is willing to stock the necessary spares Availability of skilled installation and repair services An effective programme of promotion and support, i.e. good technical and agronomic advice and training. This would probably entail donor/NGO support for five years or so to establish a sustainable programme Support on cropping techniques, including cropping calendars and irrigation scheduling Pest control using cheaper traditional methods or integrated pest management
Advantages	Raises productivity of water, land and labour; reduces loss of water In principle very low cost, robust and simple Some versions – fertilizer can be combined with irrigation water Can be targeted to poor, women, disabled people Available in different sizes, from 10 m^2 up, so can be adapted to land and water Usually portable and easy to share — they can be moved or kept at home Higher yields, better quality crop, shorter maturity which should enable higher profits
Disadvantages	Currently no effective examples of programs targeted to poor farmers in SADC Insufficient local manufacturing capacity Poor support—tend to be distributed for emergency relief which by their nature suffer poor sustainability Dirty water can cause clogging Inadequate institutional support Are, in most countries, either not available or too expensive Do not have easily and reliably available spare parts Do not have easily available repair expertise Require at least some cash outlay, which makes it difficult for poor farmers to adopt them in most SADC countries

While there are numerous individual farmers in Africa who have benefited from low-cost bucket and drum drip kits, there is no evidence of successful implementation on

a larger scale. This is in contrast to South Asia, where there has been considerable success, both in terms of market-driven systems aimed at relatively better-off farmers, and in terms of targeting poor farmers.

Drip irrigation can thus be used if care is taken that the system is maintained. The pipes are also very vulnerable to damage by hand tools or other means. That means households will need continued support over many years when using drip irrigation.



Case study 5: Drip irrigation experiments in Potshini: Three variations

In Potshini, drip kits were introduced because they were seen as a potentially useful technology to manage the use of water – in particular to save water and reduce the labour required for irrigation. Three different drip kits were tested in Potshini:

- A 200-litre drum kit (introduced through the SSI programme from UKZN);
- A 50-litre bucket drip kit (introduced through the WRC team); and
- A 20-litre disposable micro-kit (introduced through the SSI programme from UKZN).

From the table below, it can be seen that people found the drip kits somewhat tricky to manage. The idea that they provide a given amount of water every time is potentially a good one; except that here experimenters felt that the kit did not provide enough water:

Table 9: Significant innovations (extract) – Drip Kits

Innovation	Yes	No	Tried but no longer in us or did not try	Adaptations made/ comments
Drip kit	5	13	Only a few drip kit volunteers (9 disposable kits and 2 others)	No longer in use because it did not supply enough water to the plants – 2 Waste of time – 1 It helps if I don't have time – 1 Very good for lazy people – 1

Potshini Example 1: 50-litre bucket drip kit (Sizakele)

Right: Sizakele installing her dripper lines with the help of the local community facilitator, Mr Thabani Madondo.



The 50-litre bucket drip kit is a system for which all components are readily available from local hardware stores. It is possible to build this system to suit most circumstances.

Description

This kit consists of a 50-litre bucket placed on a stand, at least one meter above the beds. An inline filter is installed below the bucket. Six dripper lines (laterals) of about 2 m long can be linked to the system. Drippers are screwed into holes punched into the mainline pipes. The distance between drippers can vary according to the gardener's own preference. The pipes are standard irrigation piping and the joints are standard connectors.

Experience

Sizakele felt that enough water was applied to her beds. There were very few problems with drippers or lines clogging.

There was, however, an issue with the joints leaking. This took some time to rectify, as Sizakele felt unable to fix these herself. It took the combined efforts of the local facilitator and a supporting engineer to rectify the problem.

Sizakele had to go and collect water for the drip system from a standpipe around 300 m away. She filled the bucket twice a day.



Left: A picture of the joins between the main dripper line and the leading lines after it was fixed.

Advantages

- The drip kit provides a system of measured irrigation without much fuss;
- It saves time, in that once the water has been fetched, it can be poured into the bucket, the tap switched on and the rest can happen automatically;
- It is flexible, in that distances between drippers can be gauged by the gardener him/herself;
- Bed preparation is flexible, and as a system, the drip kit can be used on any type of bed, including (with some reservation) on trench beds;

- The system is robust and withstands general wear and tear and weather conditions;
- It is cheap and technically relatively easy to install; and
- This system can save time.

Disadvantages

- The gardener did not feel confident to maintain the system herself;
- The source of water was a bit far from the homestead;
- It is debatable whether this system does in fact save water, as the same amount of water, or more even, was applied to this bed as to others watered more conventionally with buckets;
- As gardeners are not thinking about where the water goes and little of it is visible on the surface, over-watering can be a common problem. Obviously this is not a problem with the drip kit itself, but with the way that people habitually make decisions around irrigation scheduling; and
- It is unlikely that gardeners will expand their drip system by themselves.

Potshini Example 2: 200 litre drip kit (Thabani Madondo)

The 200-litre drum drip-kit was installed in Mr Madondo's garden through the SSI programme (UKZN) around 2005.



Right: Mr Madondo's 200 litre drip system in the winter of 2005.

Description

The drum is large and placed on a 1 m high platform. The mainline and laterals cover an area of 10 mx 20 m. The laterals are spaced from 10 cm through to 50 cm apart, to accommodate different crops and spacings. Drippers themselves are moulded into the laterals.



Left: Onions and spinach planted in the drip irrigated area. The different spacing of the laterals can be seen.

There is an inline filter below the drum in the mainline.

Right: A view of the in-line filter.



Water for the 200-litre drum used to be obtained from a standpipe across the road. With each trip he could carry two 25-litre buckets, necessitating 4 trips, twice a day. Later, he was able to start using his new underground rainwater harvesting tank to provide water for the drip kit. The installation of a demonstration unit of the treadle pump by the WRC assisted greatly in easing the task of water supply to his drum-drip system.

Experience

Mr Madondo, as with most people using drip kits, prepares the soil for planting without taking up the dripper lines again; therefore only shallow incorporation of manure is done in the proximity of the drippers. He plants one seedling per dripper. The overall effect is somewhat of a "desert effect" – plants seem to be spaced far apart and have too little nutrition. The soil in the drip area is compacted and hard, and looks dry.

Advantages

- For this system, saving of time was seen as a definite plus by Mr Madondo. Being a larger system, a larger area is irrigated all at once. Mr Madondo, as the local community facilitator and development champion, was also an exceptionally busy person. It was a great advantage to him that he could fill the tank and continue with other work.
- He did not over-irrigate as most other smallholders with dripkits tend to do; probably more for the sake of expediency than any other reason – i.e. he did not always get time, or remembered to water every day or twice a day.
- The layout of different spacing allowed planting of different crops, which made it more flexible as a system.

Disadvantages

- The drippers often got clogged up, and a lot of maintenance time was required unblocking them. Mostly this consisted of opening the stoppers at the ends of the laterals and flushing them. Drippers needed to be replaced often. Mostly this was done by the SSI students, rather than Mr Madondo himself.
- Again, soil preparation in the area of the drip kit was a bit lacking and crops did not grow that well.
- The concept that the water is provided under the ground and that all the soil under the drip kit is wet, was difficult even for Mr Madondo, to use positively. One plant per dripper seems an absolute standard, although much denser planting would be possible, given that underground, the soil does in fact get wet right through. Most often, the drip systems are promoted in this way by extension staff and manufacturers. It leads in a smallholder environment to a lot of bare soil. Gardeners also tend not to do mulching in these areas.
- Being a slightly larger system can also be a disadvantage when time and availability of water could lead to under-irrigation.

Potshini Example 3: Disposable 20 litre drip kit (Thabani Madondo)

The 20 litre disposable drip kit was imported by the SSI researcher, Job Rotich, from India. They are made from cheap materials as a disposable kit that is meant to last only one season.



Left: An example of a disposable kit being rigged up in a garden.

Description

The kit consists of a 20 litre bag made from sacking and lined inside with thin black plastic, which is hung on a frame about 1.5 m above the ground.

It was exceptionally difficult to get the water into the bag, as a large bucket had to be tipped into the bag at head height. This led to a lot of spillage.



Left: The mainline and four laterals are tape-piping and the drippers are small tubes.

With these four laterals, the kit irrigates a 2 mx5 m area.

Experience

These kits were not very robust, got blown around in the wind and generally were damaged very quickly. The tape-piping was hard for gardeners to manage and manoeuvre. Nine volunteers tried them out, but not one continued to use the system for the whole season.

A disposable drip kit bag blowing in the wind at a volunteer's homestead. The piping is knotted and trampled on the ground.



Volunteers who used these kits all commented that it provided too little water to their plants even while irrigating twice a day as recommended. This was the primary reason for discontinuation of these kits.

It also became difficult for the SSI researcher to source another batch of the kits. The idea has thus been discontinued.

Advantages

- The kit is cheap and disposable.
- The little tube drippers work well, do not get clogged too easily and add some flexibility to the design.

Disadvantages

- The kit provides too little water; according to the gardeners whose crops wilted and died.
- It is difficult to fill the bag with water; as it is flimsy and hangs at head height.
- The whole system is not robust enough; bags got torn quickly, the piping would not lie evenly on the ground and mostly the whole system got blown around in the wind.

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Homestead Food Gardeners' Resource Pack (Handouts) –

Chapter 5: Garden and homestead water management for food gardening

Resource Material for Homestead Food Gardeners

Chapter 5: Handouts (English)

Handout 1 Saving and Using Water
Handout 2 Homestead Irrigation Techniques
Handout 3 Tank Maintenance and Safety
Handout 4 Watering the garden: How much, how often?

5.1 Saving and using water



Other than getting water from taps, boreholes, springs, streams or rivers, we can also harvest rainwater to meet our household water needs. If we live in areas with little rain, or long periods without rain, it is important that we harvest rainwater and reuse our water whenever possible. By harvesting and reusing water, we have more water over a longer period of time.

Another source of water for household use is **greywater**. This is water that has been used in the home for washing dishes, doing laundry or bathing. This water can be re-used in the garden. You may add ash from a wood fire to the greywater and leave it overnight to settle out the soap and impurities before it is used to water your plants. You should rotate where you irrigate your garden with greywater so that each part of your garden gets clean water as well as greywater.

With **rainwater harvesting**, we collect the water falling on and running across our yard. One of the main attractions of harvesting rainwater in the yard is that it falls where it is needed – which reduces the time and effort needed to get the water to the garden. We get more water to soak into our soil, so that the soil gets wet deep down and can sustain plants for much longer. Additionally, we can store water in containers and/or tanks for later use.

Rainwater harvesting can happen in a number of different ways, usually in this order:

- We can **catch** the water where it falls and **slow it down** so that it doesn't wash away everything in its path
- We can **channel** water to where it is needed
- We can **store** water either in the soil or in tanks or containers

Collecting water where it falls

The first step in rainwater harvesting is to catch water and slow it down to give it time to sink into the ground. This is done through proper garden layout as well as through constructing earthworks such as bunds/earthbanks, swales and tied ridges.

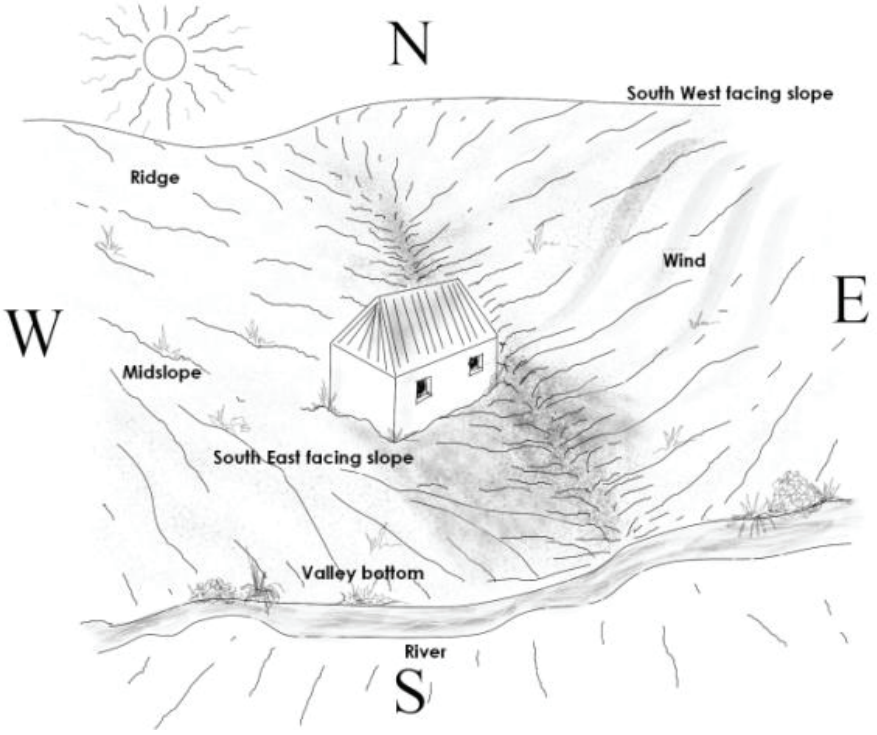
Garden Layout

When designing your garden layout you should consider elements such as wind, run-off and sun position in order to maximize the amount of moisture retained in your garden. Below are some examples of how you can collect water where it falls in your garden and keep the moisture in the soil.

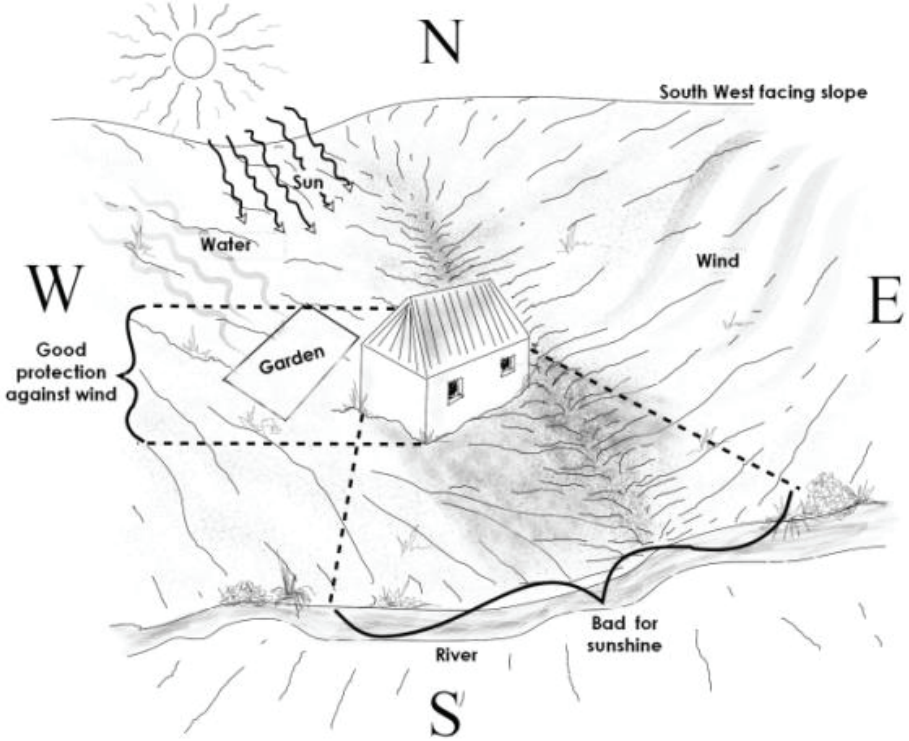
- Protect your garden from wind. In windy areas, plants and soil left unprotected will dry out.

- If your garden is on a slope, make your beds across the slope. This will catch the water and stop it from running down your beds and off your land. Notice where the water runs through the yard during rainstorms.

- Plan your beds so that full-grown plants get maximum sun exposure, while seedlings are protected from too much sun.



Where would be a good location for the garden?



This garden location is good because it's not too high on the ridge (so not too exposed to wind) and not too close to the valley bottom (so less tendency for frost). Since the house is on a south-facing slope (which tends to be colder as the sunshine cannot warm it as effectively as slopes that face north), this gardener must make the most of the available sunshine. The farmer will divert run-off from the natural drainage route. The house will provide some wind protection for the garden.

- Add organic matter to the soil. Soil with more organic matter incorporated into it retains more water for longer. Deep trench beds are an excellent way to enable garden plots to retain more water for a longer period of time.

- Add mulch to garden beds to help retain moisture in the soil. Mulching also protects your soil from crusting.

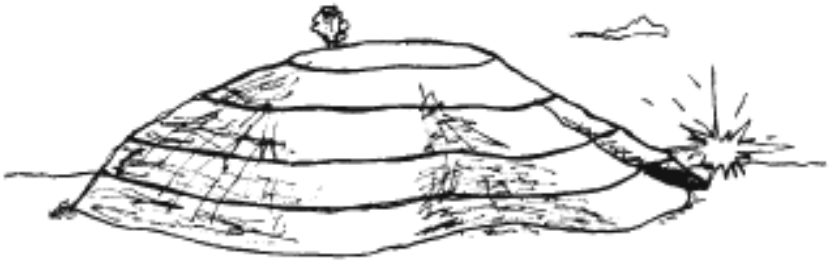
- Keep the soil covered with growing plants. Use ground covers, bushes and trees.

Bunds / Earthbanks

Bunds (also know as earthbanks) are laid out across a slope, along a contour line. A contour is a line or a series of points that runs straight across a slope. Everything along the line is level.

How to mark out a contour line

You can use an A-frame to mark out the level points along a contour.



Contour lines drawn on a picture of a hill to show the areas that are level

Materials:

2 poles, each about 3 metres long
1 pole, about 2 metres long
String and wire
A small stone



How to build an A-frame:

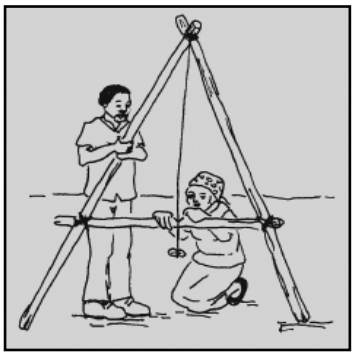


1 Take two poles of the same length and tie them together at one end, using string or wire.



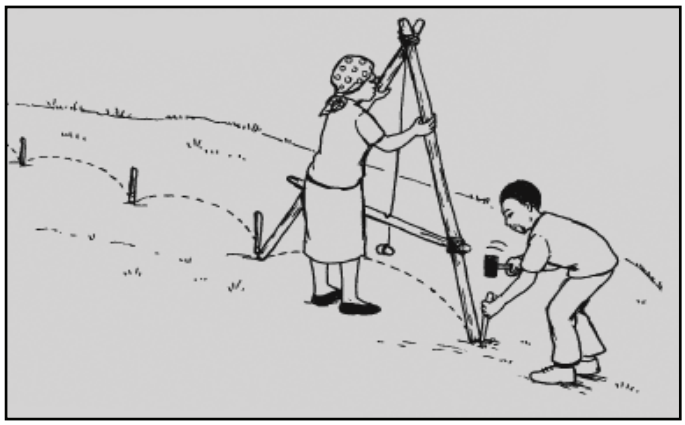
2 Then, tie the third pole across, between the two other poles, about 1 metre from the bottom.

3 Now tie a piece of string onto the frame at the top. Attach the stone onto the end of the string. When you hold the frame up, the stone should hang just below the cross pole/bottom pole. Hold the A-frame upright on a level piece of ground/floor. Mark the place where the string hangs across the bottom pole. This should be close to the middle of the pole.



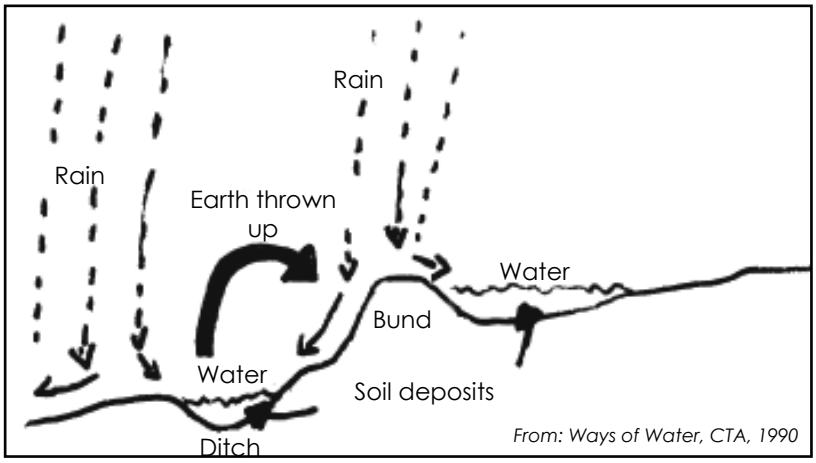
How to use an A-frame:

4 Find two level points on the left-hand side of the area where you are trying to establish the contour. Mark the two points with pegs. Now pivot the A-frame on its right leg, swinging the left leg around. Find the level for this leg by moving it until the string with the stone attached is at the marked mid-point. Continue moving the frame in this manner.

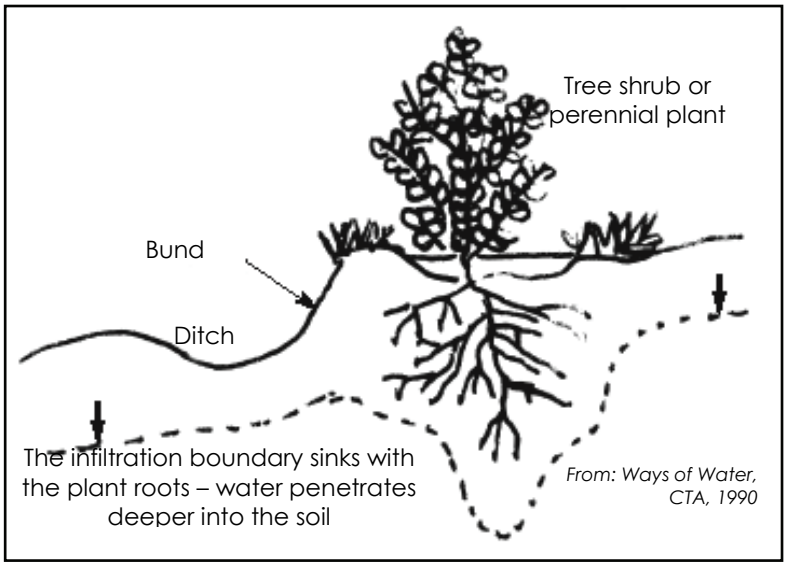


From: Farmer-to-Farmer Handbook, FSG, 1996

Build **a bund** by digging a ditch across the slope, along a contour line. Place the soil from the ditch *above* the ditch. Dig the ditch about 30 cm deep (the width of a spade) and 30 cm wide. Rainwater will accumulate above the bund and in the ditch. This water will sink into the ground instead of running off your land. As soil is washed down the slope and accumulates behind the bank, a small flat terrace/area will be formed over time.

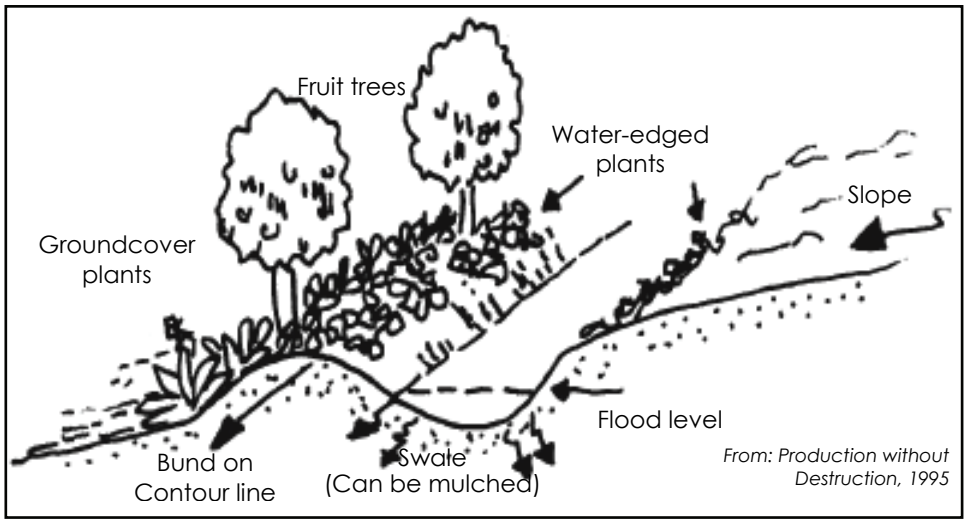


Plant long-living or perennial plants along these banks. This helps to hold the soil on the bank. It also provides your bushes and trees with water. This is a good place to plant fruit trees and medicinal plants. The ditches will fill up with soil over time and need to be cleared out when this happens.



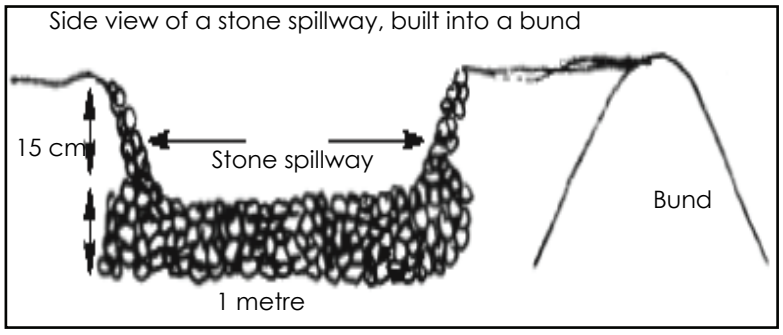
Swales

Swales are very similar to bunds/ earthbanks built along a contour line. The difference is that the earth is piled *below* the ditch rather than above. This is a very good way to concentrate water on the land. In this way, you can double the amount of water in your soil.



Swales do not lead to terracing as the first method does. The banks are planted with water-loving and long-living plants. The swales fill up with soil over time and need to be cleared out when this happens.

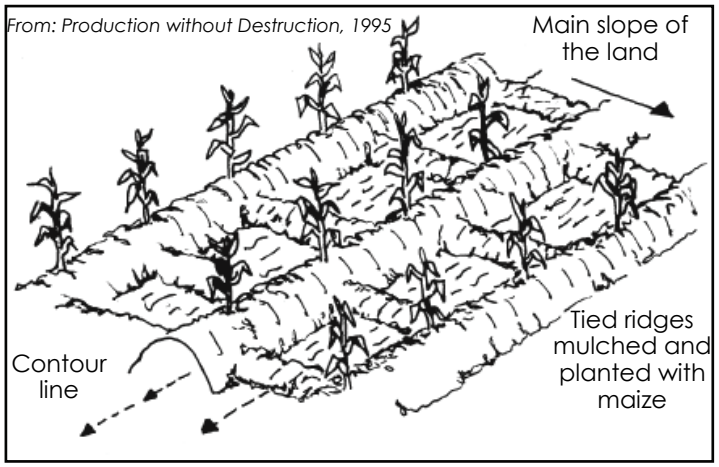
Bunds and swales must be built high enough so that water never flows over the top of the bank. If there is a danger of this, spillways need to be built into the banks (see diagram below). These will lead the excess water down the slope in a safe way.



Tied ridges

These bunds have small ridges or cross walls that help the water penetrate into the soil where it falls. The ridges also ensure that the water in the ditches won't become "streams" in heavy rain. This reduces the danger that the ditches will overflow and cause erosion.

Build the ridges about half as high as the bunds. Once the ridges are made, they are left intact. You may need to lift crumbled soil back onto the ridges and rebuild some of them from time to time.



Channelling water to where it is needed

MaTshepo Khumbane has a beautiful working system of "turning run-off into run-on" at her homestead in Limpopo. Her system – the result of years of experimentation requiring no pipes or tanks – is described below:

- A trench or furrow is dug across the slope to catch rainwater.

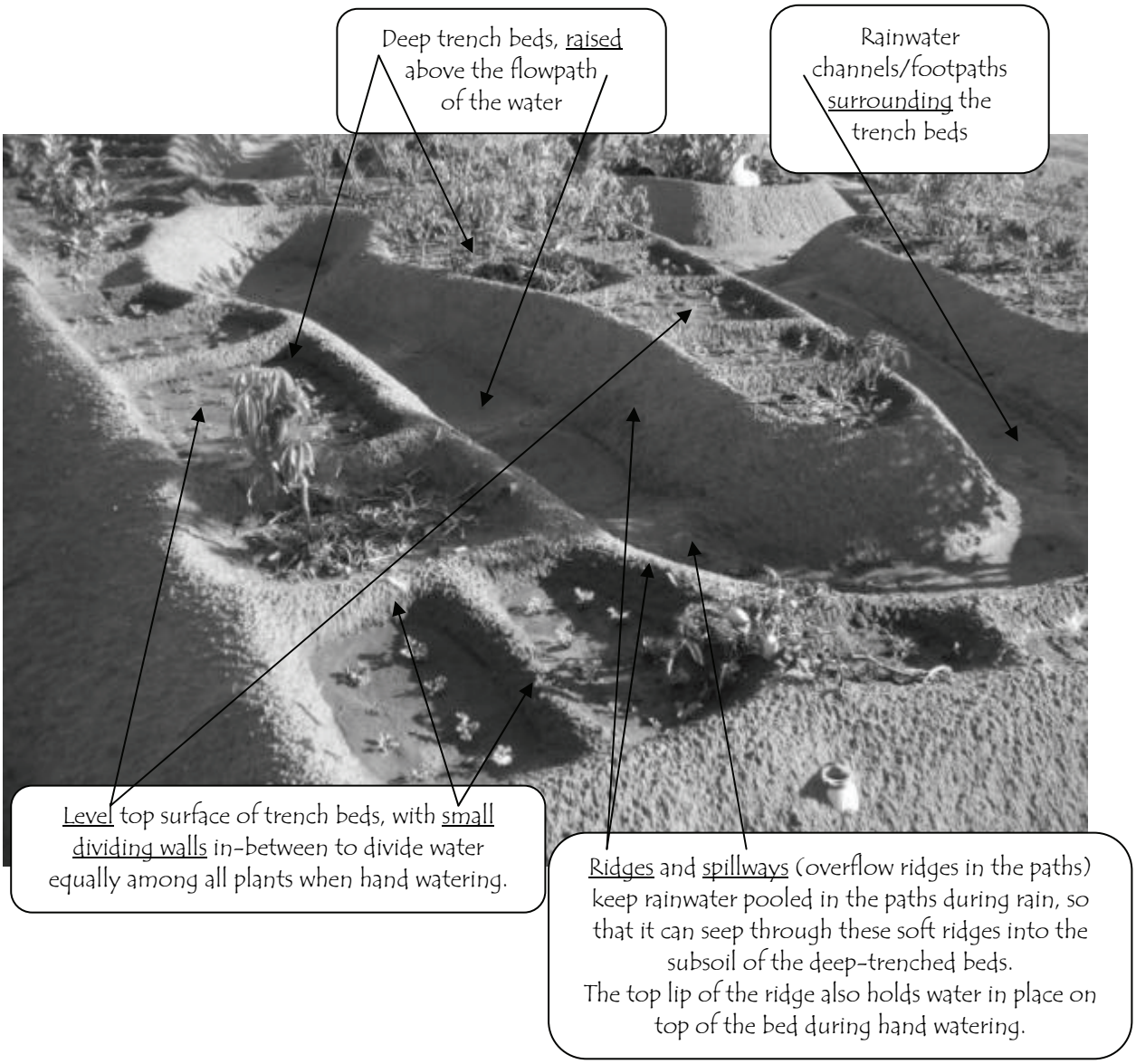
- Below the furrow the vegetable beds are dug 1 metre deep. They are filled with organic matter – grass, leaves, manure and ash – and mixed with soil. The beds

are fertile and absorb and hold water.

- The beds are edged with ridges. Some are reinforced with small stones to stop the soil from being washed away. This ridging keeps the water on the bed when you irrigate.

- Between the beds, a network of shallow ditches/channels connects the furrow above the beds with ditches/channels lower down. The water flows along these channels. The channels are also the footpaths to get to the beds.

- Fruit trees are planted on the lower side of the furrow, so that their deep roots can benefit from the extra water.



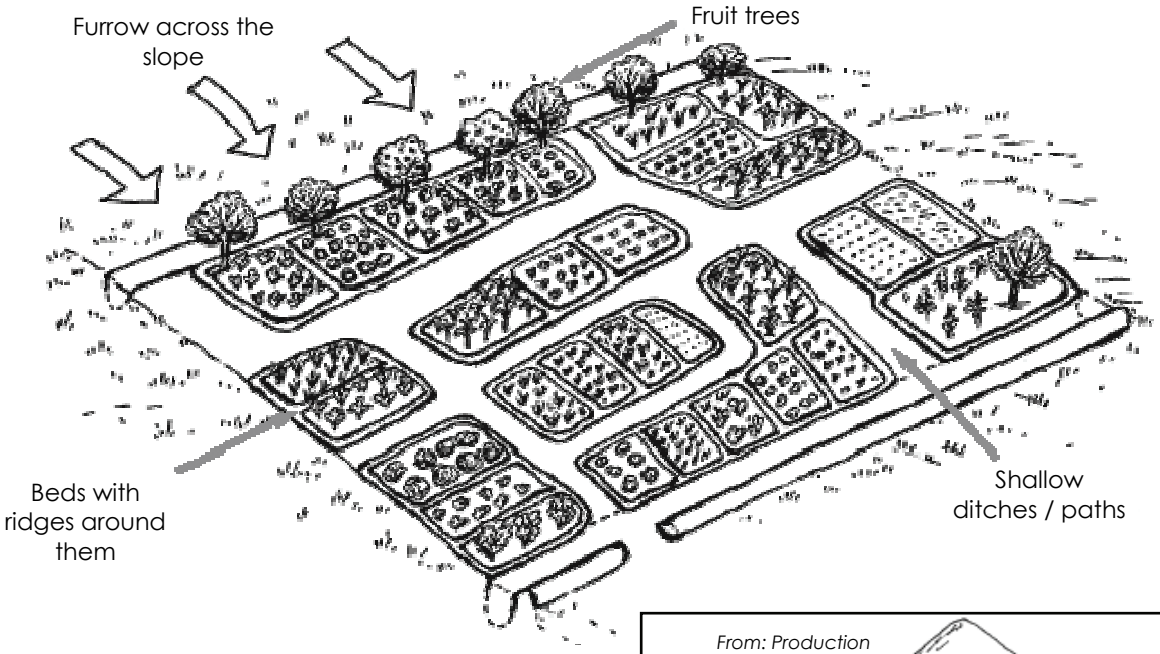
Important points to remember when channelling water:

- Notice where the water runs through the yard during rainstorms. This will always be from higher-lying areas to lower-lying areas. The steeper the slopes in the

garden, the faster the water will run. The best way to understand how the water flows in your garden is to walk your land in the rain!

- Plan how to take control of the water (slow it down) and channel it to where it is needed (in the garden beds and/or in dams or storage tanks).

- Lay out long, level garden beds along the contour (i.e. across the slope) to more easily intercept and spread out the water along each bed.

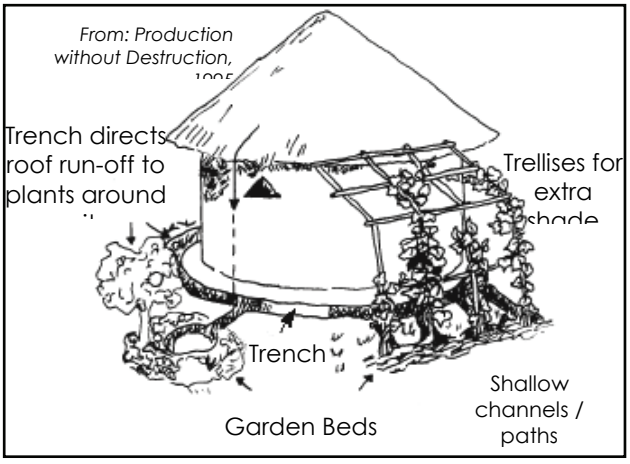


Storing water

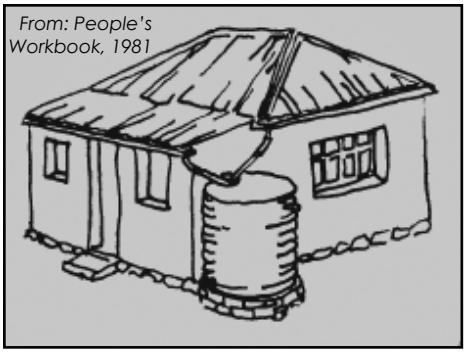
Aboveground

A good surface for collecting run off water is the roof of your house.

- It is possible to dig a ditch around the house where the rain pours off the roof. Water is led along this ditch to garden beds.



- It is also possible to put a gutter on your roof. This can lead the water straight into a storage tank. It is much easier to do this with a metal or tile roof. Water collected from your roof is good drinking water. With a thatched or grass roof, hanging gutters can be made from bamboo or metal. This water is usually too



Water is channelled by gutters to the storage tank

dirty for drinking.

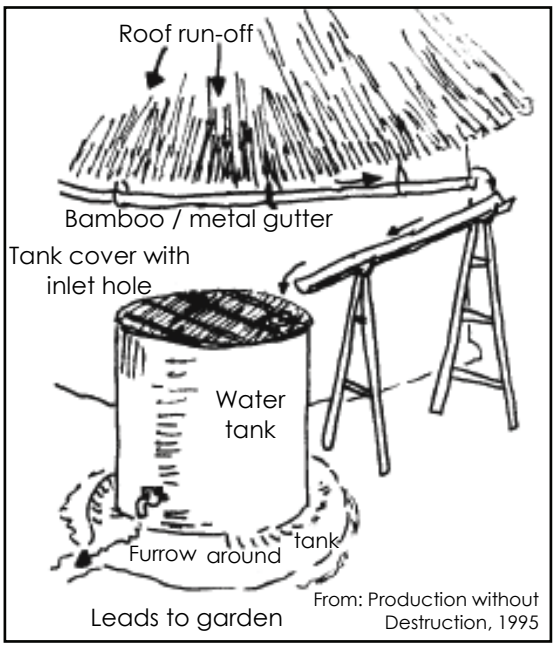
You may want to catch the first bit of rainfall after a long dry period in a different container and use it in the garden. This water is likely to contain a lot of dirt.

You can build a tank that will hold enough water to be able to water a small vegetable garden throughout the dry periods. It is a good idea to find someone who is an experienced builder to assist you in building your roof tank.

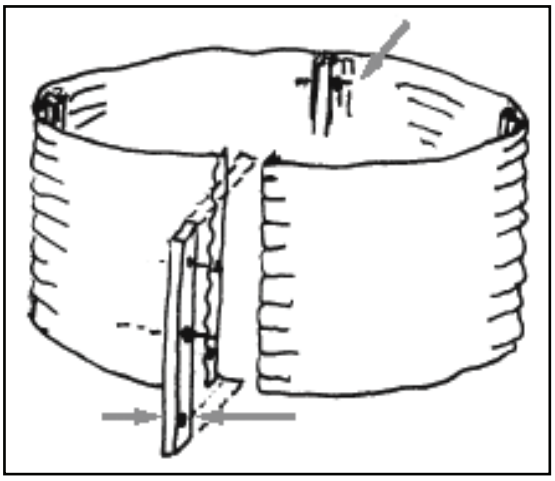


Gutters can even work on thatch! Water is collected in a plastic tanks

Roof tanks can be made from cement with wire reinforcement (ferrocement), plastic, or stone.



Collecting run-off from a thatched roof into a ferro-cement tank

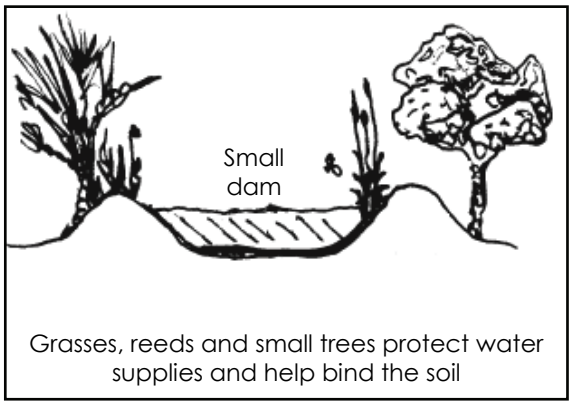


Formwork to build a ferro-cement tank



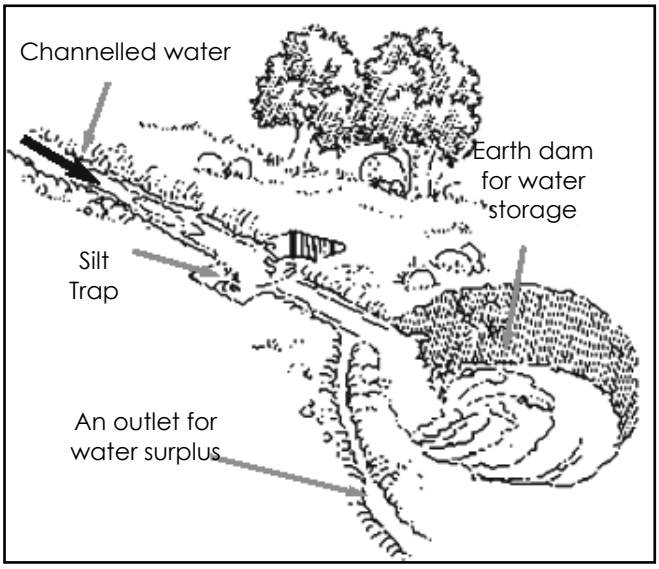
Roof tank built from stone and cement

Dams or ponds can be dug into the soil and filled from a stream or gulley or with rainwater. Dams generally do not hold water for very long. Dams can be lined with plastic or cement to increase their water holding ability. You can decrease the amount of water that evaporates into the air by digging a deep dam with a small surface. A shallow dam with a large surface loses a lot of water through evaporation. You can also surround your dam with windbreaks.



Grasses, reeds and small trees protect water supplies and help bind the soil

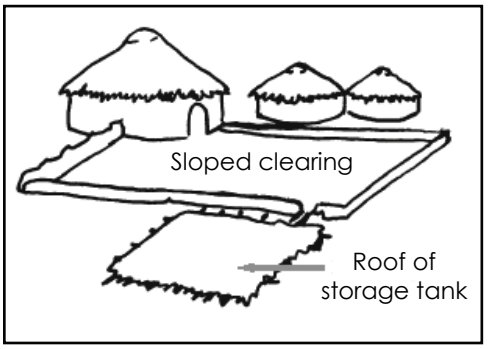
The main reason for building floors and walls in the dams is to stop the water from leaking out. In some places the soil has enough clay to seal the dam after a while and no structure or water-proofing is needed. In other places the soil may cave in when it gets too wet and the dam may leak.



❖ Underground storage

- Underground Tanks

You can collect rainwater from a flat surface, such as a large rock, or the clearing in front of your house, by building a low wall along the rock or clearing and making it slope down towards an underground tank.



Underground water storage can be made large enough to hold all the water you will need in your garden. There are various ways of building underground tanks:

- ❖ Cement lined/Ferro-cement tanks
- ❖ Geo-fabric lined tanks
- ❖ Masonry (Bricks/stone and mortar) tanks

Water runs into these tanks from the ground. It is possible to gather run-off water from any surface such as your roof, a road, paved areas around your home, ditches, swales and even the veld.

These tanks may be made large enough to store enough water for the whole dry season

These tanks can be cheaper and easier to build than large tanks above the ground.

Cement lined/Ferro-cement

Reinforcing mesh can be placed along the walls and floor and can then be plastered with cement. An experienced builder is needed; otherwise your tank is likely to leak.



The cement lined tank

Mrs. Mamotepane built an improved homestead tank that she lined with cement. There were 3 workers from the village involved. A builder showed them how it is done and then left them to do the work under his supervision. It took about 14 days to build. Only cement and chicken wire were used. The hole was dug and covered with the wire on the inside. Then it was covered with cement. The sand used for making the cement was fetched in an ox cart from the river.

The tank is almost square (5 metres long and 4 metres wide) and about 2 metres deep.



The inlet made of cement

The inlet to the tank is made of cement. This is a very good idea and helps to keep the tank strong.

The dam is fenced to keep children and animals away. A 1 000 litre header tank was placed on a structure high above the ground (about 2.5 metres). This helps for the water to flow down into the pipes and taps in the garden. A foot pump is used to pump water into this tank.



A part of the garden and the seedling nursery

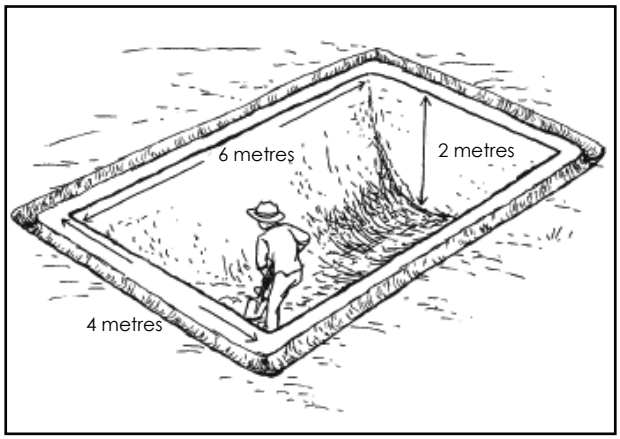
Mrs. Mamotepane says that as the water is now close by, she can concentrate on other work. She can also produce a lot more vegetables. She grows and sells vegetables and seedlings for a living. She sells at the schools and to hawkers that come to her home to buy.Mrs. Mamopetane also processes surplus vegetables by bottling and making jams.



Mme Mamopetane with a bottle of senoane or melon jam and the seed that she also sells to make an income

Geo-fabric lined tanks

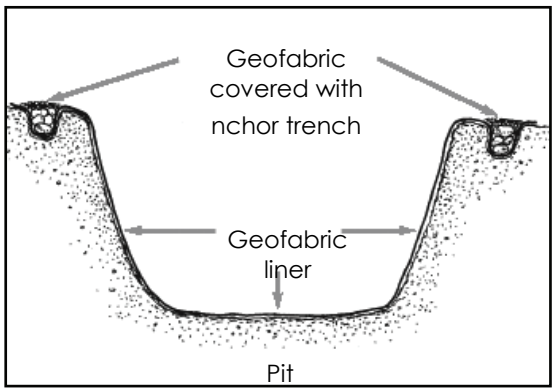
This tank holds 48 000 litres of water. It is inexpensive to build. The most labour is required for actually digging the pit.



Dig a pit 6 metres long, 4 metres wide and 2 metres deep. There is a slight slope on the inner walls. This means that they are not dug straight down, but at a slight angle. When the pit is dug, stamp the soil inside the pit down, so that it is firm and smooth.

Dig a trench about 30 cm deep around the outside of the pit. This will anchor the geofabric liner.

Lay the geofabric inside the pit and the anchor trench. Make sure there is about 1 metre of the fabric in the anchor trench. Now cover the fabric in the trench with stones and soil. This will make sure the fabric does not slip down into the tank. You will need about 90 square metres of fabric to line this size pit.



Now the fabric is painted with a bitumen type sealant. The sealant needs to stay flexible or stretchy at low temperatures. Otherwise the sealant will crack as the water gets cold. You will need about 210 litres of sealant.

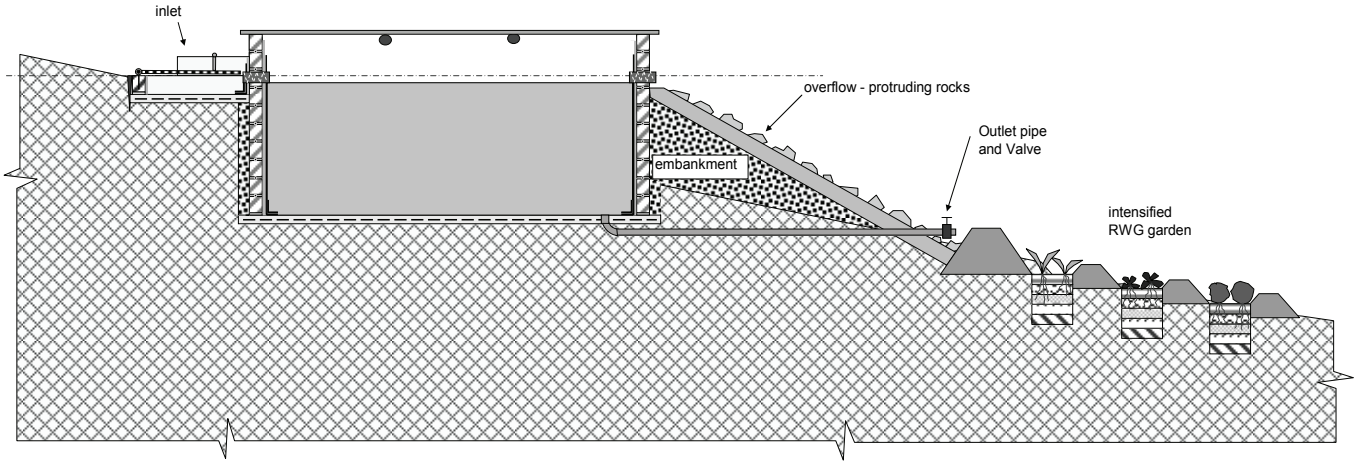
Names and contact details of suppliers:

Geofabric:
Kaytech factory in Johannesburg
Phone: 011 - 452 5310

Sealant:
Tosas; Spartan factory in Johannesburg
Phone: 011 - 902 1905

Masonry Tanks

Masonry tanks are made using bricks or stone with mortar.



Cross-section of a masonry tank



A cylindrical (round) , 30 000litre underground tank. This tank was constructed using cement blocks and mortar. Notice

These tanks need to be designed and constructed by people who know how to do this. They can easily leak, if not constructed well. Mostly, tanks such as these have been built with support form Government and implementing agents, as they can be expensive to construct.

Table: Recommended size, shape and elevation

- **Standard size: 30 000 litre**

– This provides enough water for year-round vegetable and fruit production of 100-200m^2 in the yard (when combined with run-on RWH).

- **Shape: Round** [walls: cylindrical; floor: flat]

– A round shape is geometrically stronger, and less prone to cracking and leaking than square or rectangular tanks. A flat floor helps the household to leave a few centimetres of water to protect the floor and wall/floor joint from drying out and cracking.

- **Elevation: Underground**

– Tanks are built underground to catch both roof run-off AND surface run-off. In sloping areas, half-buried dams can still catch those all-important large quantities of surface run-off.

2. Homestead irrigation techniques



There are three parts to good water management at your homestead.

- The first part is to catch as much rainwater as you can.
- The second part is to get the water to the crops.
- And the third part is to store and use the water you have as well as possible.

In this handout we discuss more ways to get water to our crops and how to irrigate in a way that uses water as wisely and efficiently as possible.

GETTING THE WATER TO THE CROPS

Mechanical Pumps

These pumps use human energy to power them, rather than fuel or electricity. There are hand and foot operated pumps.

Foot / Treadle pumps



Foot pump

The foot pump has been designed specifically for low cost and reliable operation in remote areas. The frame is small, robust and portable. It is capable of pumping water for small-scale irrigation and household water supply.



Two cylinders push the water through the pump.

How the pumping works:

The pump is not very compact, but is very robust and is easy to maintain with locally available materials. It weighs around 22 kilograms.

There is an inlet (32 mm) and outlet pipe (25 mm) and two cylinders with leather bushes that push the water through.



Filter on inlet hose

A filter needs to be attached to the end of the inlet hose. The pump cannot tolerate silt.

The total pumping height is around 14 metres. This is the sum of the suction depth below the pump and the pressure head above the pump. The maximum suction depth is around 7 metres. The pump then lifts water though the outlet to a height of 7-10 metres. The volume of water pumped is between 0.4 litres per second to 1.5 litres/ second, depending on the height. A fitting can be added so that watering is possible straight from the pipe.

Suppliers:

This ApproTEC foot pump is produced in Kenya. At the moment they can be sourced in South Africa:

Contact: Chris Stimie, Rural Integrated Engineering

Tel: 082 469 4535 or 012- 842 4106 Email: dir@rieng.co.za

Or directly: ApproTEC/ Kickstart, Nairobi; PO Box 64142, 00620.

Tel: +254-(0)-20-787 380 / 787 381. Email: approtec@approtec.org.

USING WATER WISELY



This bed is built up and mulched with stones to conserve moisture.

There are many ways to conserve water. Ideas include:

- Use mulching (dried grass or leaves) to cover the soil and keep the water in the soil. Stones can also conserve water as the stones act as mulching on the edges of the bed.
- Add organic matter to the soil.
- Plant along the contours or make terraces. Terraces are useful when your land is very steep, or your soil is shallow and you need to build up your beds or soil.
- Use ditches and swales to channel and catch water, so that it can seep into the soil and not be lost.
- Protect you garden from the drying effects of wind.
- If you have really sandy soils, lay plastic or feed bags at the bottom of your trench before building up your bed. This will help to keep the water in your bed.
- Use greywater wisely.



This garden is built on a very rocky slope. All the beds have been built up as terraces. Both soil and water are beautifully conserved.

Greywater is water that has been used in the home for washing dishes, doing laundry or bathing. This water can be re-used in the garden. You may add ash from a wood fire to the greywater and leave it overnight to settle out the soap and impurities before it is used to water your plants. You should rotate where you irrigate your garden with greywater so that each part of your garden gets clean water as well as greywater.

We will now focus on two ways of **applying water** in ways that conserve water, time and labour: drip irrigation and keyhole beds.

Drip irrigation

Drip irrigation is a method of applying water directly to the roots of plants, which saves a lot of water. Drip irrigation is good at reducing both direct evaporation as well as evaporation from the soil surface. Water is applied evenly and with deep penetration. However, be warned! Drip irrigation can be very bad on coarse sandy soils where water runs straight down without spreading sideways in the

Advantages of drip irrigation:

- Water is applied directly to the roots of plants and can infiltrate deeply into the soil.
- It saves time and labour.
- It can also save water, but this depends on how you use the system.

soil to reach the plant roots.

Drip systems need careful management because the drippers can easily become blocked without the gardener noticing it. Also, gardeners often find it hard to believe that the plants get enough water, because there could be just a small wet patch on the soil surface. More than with any other type of irrigation, with drip systems it is important to take a spade and dig to see where the water goes. Do this as often as you need to until you know your system well, and how it reacts on your soils.

Generally, with drip irrigation systems, plants are watered once a day, every day. At the beginning of the season, this ensures that the soil stays wet as deep as possible. Later in the season the bigger plants can use the water that has been stored in the soil (as well as the little water that is provided every day).

Drip irrigation kits

Drip irrigation kits are pre-designed and usually come with the pipes already cut into specific lengths and the drippers placed in the pipes. There are many different kinds of kits. One of the common designs for drip irrigation kits is known as **Netafin**.

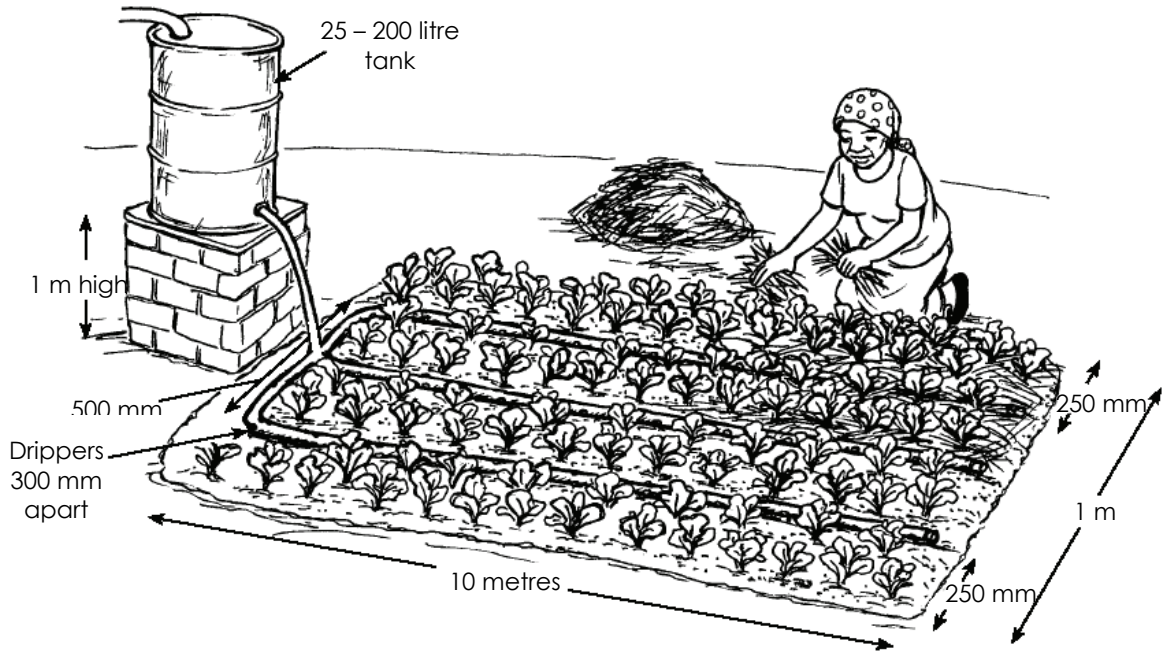


Mr. Mokethi shows his 200 litre drum with the filter attached. The dripper lines lie next to the drum.

The Netafin system has a 200 litre drum with a filter attached and enough dripper lines to cover 200 square meters of garden. 100 square meters can be watered at a time. The dripper lines have been specially made. The drippers themselves are inside the pipe and are spaced 30 centimetres/ 300 millimetres apart.

After experimenting with the Netafin drip irrigation system for six months, Mr. Mokethi says, *"This system saves me time. It also saves water, as the water now goes directly to the roots."*

He removes the whole system at night and replaces it every morning to irrigate. He places the system on two flat rocks to make it slightly higher than the beds. Mr. Mokethi spaces his plants so that each one will be next to a dripper. He does not use this system for row crops like carrots, but for individual plants like cabbage.



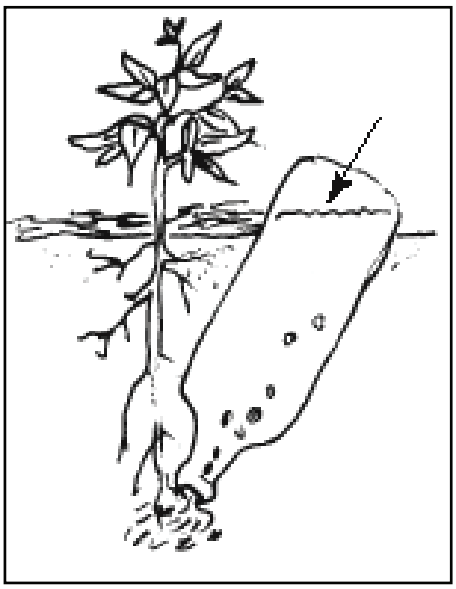
Important points

- The drum should be placed on a surface/platform about 1 metre (one spade length) above the garden.
- The garden/area should be completely flat. If the area is not flat, the amount of water from each dripper will be different. The distribution of water will not be equal.
- The drip irrigation system cannot be left out on frosty nights because the pipes may burst if ice forms inside.
- The drip irrigation system may be used with greywater.
- When drippers remain blocked, pipes must be replaced. Replacement parts are easy to find in shops.

Variations on drip irrigation

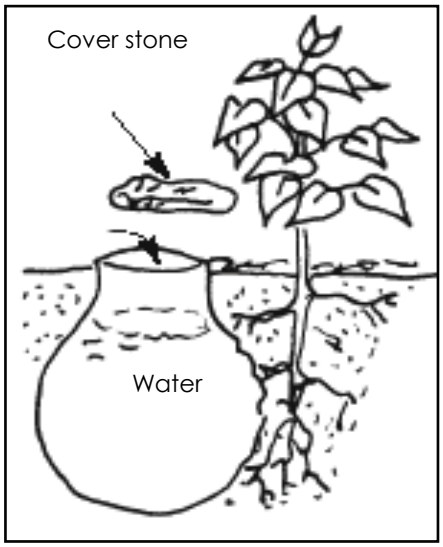
Drip systems cost money and a food insecure family may not be able to afford the replacement costs. Below are a few methods of making your own variations on the standard drip system

Buried vessels



Water can drip slowly from an upside-down bottle

From: Production without Destruction, 1995



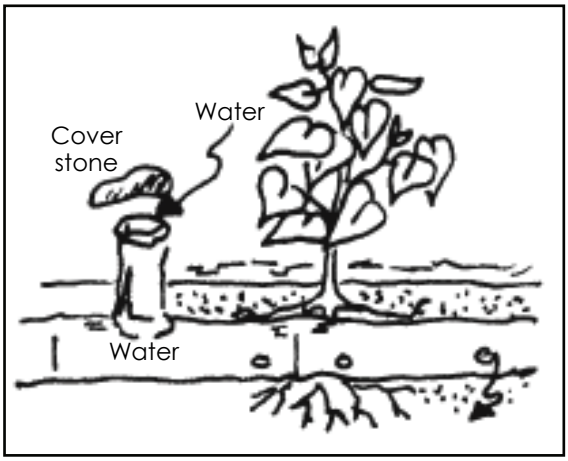
Water can seep through an unglazed clay pot to plant roots.

Water

Buried pipes

You can also use a plastic pipe with slits/holes drilled or burned into the pipe. The pipe is laid on top of the ground and the whole bed (including the pipe) is covered with a good layer of mulch.

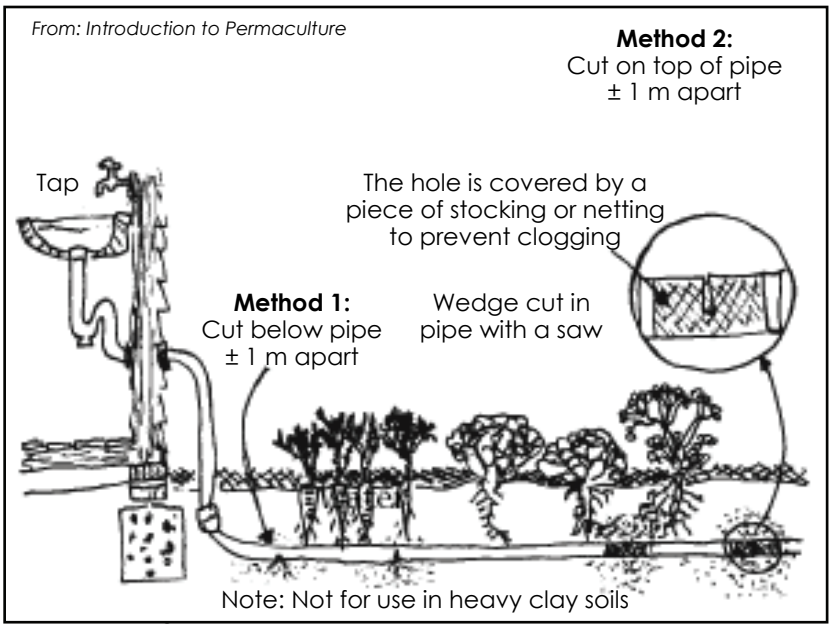
Water can be poured straight into the opening of the underground pipe or water can be led from a tap or storage tank. You can use greywater as long as there are no bits in the water that will clog up the slits in your pipe.



From: Production without Destruction, 1995

- The holes in the pipe should be about 20-25 cm apart. The one end of the pipe is closed with a plug. The other end is attached to a pipe leading to a large water storage container or tap.
- If water is coming from a container, it must be at least 1 metre above the ground. The vegetable beds must be as level as possible.

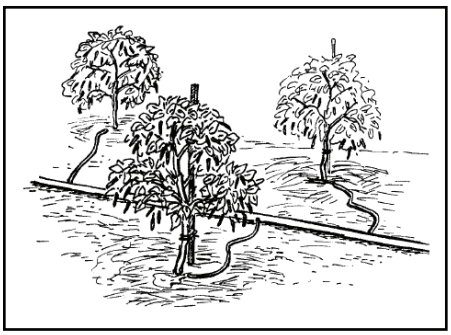
From: Introduction to Permaculture



- If you use this method, you will need less than half the amount of water to wet the whole bed than you would use if you were pouring or spraying the water onto the bed.

Spaghetti lines

Spaghetti line systems consist of small pipes connected to a larger main line aboveground. Spaghetti lines are easy to unblock – you just suck on the opening of the spaghetti pipe. The beds must be quite level and the pipes and spaghetti lines also need to be at the same height. Height differences give differences in the amount of water coming out of the end of each spaghetti line.



Spaghetti line systems consist of small pipes connected to a larger main line.

- Use any tank that can be easily found – from 25-200 litres. The system is designed to use 25 litres a day. If your tank holds 50 litres you can fill it and irrigate every second day. If your tank holds 200 litres, you should be able to irrigate once a week only. This however depends on the climate, your soil and the size of your plants. Seedlings will need less water more often.

- Place this tank above the bed, which is made to be 1 metre wide and 10 metres long. It is long and narrow to make it easy to work in.

- Use normal black plastic piping (15 mm) to make a main line from the tank to the garden. Make three lines – each should be 10 metres long and 500 millimetres apart.

- Make small holes in the pipe 300 mm apart and fit the thin spaghetti lines into these holes. You will need 93 of these.

- Plants are spaced to have one spaghetti line for each plant.

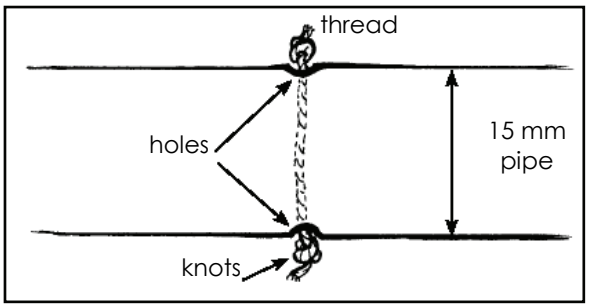
This system irrigates an area of 15 square metres. It uses around 25 litres of water in 5 minutes. It provides about 260 millilitres of water per spaghetti line dripper per day.

Sponge lines and string lines

Sponge lines and string lines are controlled flood systems of drip irrigation that are good for row crops such as carrots, onions, turnips and peas. For sponge line systems, holes are punched in the irrigation pipe (usually 15-20 mm black plastic piping) using a heated nail or binding wire. The holes should be about 2.5 mm in size. Small pieces of sponge are forced into these holes. Water then trickles out of the holes.

String line systems are similar to sponge lines, except that you use string instead of sponge.

To make a string line system:

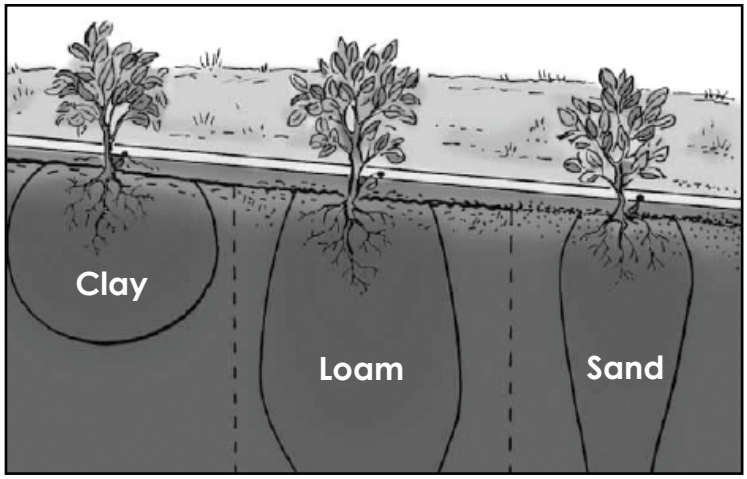


- Make a series of paired holes on opposite sides of the pipe. There will be two holes across from each other at each dripping point.
- Thread a piece of string through these holes and tie knots on both ends. This thread can be jiggled if the hole becomes blocked and also makes sure the water trickles out, rather than pouring out too fast.

An advantage of sponge line and string line systems is that the holes in the pipe can be made any distance apart, depending on need. A disadvantage is that it is difficult to control the amount of water that comes out of the holes. Another disadvantage for sponge lines is that the small pieces of sponge need to be replaced each year.

Each drip irrigation system has been designed to work in a specific way. You can use one of the systems explained above or you can design your own. A few keys to remember when you use drip irrigation are:

- Make level planting beds and furrows
- Make sure your drippers are never clogged
- Space sprayers so that their sprays overlap enough to create equal watering across the whole area.



A note on distribution

Distribution is how the water moves into and inside the soil. This depends on the kind of soil and the kind of irrigation or dripper. To the right are pictures of how the water may move in different kinds of soil:

- Above ground, on top of the soil, you will see little circles of wetness, which may be close together or more spread out and further apart.

- Underground the circles of wetness may flow into each other.

- You will need to check what is happening under the ground to know what the water is actually doing. You can press a stick or a rod into the ground as far as it will easily go – close to the drippers and then further away – to get an idea of how even the distribution of water is.

- There may be some dry patches inside the soil, which is why it is more difficult to use drip irrigation with row crops. People usually put one plant next to a dripper.

- How fast the water comes out of the small hole or dripper will also change how the water moves. The systems that use large holes in the pipes, like the sponge and thread systems are more like a controlled flood irrigation system than a dripping system as the water pours out, rather than drips.

The secret to good irrigation is to check what is happening in the soil! Take the time!!!

BED DESIGN FOR WATER CONSERVATION

It is possible to design your garden and beds in a way that will use as little water as possible and also to save as much water as is possible.

Keyhole beds

Meet Mr. and Mrs. Matlole, a retrenched miner and his wife growing vegetables for home and for sale. They plant their vegetables in keyhole beds, which are raised beds made of stone that require less water than regular beds. Additionally, you can use greywater in keyhole beds because the ash in the soil filters out the soap in greywater.



Mr. and Mrs. Matlole and one of their keyhole beds

Where do I build a keyhole bed?

Find a sunny place, close to the door of the house on any base rock, compacted soil or hard clay.

Advantages of keyhole beds:

- The garden can provide fresh vegetables all year-round under all conditions
- Greywater can be used to irrigate
- It can be built on top of hard clay or rock.

What do I need?

- Good dark soil
- Rocks, manure, wood ash, dried grass, leaves, yard sweepings and any plant wastes
- Black wattle or other sticks or netting

How do I build a keyhole bed?

Where the centre of the garden will be, build a tall basket of sticks; 40 cm x 40 cm round and 1.5 metres high.



The central basket may be made out of a feed bag rather than sticks.

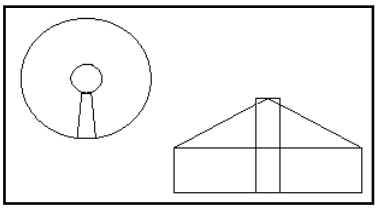
Begin to fill the basket with composting material such as wood ash, grass and manure. Pack it in quite firmly.

Now measure out from the basket, one arm's length, all around in a circle. This is where the rock wall will go. It will be about 1.5 – 2 metres in diameter. This diameter is measured from one side of the bed to the other. Build a wall about 1 metre high with an entrance to the basket. This entrance should be about 60 cm wide.



Completed keyhole bed
(from D. Hall and V. Gibberd for LRAP)

Fill up the inside of the circle as you go, making alternate layers of soil-manure, soil-ash, soil-plant wastes, soil-manure and so on until you reach the top. The soil should reach from the top of the wall to the top of the basket in a gentle slope. Do not make it flat. Seen from the top it looks like a keyhole; from the side it looks like a house.



Top-view and side-view of keyhole bed



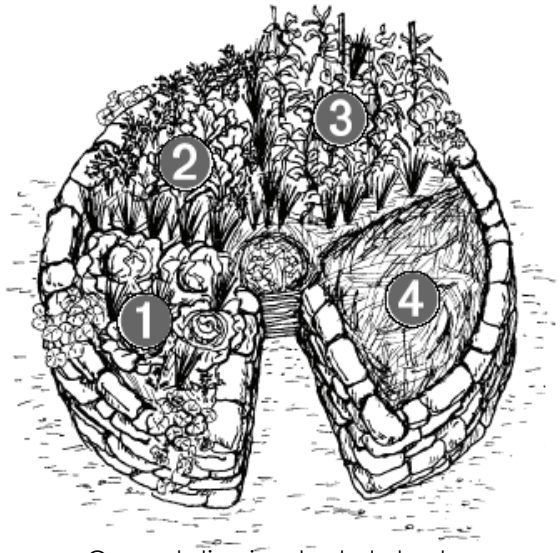
A keyhole bed built on hard clay
(from d.hall and v.gibberd, for lrap)

The soil must then be covered with a thick mulch of dried grass and leaves and must always be covered like this. The basket must have a cover of grass on top of the manure.

Rotating crops in keyhole beds

It is a good idea to grow different crops in different places each season. Divide the garden into 4 sections.

The first section is for leafy crops (except spinach).



Crop rotation in a keyhole bed

The second section is for root crops and spinach.

The third is for peas and legumes in winter or potatoes, egg plants, tomatoes, peppers and chillies in summer. These need extra wood ash in the soil to give a good crop

The fourth section has 2kg of lime dug into it and is covered with a thick layer of manure and mulch. This section rests for 1-2 months before the manure is dug in. Now the leafy crops are planted here.

Every time you plant, you move the crops around to the next place.

Plant onions among all the crops. Plant herbs and strong smelling plants such as chives, nasturtiums and marigolds around the edges of the garden.

Sowing seed in keyhole beds

To sow seed, pull the mulch aside, leaving a line of soil exposed. Here, you make a furrow and put your seeds in. Cover with earth and pat it down a little. Water the seeds and then cover the line with mulch again. As soon as you see the seeds coming up reduce the mulch so that enough sun shines on the seedlings. Always leave a light cover of mulch, so that the soil does not dry out.

Watering keyhole beds

- Greywater from the home is poured into the basket. You can pour it underneath the mulch in the basket. From here it spreads into the rest of the bed.
- The next time you water with greywater, move the mulch aside and pour the water along the root line. Then replace the mulch.
- It is best to water early in the morning or evening, not in the heat of the day.


It's important to have a slight slope of the bed towards the edge and to mulch your keyhole bed.

Watering the garden: How much, how often?

One of the most common wasteful irrigation practices is to spread a small quantity of water across the whole garden once or twice a day or every day or two. It is understandable that people tend to do this, because they reason that 'at least all the plants will get a little bit of water'. Most of this water simply evaporates out of the topsoil without doing much good at all. Shallow watering also promotes shallow root systems and our plants become water stressed, or wilt, easily. We should rather try to apply more water at a time and water less often. We can try to apply more water every second day and see how that goes. For more mature crops, such as fully grown spinach or half grown cabbages, we can even water well once a week!

Deep watering

If plants receive regular deep waterings, they develop deep, strong roots, meaning that they can produce large, strong stems, leaves and fruit. If they get just a little water on the soil surface most of the time, the roots will be shallow and the plants will have very little resistance to dry periods.

Rather than giving our gardens a small amount of water every day or two, a much better approach would be to divide the garden into imaginary 'blocks' or 'sections', and to provide a good deep watering to each section every four to seven days. This allows the water to seep deep into the soil and less of it will be lost to evaporation.

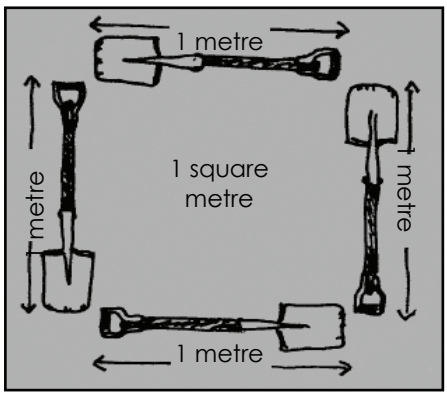
Beware: deep watering can also be overdone. If the water seeps down too deep, the plant roots can reach it. However, this is a less common mistake than watering too little and too frequently.

Did you know that plants can also suffer if there is too much water around their roots all the time? If the soil is water logged, the roots don't get enough air. Plants need well-drained soils to prevent the roots from rotting and dying.

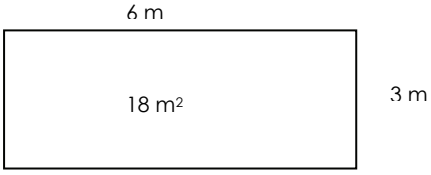


We use deep watering, because we want to draw the roots of our plants down into the ground. Deeper in the soil the water is distributed more evenly and the soil is not subject to fast drying and wetting cycles that are dependent on watering and evaporation. Thus, applying MORE water, LESS OFTEN is crucial.

As a general rule of thumb, vegetables require around 20mm of irrigation a week. This means that you need to apply 20 litres of water to every square meter square of garden bed.



How much water would you need to apply, to this garden below which is 18m^2 in size? (answer 20x18=360l)



20mm/week is a good assumption to start our planning on, but of course, our plants would not need exactly the same quantity of water week after week!

20mm/week is equivalent to 20litres/week which is a 20-litre bucket on 1m².

For drip irrigation systems 20litres/1m² equates to about 340 ml of water/dripper/week.

- When it rains, they need less irrigation.
- When the plants are still very small, they need less water, but just like human babies, they need it more often. Human babies drink every two or three hours after birth; your seeds/seedlings must never dry out, so check them several times a day in the beginning.
- When plants are making fruit, like nursing mothers, they need extra food and water!
- This often coincides with peak season, when all the plants need extra water because it is extra hot. In cooler periods, plants would need less.
- Towards the end of their life, like older people, plants need less.
- The plants in your garden will be at different growth stages, and of different types – all having their own level water needs from week to week.

How can one know how deep the water has gone?





Here a steel rod is being pushed into the ground next to a drip line. The wet circles of irrigation can be seen. In the next picture the rod has been taken out of the ground to show soil that is uniformly wet to 30cm below the surface.

The simplest method is to push a steel peg into the soil a few hours after watering the bed, when the water has had time to infiltrate properly into the soil. The peg goes in quite easily until it reaches the dry soil below, which gives you a good idea of how deep the water had gone down. Combine this with knowledge about the typical rooting depth of the crop, and it becomes easier to strike a balance between over- and under-watering. If you measure rain in a rain gauge, you will measure this in millimetres. 1mm of rain is equivalent to 1litre of water on m² of soil.

Golden rules of watering

Day-to-day, how and when you irrigate your plants has a big influence on how much water you use in the end. Here are a few golden rules:

- Start the growing season with your soil thoroughly wet to at least one meter deep – especially for the dry season crop when there will be very little rain for a few months. At first, the young roots won't reach this water, but the water will stay there and the plants will draw on it later in the season when they may need more than you can give. Wetness in these deeper soil layers also encourages your plant to develop deep roots, which makes it stronger and more resistant to drought.
- Deep wetting, once a week. In very hot periods you can shorten this to once every three days, but give enough water to make sure that it will seep deep into the ground, and not all just evaporate out of the top 10-15cm of your soil. You can also mulch to help reduce evaporation losses. But NEVER give shallow daily wettings to mature plants. Other than evaporation losses, you are also encouraging your plants to make only very shallow roots.
- Try to give soft, fine showerings rather than big hard drops (which will compact your soil), or gentle flows rather than rapidly running water (which will wash out your soil and expose the plant roots).
- Distribute water evenly across the planting bed. If all the plants get equal amounts of water, you will be getting the most 'crop per drop'. With uneven water sharing between the plants, those plants that get too much water, use too much 'drop'; while those that get too little water, will give you too little 'crop'.
- Measure! Monitor! Keep a record of how much water you are giving; how much rain you are getting; and how the level changes in your rainwater tank(s). Every year you will get better at stretching your water to get the most 'crop per drop'. Always dig the day after you have given water to see how deep the wetness goes. Do these until you have developed a feel for how your soil reacts to irrigation and rain; and check again whenever you are uncertain whether the deeper soil layers are beginning to dry out.



Activity 1
How much water does the garden need?

Aim

To develop useful 'Rules of Thumb' on how many buckets per week your food garden needs, and how much water you can get from rain.

Instructions

1. Make sure you understand these two rules of thumb, and REMEMBER THEM.

Rainfall:

If 1mm rain has fallen, then 1 litre has fallen on every area of 1m x 1m.

The rule of thumb is: Every 1mm of rain gives 1 litre per m^2.

Watering the garden:

In most areas, a garden needs about 20mm per week.

To give 20mm per week, we need to give one 20 litre bucket of water per week for every 1m x 1m area of garden beds.

The rule of thumb is: One 20 litre bucket per week for every m^2 of garden beds.

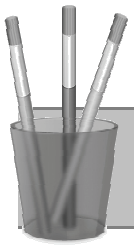
2. Now use your rule of thumb to work out how many buckets per week a garden with 10 planting beds of 1m x 6m would need.
3. How many buckets is that per day if the gardener waters 6 days per week?
4. Should the gardener try to divide these buckets evenly between all the beds every day?

Answers:

2. *60 buckets (20 litre size) per week.*
3. *10 buckets per day, which is the same as one 200 litre drum per day.*
4. *No, definitely not! Every bed would just get a thin sprinkling and will dry out again almost immediately – all the hard work and precious water to waste. Much better: divide the garden into six parts and water one part per day, moving on to the next part the following day. In very hot periods, water one-third of the garden per day and increase the number of buckets per day if necessary.*

How big is your garden? (Remember to just consider the beds. You don't need to include the paths in your measurement)	**How many litres per week do you need to water your garden?**	**How many 20 litre buckets per week does your garden require?**
10 m^2	200 litres per week	10 buckets per week
20 m^2	400 litres per week	20 buckets per week
30 m^2	600 litres per week	30 buckets per week
40 m^2	800 litres per week	40 buckets per week
50 m^2	1000 litres per week	50 buckets per week
60 m^2	1200 litres per week	60 buckets per week





Activity 2: Estimating garden water needs

Aim

To make an estimate of the water needs of a typical food garden according to the rainfall area.

Average water needs for vegetables in different rainfall areas per 10m^2 deep trenched garden beds

Types of crops	**Summer rainfall area**		**Winter rainfall area**	
	Summer	**Winter**	**Summer**	**Winter**
Spinach (High demand)	2 800 ℓ	3 900 ℓ	6 600 ℓ	900 ℓ
Mixed (Medium demand)	2 500 ℓ	2 900 ℓ	5 400 ℓ	1 000 ℓ
Cabbage (Low demand)	1 000 ℓ	1 900 ℓ	2 600 ℓ	200 ℓ

Instructions

Using table above, work out how much water your 60m^2 garden would need for your summer crops, and for your winter crops in your area.

Managing stored water

It's a good idea to start the dry season with a full rainwater tank and with a full soil profile. Our strategies differ for dry and wet seasons.

Irrigation strategy in the dry season

This would be **winter**, in most parts of South Africa. There is no rain, and thus no crops. Or, in some parts, there is some rain, but not enough to see crops through to harvest, so crops may grow well initially, but die before we can benefit from them.

Dry season strategy: START FULL, END EMPTY

1. Start the dry season with the trench beds thoroughly wet, and the water tank full. You will try to use as much water from the tank as you need to get through the winter, and should end the dry season with the tank nearly empty.
2. If you are worried that your water may run out before the end of the season, plant a smaller portion of your garden in the dry season.
3. Decide how many days per week you will irrigate your garden. Divide the garden in equal parts to be watered every day (e.g. if you are planning to irrigate five days per week, divide the garden into five parts).
4. IRRIGATE ONE PART OF THE GARDEN PER DAY, do not try to give a little bit of water to every bed in the garden every day. (The exception is for seeds and seedlings, which need a small sprinkling once or twice a day until their roots area strong and deep enough to cope with less frequent watering).
5. Keep an eye on how much water remains in the tank, and how long before the next rain is expected. Write this down every day, so that next winter you can try to benefit from this year's experience.
6. If it looks as if your water will run short, decide which crops are most valuable to you, and keep them going with the water you have left. It is better to lose a few beds than to harvest hardly anything from all your beds. Keep in mind that some types of plants need less water than others; e.g. cabbage uses less water than spinach. So in a crisis you may decide to save fewer spinach plants and more cabbage plants.

Irrigation strategy in the wet season (Points 2-5 above also apply here)

This would be **summer** in most parts of South Africa. Some years there is an abundance of rain, but some years can be very dry. A very difficult problem is when there are long dry stretches in an otherwise good rainy year, and this is where stored water will help you to save your plants. It is hard to predict when to expect a good or bad rainy year, therefore we have to plan for the worst, or 'almost the worst'.

Wet season strategy: START EMPTY, END FULL

1. If you can wet your beds thoroughly at planting, this is always a good strategy. Your rainwater tank will be nearly empty if you have made good use of it during the dry season, but should fill up quickly with the first few rainstorms.
2. You will then need to balance your irrigation with the amount of rain that has fallen, so that you do not irrigate unnecessarily. Remember the calculations in the sections above
3. During really hot dry weather you will need to irrigate more, but by now your tanks should be full and you can empty it dealing with these "dry spells" so that it can re-fill. The assumption is that your tank should be able to fill up at least twice during the summer season and should be full for the start of the winter season.





Left: An underground tank holding around 30 00 l of water and
Right: A plastic roof tank 'jo-jo' that holds about 5 000 l of water

3.Tank Maintenance and Safety



Both underground and aboveground rainwater harvesting tanks are a big investment in your homestead. It's important that you take responsibility for your tanks and ensure proper maintenance, cleaning, safety, and protection from fire. If you care for your tanks properly, they'll provide water for your garden for several decades.

Roof Tanks

Roof tanks must be cleaned out at least once a year. All the tanks have been fitted with ladders, so it is easy to climb in and out.

You should place a pile of stones or concrete under the tap in order to reduce splash erosion and to avoid having a muddy mess in your yard. You may want to keep a container under the overflow…every drop of water counts! Lead any excess water away so that you won't have standing water next to the house. Uncovered standing water offers a breeding ground for mosquitoes and various diseases.



Stones help to decrease splash erosion

Gutters

Gutters should be attached as close to the roof as possible to ensure that most rainwater runs off the roof into the gutters without splashing out or dripping straight to the ground. If gutters become loose over time, you may need to tighten the wires holding the gutters in place. It is advisable to remove gutters if you expect heavy snow because the weight of the snow may permanently bend them.

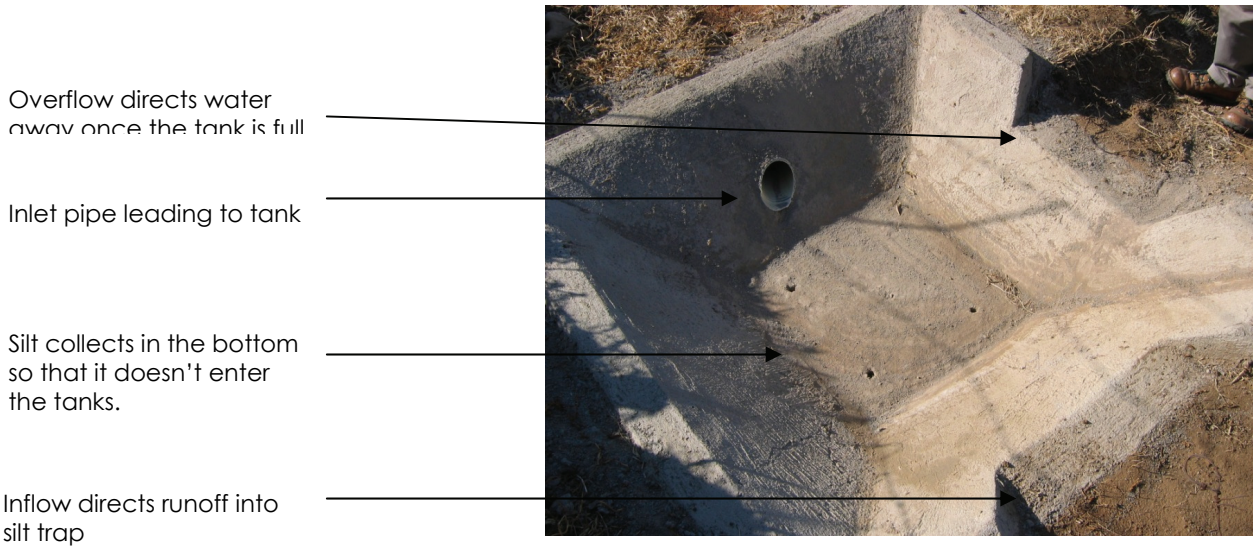


Gutters should be placed as close to the roofline as possible so that most rainwater will go into the tank.

Gutters must be checked for leaks occasionally. Leaks can be fixed with silicon. You can buy silicon for around R20 at your local "Spares" shop or hardware store. You should clean out your gutters as needed in order to keep the water in your roof tanks relatively clean. During the rainy season it is advisable to clean out your gutters once a month.

Underground Tanks

Your underground rainwater harvesting tanks are a unique design using plastic tanks. A silt trap leads water to your underground rainwater harvesting tank. Remember, water that enters your underground rainwater harvesting tanks is not fit for drinking.



Silt trap leading to underground rainwater harvesting tank also serves as an overflow.

Clean your silt trap after each storm with a flat-edge spade. Check regularly that the trenches leading to your inlet are still shaped properly to direct water towards the silt trap. Also, after each storm you should clean debris out of the metal strainer inside the pipe leading to your tank.



You should clean debris out of the strainer in your silt trap after each storm

It's very important to protect your underground tanks from cattle. If cattle graze the area around your tanks, place a fence around the tanks or pile thorny bushes as a barrier around the tanks. If a large bull steps on one of your tanks, he may cause serious damage!

It's also important to protect your tanks from fire. It is advisable to cut the grass around your tank, leaving a border of *bare ground* for at least 3 metres around the tanks. You may consider doing a wider firebreak if your tanks are in a vulnerable position.



This was a storage area at a JoJo factory. Notice the circles where the tanks once stood.

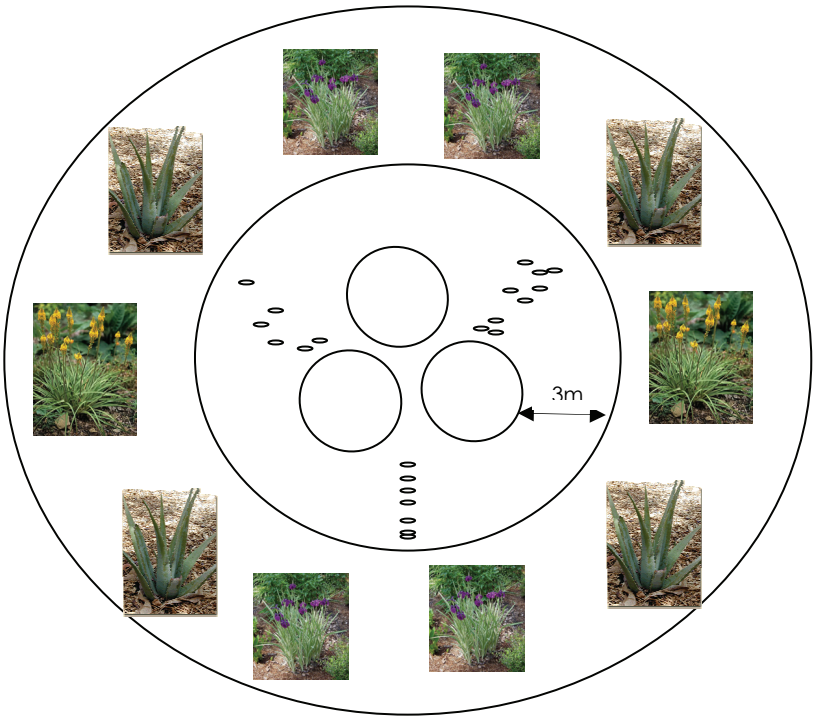
Remove the silt from the bottom of your underground tanks annually. Be careful not to damage the non-return valve placed near the bottom of the tank below the tank door!

Your tanks all come with a lock and key so that you can ensure the safety of curious children who may try to open the tanks. Since you will very seldom need to unlock the tanks, it is advisable to protect the lock from rusting. You can do this by greasing it with vegetable oil, wrapping it in plastic, or placing a small bit of prestik over the keyhole.



Be careful not to damage the non-return valve at the bottom of your tanks when you are cleaning them.

Depending on the layout of your yard, you may consider adding swales or stone lines around your tank in order to prevent soil erosion where you have carefully shaped the land. This will mean less work for you in the long run because you won't have to spend as much time reshaping the slopes around your tanks. Remember, it's important to direct the water around the tanks away so that you won't have standing water directly above your tanks.



In this yard, the tanks are surrounded by 3 metres of bare ground for fire protection. Three stone lines help to keep the soil around the tanks shaped to move water away. In the outer circle, aloes, irises, and bulbinella also help to retain the shape of the land as well as add extra fire protection.

Hand Pump

Your underground tanks have been fitted with a pipe pump that is powered by hand. This unique design offers a simple way to pump the water from each of the JoJos into a watering can.

It's important to keep the black pipes leading to the JoJos plugged so that no debris enters the tank. Emphasize with your children the importance of not putting any sticks in the tank because rubbish will become stuck inside and seriously damage your pump.

Notice the muddy mess in this picture. To avoid this splash erosion, place a pile of stones where the water will hit the ground. This will also help to maintain the shape of the soil around your tank.



Ntate Tladi shows how to use the pipe pump.

Watering the garden: How much, how often?

One of the most common wasteful irrigation practices is to spread a small quantity of water across the whole garden once or twice a day or every day or two. It is understandable that people do this, because they think that "at least all the plants will get a little bit of water." This kind of shallow watering is actually very wasteful, because most of the water simply evaporates out of the topsoil without doing much good at all. Shallow watering also promotes shallow root systems, which means our plants will wilt easily. Instead we should apply *more* water at a time and water *less* often. We can try to apply more water every second day and see how that goes. For more mature crops, such as full grown spinach or half grown cabbages, we can even water deeply once a week!

Deep watering

We all know that plants cannot grow without water. If plants receive regular deep waterings, they develop deep, strong roots, meaning that they can produce large, strong stems, leaves and fruit. If they get just a little water on the soil surface most of the time, the roots will be shallow and the plants will have very little resistance to dry periods.

To do deep watering, divide the garden into imaginary sections and provide a good deep watering to each section every four to seven days. This allows the water to soak deep into the soil and less of it will be lost to evaporation.

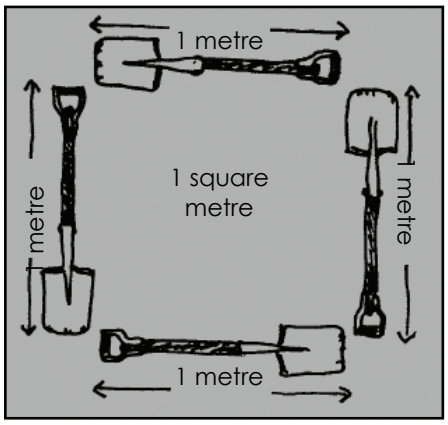


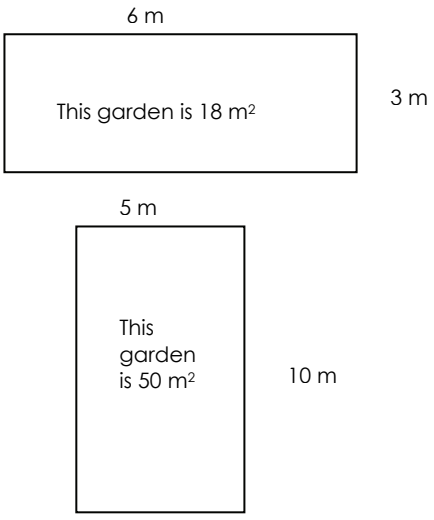
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Did you know that plants can also suffer if there is too much water around their roots all the time? If the soil is water logged, the roots don't get enough air. Plants need well-drained soils to prevent the roots from rotting .

We use deep watering because we want to draw the roots of our plants down into the ground. Applying MORE water, LESS OFTEN is crucial.

As a rule of thumb, vegetables require around 20mm of irrigation a week. This means that you need to apply 20 litres of water to every square meter square of garden bed.





20mm/week is a good assumption to start our planning on, but of course, our plants would not need exactly the same quantity of water week after week.

- When it rains, plants need less irrigation.
- When the plants are still very small, they need less water, but just like human babies, they need it more often. Human babies drink every two or three hours after birth; your seeds/seedlings must never dry out, so check them several times a day in the beginning.
- When plants are making fruit, like nursing mothers, they need extra food and water!
- Plants need extra water because when it is extra hot. In cooler periods, plants need less.
- Towards the end of their life, like older people, plants need less water.
- The plants in your garden will be different types and sizes, so they all have their own water needs each week.

20mm/week is equivalent to 20litres/week which is a 20-litre bucket on 1m².

For drip irrigation systems 20litres/1m² equates to about 340 ml of water/dripper/week.

How deep has the water gone?

The simplest method is to push a steel peg into the soil a few hours after watering the bed, when the water has had time to infiltrate properly into the soil. The peg goes in quite easily until it reaches the dry soil below, which gives you a good idea of how deep the water had gone down. Combine this with knowledge about the typical rooting depth of the crop, and you can decide if you have given enough water. If you measure rain in a rain gauge, you will measure this in millimetres. 1mm of rain is equivalent to 1litre of water on 1 m² of soil.

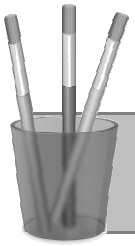
Golden rules of watering

Day-to-day, how and when you irrigate your plants has a big influence on how much water you use in the end. Here are a few golden rules:

- ❖ Start the growing season with your soil thoroughly wet to at least one meter deep – especially for the dry season crops when there will be very little rain for a few months. At first, the young roots won't reach this water, but the water will stay there and the plants will draw on it later in the season when they may need more than you can give.
- ❖ Provide your plants with a one deep watering each week. In very hot periods you can shorten this to once every three days, but give enough water to make sure that it will soak deep into the ground, and not just evaporate out of the top 10-15cm of your soil. You can also mulch to help reduce evaporation losses. But NEVER give shallow daily wettings to mature plants.
- ❖ Try to give soft, fine showerings rather than big hard drops (which will compact your soil), or gentle flows rather than rapidly running water (which will wash out your soil and expose the plant roots).
- ❖ Distribute water evenly across the planting bed. If all the plants get equal amounts of water, you will be getting the most 'crop per drop'. With uneven water sharing between the plants, those plants that get too much water, use

too much 'drop'; while those that get too little water, will give you too little 'crop'.

- ❖ Measure! Monitor! Keep a record of how much water you are giving; how much rain you are getting; and how the level changes in your rainwater tank(s). Every year you will get better at stretching your water to get the most 'crop per drop'. Always dig the day after you have watered to see how deep the wetness goes. Do these until you have developed a good understanding of how your soil reacts to irrigation and rain; and check again whenever you are uncertain whether the deeper soil layers are beginning to dry out.



Activity 1
How much water does the garden need?

Aim

To develop useful 'Rules of Thumb' on how many buckets per week your food garden needs, and how much water you can get from rain.

Instructions

1. Make sure you understand these two rules of thumb, and REMEMBER THEM.

Rainfall:

If 1mm rain has fallen, then 1 litre has fallen on every area of 1m x 1m.

The rule of thumb is: Every 1mm of rain gives 1 litre per m^2.

Watering the garden:

In most areas, a garden needs about 20mm per week.

To give 20mm per week, we need to give one 20 litre bucket of water per week for every 1m x 1m area of garden beds.

The rule of thumb is: One 20 litre bucket per week for every m^2 of garden beds.

2. Now use your rules of thumb to work out how many buckets per week a garden with 10 planting beds of 1m x 6m would need.
3. How many buckets is that per day if the gardener waters 6 days per week?
4. Should the gardener try to divide these buckets evenly between all the beds every day?

Answers:

2. *60 buckets (20 litre size) per week.*
3. *10 buckets per day, which is the same as one 200 litre drum per day.*
4. *No, definitely not! Every bed would just get a thin sprinkling and will dry out again almost*

immediately – all the hard work and precious water to waste. Much better: divide the garden into six parts and water one part per day, moving on to the next part the following day. In very hot periods, water one-third of the garden per day and increase the number of buckets per day if necessary.

How big is your garden? (Remember to just consider the beds. You don't need to include the paths in your measurement)	**How many litres per week do you need to water your garden?**	**How many 20 litre buckets per week does your garden require?**
10 m^2	200 litres per week	10 buckets per week
20 m^2	400 litres per week	20 buckets per week
30 m^2	600 litres per week	30 buckets per week
40 m^2	800 litres per week	40 buckets per week
50 m^2	1000 litres per week	50 buckets per week
60 m^2	1200 litres per week	60 buckets per week

Managing stored water

It's a good idea to start the dry season with a full rainwater tank and with water deep in your soil. Our strategies differ for dry and wet seasons.

Irrigation strategy in the dry season

In winter when there is no rain, there are few crops. Sometimes there is some rain, but not enough to see crops through to harvest, so crops may grow well at first, but die before we can eat them.

Dry season strategy: START FULL AND END EMPTY

1. Start the dry season with the trench beds thoroughly wet and the water tank full. You will try to use as much water from the tank as you need to get through the winter, and should end the dry season with the tank nearly empty.
2. If you are worried that your water may run out before the end of the season, plant a smaller portion of your garden in the dry season.
3. Decide how many days per week you will irrigate your garden. Divide the garden in equal parts to be watered every day (e.g. if you are planning to irrigate five days per week, divide the garden into five parts).
4. IRRIGATE ONE PART OF THE GARDEN PER DAY, do not try to give a little bit of water to every bed in the garden every day. (The exception is for seeds and seedlings, which need a small sprinkling once or twice a day until their roots area strong and deep enough to cope with less frequent watering).
5. Watch how much water is in your tank, and estimate how long before the next rain is expected. Write this down every day, so that next winter you can try to benefit from this year's experience.

6. If it looks as if your water will run short, decide which crops are most valuable to you, and keep them going with the water you have left. It is better to lose a few beds than to harvest hardly anything from all your beds. Keep in mind that some types of plants need less water than others; e.g. cabbage needs less water than spinach. So in a crisis you may decide to save fewer spinach plants and more cabbage plants.

Irrigation strategy in the wet season

In summer there is usually an abundance of rain, but some years can be very dry. A very difficult problem is when there are long dry stretches in an otherwise good rainy year, and this is where stored water will help you to save your plants. It is hard to predict when to expect a good or bad rainy year, so we have to plan for the worst.

Wet season strategy: START EMPTY AND END FULL

1. (Points 2-5 above also apply here)
2. If possible, wet your beds thoroughly at planting. Your rainwater tank will be nearly empty if you have made good use of it during the dry season, but it should fill up quickly with the first few rainstorms.
3. Balance your irrigation with the amount of rain that has fallen, so that you do not irrigate unnecessarily. Remember the calculations in the activity above.
4. During really hot dry weather you will need to irrigate more, but by now your tank should be full and you can empty it dealing with these dry spells so that it can re-fill. Your tank should be able to fill up at least twice during the summer season and should be full for the start of the winter season.

Resource Material for Homestead Food Gardeners

Chapter 5: Handouts (seSotho)

Handout 1 Pokello le tšebeliso ea metsi (Saving and using water)

Handout 2 Mekhoa ea ho noesetsa liratsoana malapeng (Homestead irrigation techniques)

Handout 3 Ho nwesatsa serapa hakae le neng (How Much, How Often to Water)

Handout 4 Tokiso le polokeho ya tanka

1. Pokello le tšebeliso ea metsi



Ho bohlokoa hore ha pula e na u bokelle metsi ao u tla a sebelisa nakong ea komello. Hona ho tla u thusa hore u be le metsi ao u ka a sebelisang nako e telele.

Pokello ea metsi e ka etsoa ka mekhoa e mengata:

- Ka ho a khakeletsa
- Ka ho a sebelisa ka hloko
- Ka ho a bokella ho tsoa liphuleng kapa marulelong

Ho khakeletsa metsi

Sepheo sa mantlha ke ho:

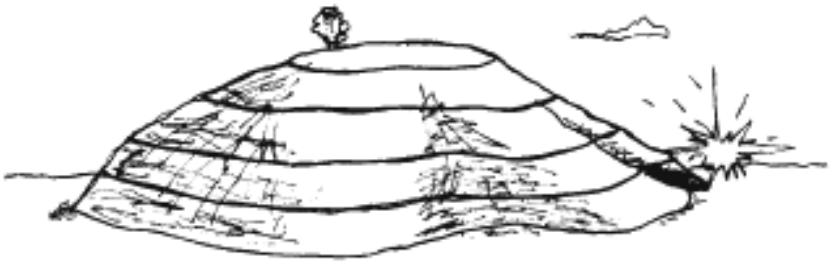
- Hasa mosuoela mobung. U ka ikh'opotsa ka ho bala lihloho tse latelang; '*Ntlafatso ea mobu*' le '*Ho haha lirapa*'.

- Koahela mobu ka joang kapa moiteli le tse ling. U ka fumana lintlha ka botlalo tlas'a sehloho sena '*Ho koahela mobu hore o se lahleheloe ke mongobo*'.

- Sireletsa mobu ka ho lema lifate, cheche kapa joang.
- Sireletsa lirapa ka makhoakhoa. Ikh'opotse ka ho bala sehloho sena *'Tšireletso ea lijalo moeeng le serameng'*.
- Haha lirapa ho tšekalla le motheo e le hore metsi a monyele ka mobung a se ke a phalla.
- Haha limotomoto ho laola sekhahla sa metsi le ho a bokella.
- Haha limotomoto tse bitsoang 'swales'. Mofuta ona o hlalositsoe karolong tse hlahlamang tlas'a sehloho sena.

Limotomoto

Hona ke limotomoto tse bonahalang masimong a mothipolohong. Li hahoa ho latela matšoao a entsoeng a kolokile ho khoahanya mothipoloho. Matšoao ana kaofela a bapile.



Limotomoto tse sebakeng se mothipolohong. Sebaka se lipakeng tsa tsona se batelehile

Mokhoa oa ho etsa matšoao



U ka sebelisa 'A- frame' ho etsa matšoao a bapileng sebakeng se mothipolohong. 'A-frame' ke kosene e sebopeho sa tlhaku 'A'.

Mokhoa oa ho etsa kosene:

1. Nka lipalo tse peli tsa bolelele bo lekanang. Li fase 'moho lehlakoreng le leng ka terata kapa khoele.



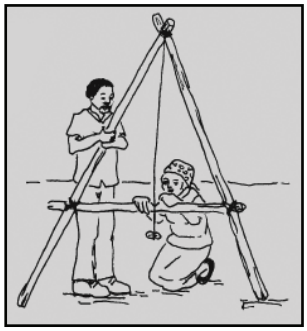
Tse hlokahalang:

Lipalo tse peli. E le 'ngoe e be bolelele ba likharafu tse tharo.
Ea boraro e bolelele ba kharafu tse peli.
Khoele le terata.
Lejoe le lenyane.

2 Faseletsa palo ea boraro ho tseo tse peli feela li takalalitse. O efase bophahamo ba bolelele ba kharafu ho tloha fatše.



3 Fasa khoele lehlakoreng le kaholimo la kosene. Ntlheng engoe ea khoele u faseletsa lejoe. Phahamisa kosene, e tšehetse hore e eme e otlolohile holim'a sebaka se batelehileng hantle. Khoele le lejoe li lokela ho leketlela fatše. Etsa letšoao palong e tlamelletsoeng ho tse peli tse telele (maoto) moo khoele e thetsang teng. Tebello ke hore letšoao le tlaba bohareng ba eona palo eo.



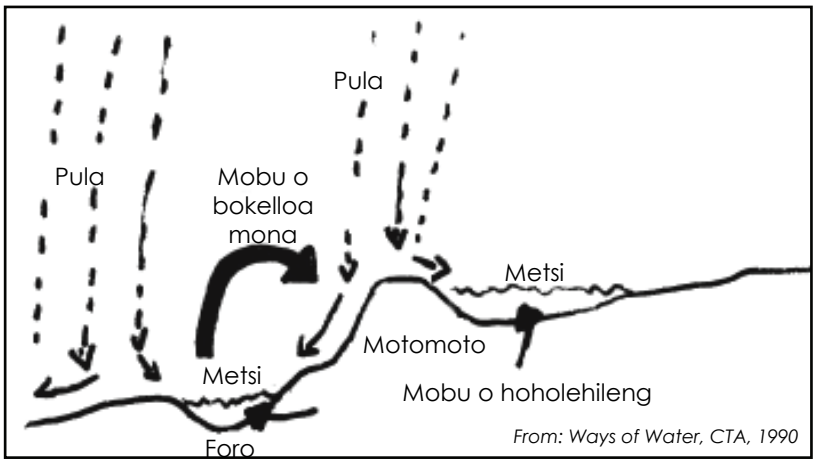
Tšebeliso ea kosene:

4 Fumana sebaka se batelehileng ka thoko ho sebaka seo u batlang ho haha limotomoto ho sona. Tšoaea libaka tse peli ka thupa tse peli. Tsamaisa leoto le letšehali la kosene ha le letona le ntse le hatile fatše. Etsa joalo ho fihlela khoele e leketlileng e thetsa letšoao le palong e kopantseng maoto a kosene. Latela mokhoa ona ho etsa matšoao ao u a batlang.



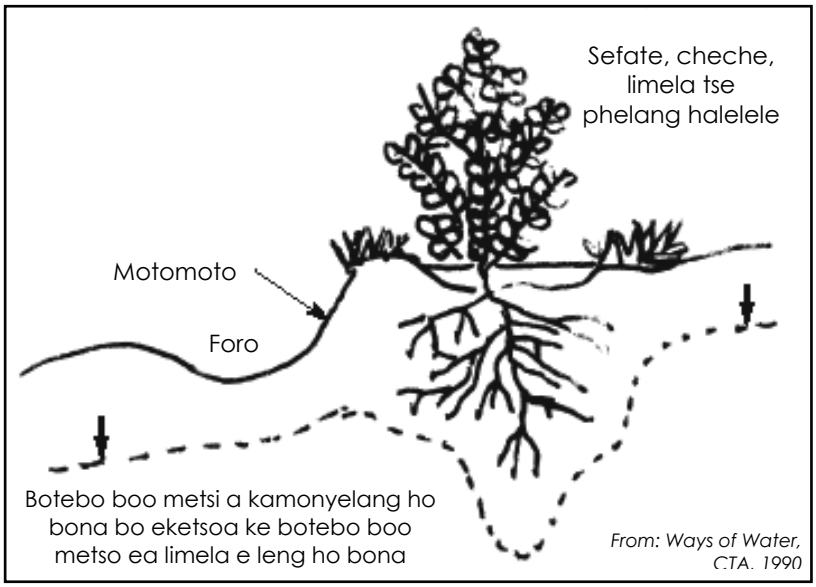
From: Farmer-to-Farmer Handbook, FSG, 1996

Cheka foro ea botebo ba lisenthimithara tse mashome a mararo le bophara bo lekanang sebakeng seo u se tšoaileng. Bokella mobu lehlakoreng le kaholimo ho foro ho etsa motomoto ka ona. Metsi a pula a tla bokellana ka forong 'moho le lehlakoreng le ka moepeng la motomoto.

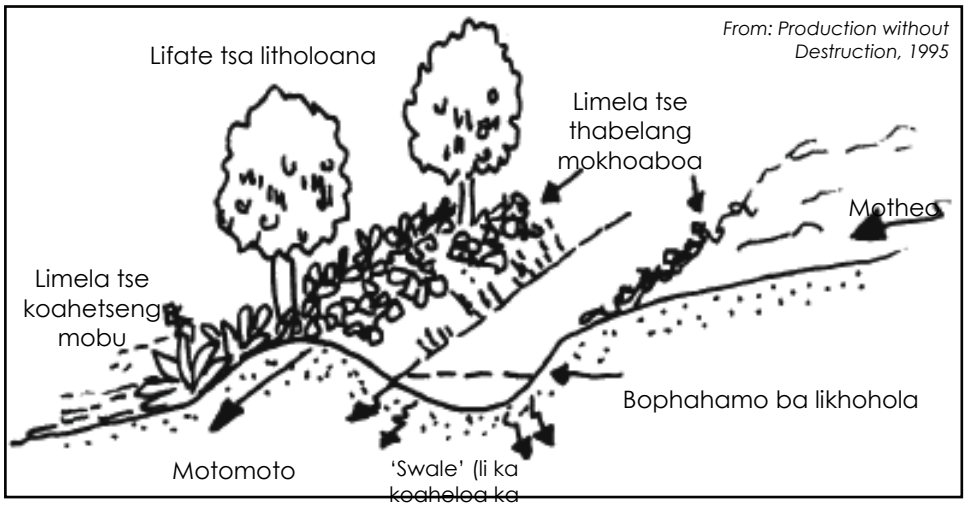


Metsi a tla monyela ho fapana le ho phalla. Ha mobu o hohotsoeng ke metsi o bokellana lehlakoreng le kaholimo la motomoto sebaka seno se tla qetella se batelehile. Leha ho le joalo hona ho tla etsahala ka mor'a matsatsi a mangata.

Jala mefuta ea limela e sa shoeng mariha holim'a motomoto. Li tšoara mobu ka metso ea tsona le ho o koahela ka holimo. Limotomoto li boloka metsi bakeng la lifate 'moho le licheche. U ka boela ua hloma lifate tsa litholoana le litlama-tlama tsa li matlafatsi. Bakeng la khetho ea mefuta e meng ea limela eo u ka e jalang motomotong u ka bala sehloho sena *'Tsireletso ea lijalo moeeng le serameng*'. Ha mobu u tlala ka forong u lokela ho u ntša.



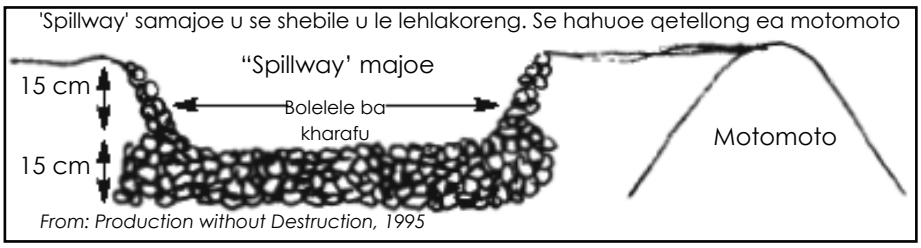
Limotomoto tse bitsoang 'Swales'



Ke mofuta oa motomoto o sa tšoaneng le mofuta o hlalositsoeng pele ka hore ho oona mobu o bokelloa lehlakoreng le ka tlase ho foro. Mofuta ona o na le makhabane a hore o bokella metsi a mangata ho feta a bokelloang ke mofuta oa pele, ka hona mobu o ba le mongobo o mongata.

Mofuta ona ha o qetelle ka sebaka sa batelehileng ka lebaka la mobu o hohotsoeng ke liphororo joalo ka mofuta oa pele. U ka jala limela tse thabelang moo ho leng mokhoabo 'me li sa shoe kapele. Ha mobu o bokelleha u lokela ho u ntša.

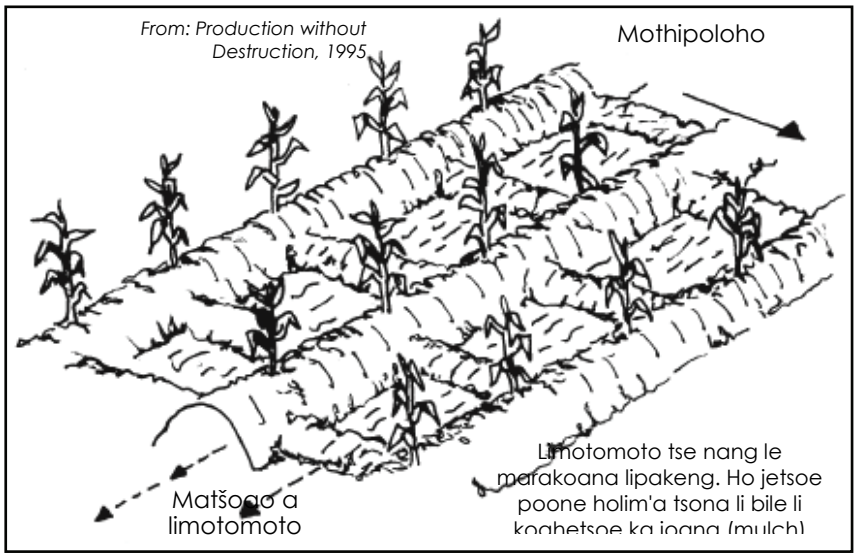
Mefuta e 'meli ea limotomoto e hlalositsoeng kaholimo e lokela ho ba bophahamo bo ke keng ba lumella metsi ho phalla kaholimo. Ho qoba boemo bona u lokela ho haha 'spillway' ka majoe hore ha metsi a le mangata a tšolohe le hona teng a nto phallela tlase ho mothipoloho



Limotomoto tse nang le marakoana lipakeng

Marakoana a hahoa lipakeng tsa limotomoto. Marakoana a laola phallo ea metsi haholo nakong ea lipula tsa litloebelele. A boetse a matlafatsa ho monyele hoa metsi ka mobung. Marakoana a ba bophahamo ba halofo ea bophahamo ba motomoto.

Marakoana a hahuoeng ha ho kenakenanoe le ona. Bonyane u ka mpa ua haha marakoana a mang kapa oa bokella makote holim'a marakoana a seng a ntse a le teng.



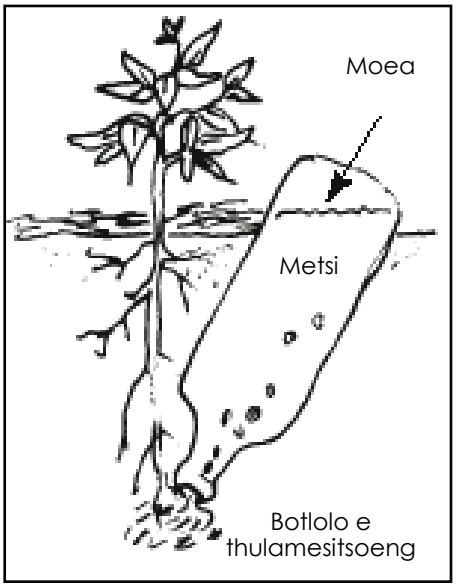
Tšebeliso ea metsi ka hloko

Karolo ena e hlalosa mekhoa ea ho phetaka tšebeliso ea metsi bakeng la serapeng.

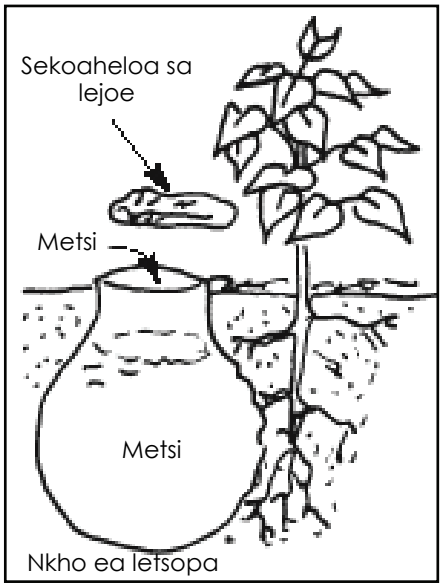
- **Greywater:** Ke metsi ao uena le ba lelapa la hau le a sebelisitseng bakeng la ho itlhatsoa 'moho le ho hlatsoa. U ka sebelisa metsi a joalo bakeng la ho tšella.

- **Drip irrigation:** Ke mokhoa oa ho tšella metso ea lijalo ka kotloloho. Mokhoa ona o nepahetse tšebelisong ea metsi ka hloko.

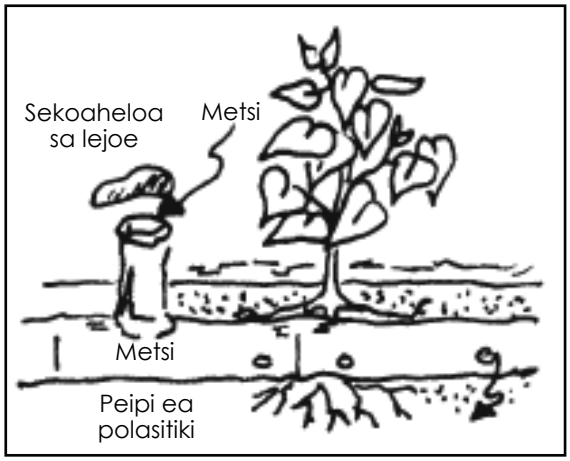
Mekhoa ea ho tšella e fokotsang tšenyo ea metsi



From: Production without Destruction, 1995



From: Production without Destruction, 1995



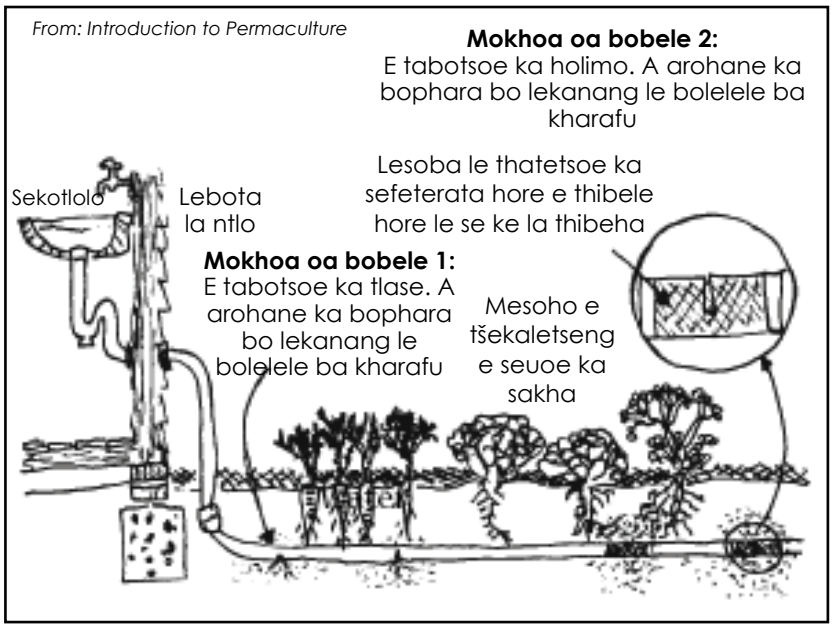
U ka sebelisa peipi e nang le masoba e paqamisitsoeng ka tlas'a mobu.

U ka tšela metsi ka kotloloho ka peipeng kapa ua e hokela sekotloloaneng se hlatsoetsang (sink). U ka sebelisa metsi a seng a sebelisitsoe ka mokhoa ona. Hlokomela hore ho se ke hoa e ba le lintho tse kibang masoba ka har'a peipi.

Ha mobu u le lehlabathe haholo u ka ala lipolasitiki ka tlase nakong eo u hahang seratsoana e le hore li thibele metsi ho monyela tlaase haholo.

Peipi e nang le lesoba e qhalla metsi lijalong. tseo e bang li rata metsi haholo li lokela ho jaloa pel'a lebota

From: Introduction to Permaculture

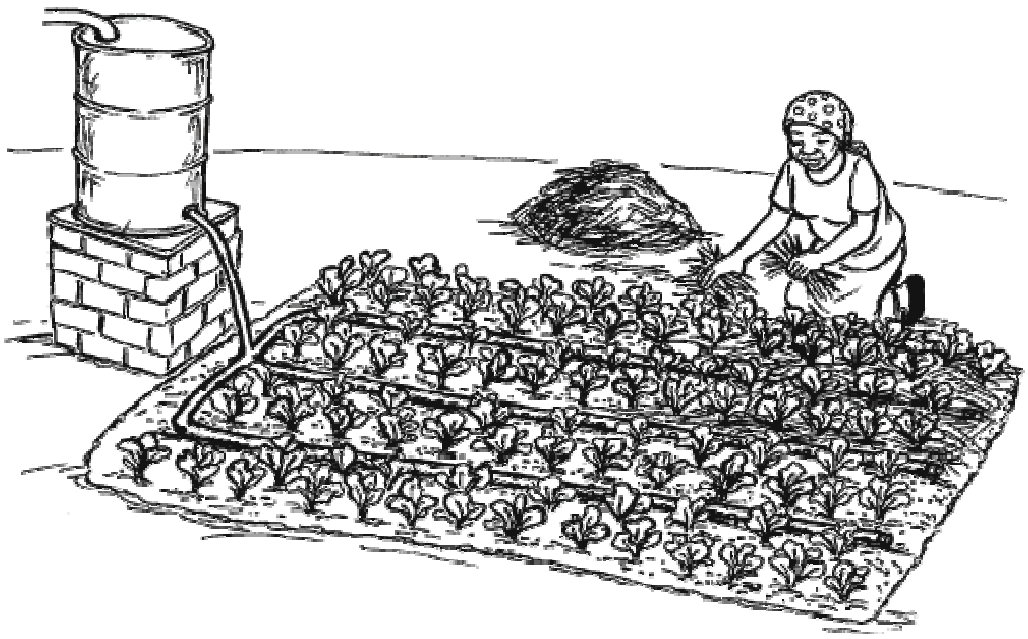


Tlhokomeliso: U se ke ua sebelisa mokhoa ona mobung o letsopa le lengata

Mofuta oa bobeli oa 'drip irrigation' o bontšitsoe ka mor'a mona. Ha u sebelisa mokhoa ona u sebelisa lipeipi tse maloa. U phunya masoba. Kaofela ha tsona li ba kaholim'a mobu oa lirapa tsa hau. Lipeipi 'moho le mobu li koaheloa ka joang.

Lipeipi li hokelloa ho e le 'ngoe e hokeletsoeng mohloling oa metsi. Mahlakore a ka qetellong a lipeipi tsena a koetsoe hore metsi a se ke a tsoa. Masoba a phuntsoeng holim'a e 'ngoe le e 'ngoe a arohana ka lesenthimithara tse mashome a mabeli ho isa mashomeng a mabeli le metso e mehlano. Haele sebaka seo metsi a phallang ho tloha ho sona se lokela ho ba bophahamo ba bolelele ba kharafu kaholimo ho serapa sa hau.

Makhabane a mofuta ona ke hore u ka sebelisa halofo ea metsi ao u ka a sebelisang ha u tšella ka mokhoa o tloaelehileng oa ho sebelisa shetiri.



Mokhoa o mong oa tšebeliso ea metsi ka hloko ntle ho lipeipi le tanka ke ona:

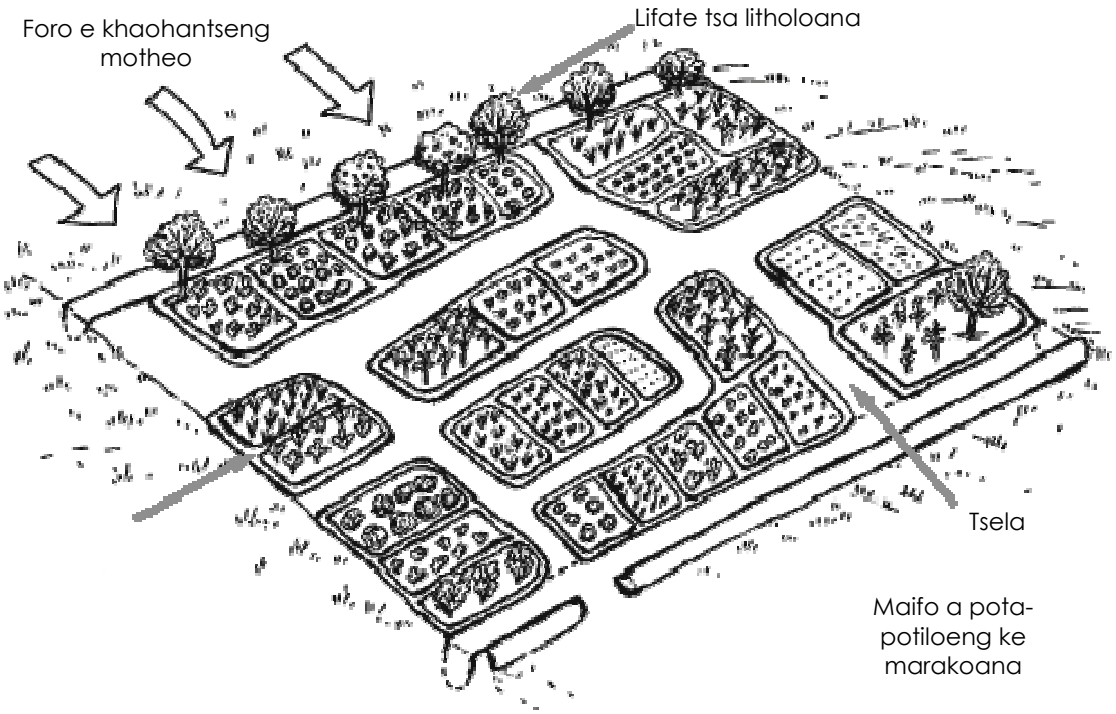
- Foro e chekoa ho khakeletsa metsi a phallang mothipolohong

- Lehlakoreng le ka tlase ho foro u etse liratsoana tse lengoeng botebo ba mohato o le mong (bolelele ba kharafu). Phetolella mosuoela le moiteli. Li tla ntlafatsa mokhoa oa ho monya metsi le ho boloka mongobo nako e telele.

- U ka haha marakoana lipakeng tsa liratsoana. U ka ala majoe a manyane ho sireletsa mobu hore o se ke ua hoholeha.

- Metsi a ka khelosoa ho tloha forong e chekuoeng hore a phalle lipakeng tsa liratsoana. U ka a khelosa hore a phalle ka har'a litsela tse lipakeng tsa liratsoana.

❖ Lema lifate tsa litholoana lehlakoreng le ka tlase ho foro hore li sebelise karolo e 'ngoe ea metsi.

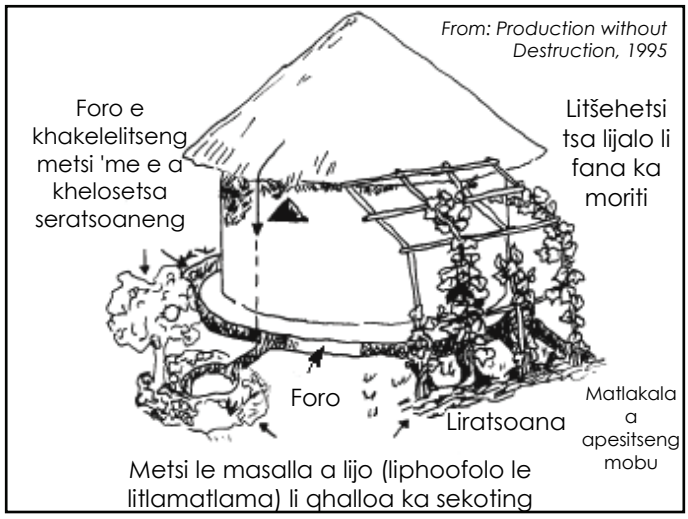


Pokello ea metsi a phallang liphuleng kapa marulelong

❖ Metsi a tsoangmarulelong

Marulelo a ntlo ke sebaka seo u ka khakeletsang metsi ho tsoa ho sona.

- Ho bohlokoa ho etsa foronyana ho potoloha le ntlo hore e khakeletse metsi a theohang marulelong. Metsi ano a ka khelosetsoa seratsoaneng se haueng ka sebopeho sa tlhako ea pere. U ka bala sehloho sena 'Ho haha lirapa' bakeng la tlhaloso ea mokhoa oa ho haha seratsoana se joalo.

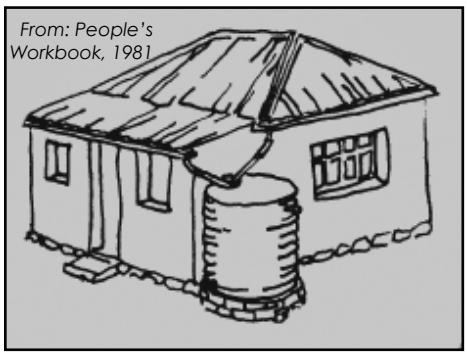


Metsi le masalla a lijo (liphoofolo le litlamatlama) li qhalloa ka sekoting

- U ka sebelisa likhakeletsi tsa metsi (gutters) tse hokelloang marulelong. U ka sebelisa likhakeletsi ho bokella metsi ka tankeng e kholohali. Ho bobebe ho khakeletsa metsi ho tsoa marulelong a masenke le lithaele. U ka sebelisa metsi a joalo ka kechineng.

U ka sebelisa mofuta o mong oa tanka bakeng la ho bokella metsi a ho tšella lirapeng nakong ea komello. Leha ho le joalo metsi ano a ka 'na a ba le litšila.

U ka ikhahela tanka e ka bolokang metsi a bongata bo lekaneng ho sebelisoa nakong ea komello.



Metsi a khelosetsoa ka tankeng

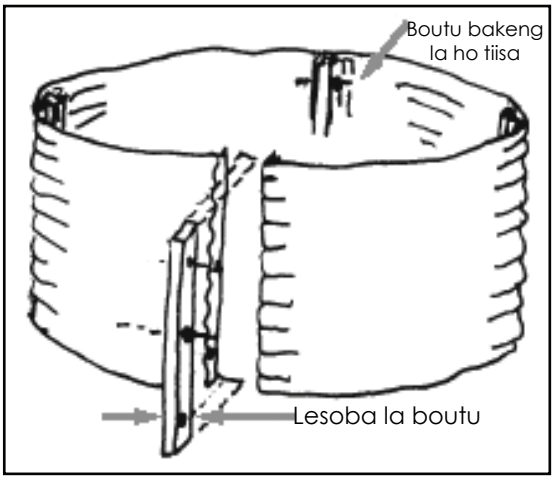
Mokhoa oa ho haha tanka ea samente (ferrocement)

Boholo ba tanka:
Lilithara tse likete li leshome

Tse hlokahalang:

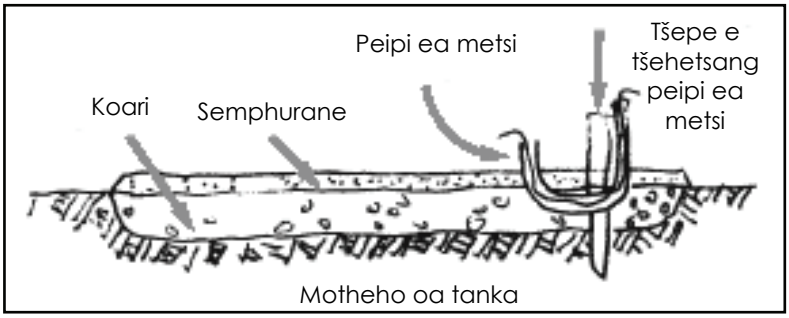
- Samente - 600kg
- Lehlabathe - 1 000 kg
- Koari - 500 kg
- Terata e senang metsu (botenya e be 2.5 mm; bolelele e be 200 m)
- Sefeterata (boholo ba masoba e be 50 mm; botenya ba eona e be 1 mm; bolelele e be 16 m; bophara e be 1 m)
- Peipi ea tšepe (botenya e be 20 mm; bolelele e be 1 m)
- Pompo (mofuta o bitsoang 'No1')
- Peipi e qhalang metsi (ea tšepe: botenya e be 8 cm; ea polasitiki: botenya e be 20 cm)
- Masenke (mofuta o rulelang) le 'angle iron' bakeng la ho koahela.

Foromo: U hloka foromo e tiileng e tla u thusa ho haha tanka ea samente. Mofuta oa foromo oo u ka u sebelisang ka bobebe le ka katleho ke o entsoeng ka mofuta oa masenke a rulelang matlo. U ka sebelisa masenke a leshome le metso e tšeletseng. Bolelele ba le le leng e be likharafu tse peli. U tla hloka 'steel angle iron' (40 mm x 40 mm x 5 mm) bakeng la ho hokella masenke 'moho. Masenke a fasoa ka liboutu tšepeng ho etsa sebopeho se chelikoe. Lipakeng tsa masenke ho ba le tšepe (wedge) eo holeng bobebe ho e hula ha u se u hahile tanka. Ketso ena e bebofatsa hore u arole foromo.



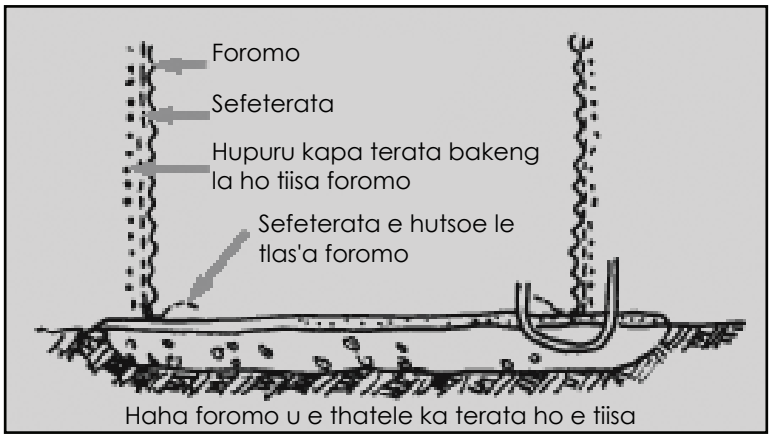
Foromo bakeng la ho haha tanka ea samente

Bofatse: Cheka sekoti se chelikoe sa botebo ba likharafu tse peli le metso e 'meli. Tšela lehlabathe 'moho le koari ka ho lekana. Li etse morumo oa lisenthimithara tse leshome. Beha peipi e bolelele ba kharafu e kobehileng ka mokhoa oa hore karolo e hlaheletseng kantle e be bophamo ba lisenthimithara tse leshome ho tloha moo bofatse ba tanka boleng teng. Tšela motsoako oa litekanyetso tse latelang; karolo tse peli tsa lehlabathe, e le 'ngoe ea samente le tse 'ne tsa koari. Morumo oa motsoako e be lisenthimithara tse supileng le halofo holim'a lehlabathe le koari.



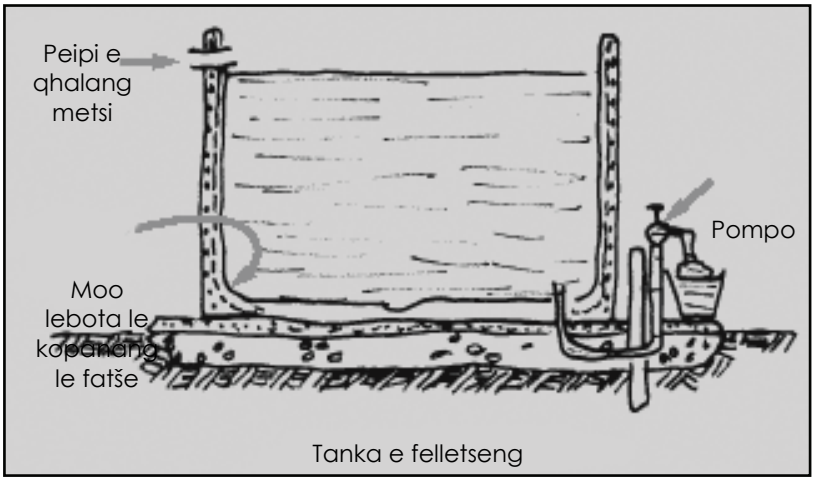
Motheho oa tanka

Mabota: U faseletsa thepa eohle ho bopa foromo e be u e beha holim'a motheho o tiileng hantle. Potisa sefeterata kantle ho foromo. E faseletse hore e tie. Potetsa karolo ea sefeterata tlas'a foromo e le hore u tle u e lilelle nakong eo u tšelang fatše kahar'a tanka. Potisa terata ka holimo ho sefeterata. Terata ka 'ngoe e lokela hoba kahar'a liforo tsa masenke ao u entseng foromo ka ona.



Haha foromo u e thatele ka terata ho e tiisa

Etsa motsoako oa lehlabathe le samente ka litekanyetso tsa likaralo tse tharo tsa lehlabathe ho e le 'ngoe ea samente (3:1). Sebelisa metsi ho etsa motsoako oo u tla lila ka ona. U khothaletsoa ho etsa motsoako oa bongata boo u tla atleha ho bo sebelisa bo be bo fele ka nako ea hora. Lila bokantle ba foromo u etsa morumo oa motsoako oa senthimithara e le 'ngoe. Qala ho lila ho tloha tlase ho foromo u ee holimo. Ha karolo ea pele e omme u lokela ho fafatsa metsi ka borashe e be u boela u lila u etsa morumo o lekanang le oa pele. Kaha u lila bokantle ba tanka ha ho boima, u ka qeta kapele.



Tanka e felletseng

Tlosa foromo letsatsi le hlahlamang. Kaha bokahare ba tanka bo tla be bo nomorehile ke liforo tsa masenke a foromo, le literata li hlaheletse u lokela ho lila joalo ka ha u entse kantle. U qale ka ho etsa morumo oa pele. Ha o omme u etse oa bobeli. Le ona ha o omme u eketse oa boraro. U khothaletsoa ho phethela ho lila morumo ka mong ka letsatsi. Ho seng joalo u lile u etsa lebanta ho pota tanka e le hore nakong eo u tsoelang pele ho tle ho be bobebe ho kopanya likarolo tseo. Hona ho tla fokotsa monyetla oa ho peperana hoa tanka. Ha u phethela tšela motsoako fatše oa morumo oa lisenthimithara tse hlano. Karolo eo lebota 'moho le fatše li kopanang li lokela ho liloa ka morumo o lekanang le o tšetsoeng fatše e leng lisenthimithara tse hlano. Ha u phethetse ho lila penta kahare ka motsoako oa samente le metsi ho thiba matlere ka har'a tanka.

Mothati oa ho qetela ke ho fafatsa fatše ka har'a tanka ka metsi e be u bokoahela ka mekotla e metsi kapa polasitiki e ntšo nako ea matsatsi a supileng ho isa ho a leshome. Phunya lesoba la peipi matsatsing a se makae kamor'a ho phethela mosebetsi. Pele u ka qalella ho tlatsa tanka metsi u lokela ho tšela metsi a fokolang nako e ka etsang matsatsi a supileng.



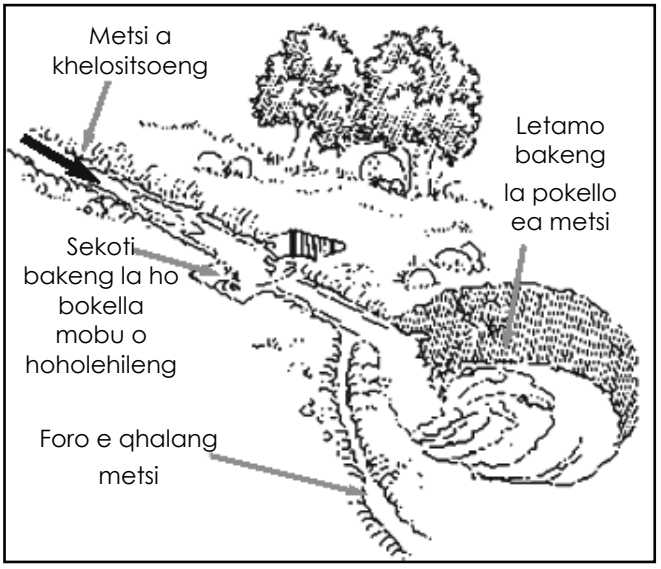


Likhakeletsi tsa lesenke kapa polasitiki li kasebelisoa ho khakeletsa metsi ho tsoa ntlong ea joang. Leha ho le joalo metsi a joalo ha a lokele ho nooa ka lebaka la litšila.

❖ Pokello ea metsi ka tlas'a lefatše

- Matamo

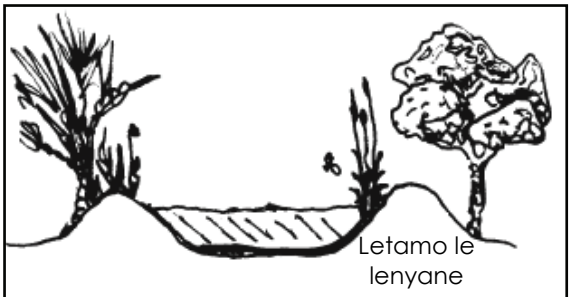
U ka haha letamo ka ho cheka mobu e be u tlatsa metsi a pula kapa a tsoang lengopeng. Mofuta ona ha o boloke metsi nako e telelele. Ka hona u ka ala polasitiki kapa ua lila ka samente hore le seke la lahla metsi kapele.



U ka fokotsa tahlehelo ea metsi ka lebaka la moea le mocheso oa letsatsi ka hore u etse letamo le tebileng empa le se sephara haholo. Letamo le sa tebang le bile le le lephara le lahlaheloa ke metsi a mangata ka lebaka la moea le mocheso oa letsatsi. U ka lema lifate haufi le lona hore li tle li lesireletse. U khothaletsoa ho bala sehloho sena 'Tšireletso ea lijalo moeeng le serameng'.

- Tanka tse hahueng ka mobung

U ka khelosa metsi a phallang lebaleng kapel'a ntlo kapa leralleng hore u a bokelle ka tankeng e ka mobung. U ka haha lebota le lenyane bakeng la ho a khelosetsa ka tankeng.



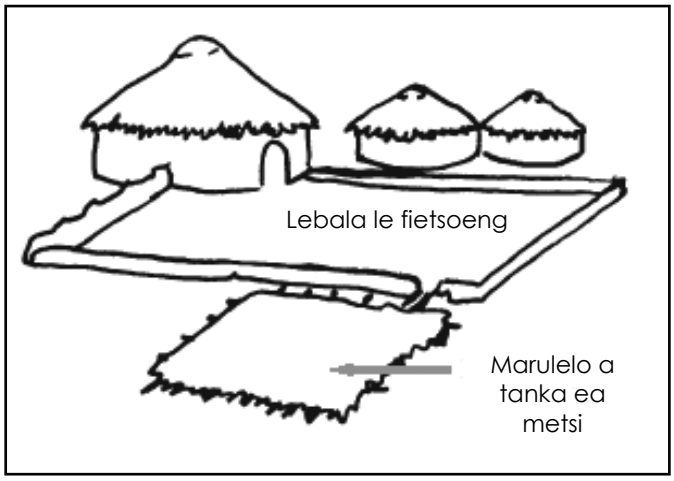
Joang, lehlaka le lifate tse nyane li sireletsa mehloli ea metsi hape li tšoara mobu

U ka haha tanka e kholo hore u tsebe ho bokella metsi a mangata bakeng la ho tšella lijalo serapeng. U ka sireletsa mabota a mokoti ka mekhoa e latelang:

- Ala sefeterata maboteng le fatše. Lila ka samente. U ka batla sehahi bakeng la mosebetsi ona hore mosebetsi e tle e be o makhethe, tanka e sa lutle.

- U ka haha mabota ka litene ua ba ua lila ka samente ka hare. Mokhoa ona o bobebe, e bile ha u hloke lisebelisoa tseo ho leng thata ho li fumana.

- U ka ala mofuta oa polasitiki o bitsoang 'HDPE' maboteng le fatše. Mofuta ona o morumo o motenya. U ka sebelisa mofuta o mong o bitsoang 'geofabric'. Mofuta ona oa bobeli o fumaneha e le likaroloana tse ngata. U li ala fatše le maboteng a tanka e be u tlotsa moo likaroloana li kopanang ka mofuta oa mokeli-keli o khethehileng (sealant). Ha u tlotsa ka 'sealant' u thiba masoba hore metsi a se ke a lutlela kantle ho tanka. Tšebeliso ea mofuta ona oa bobeli e bobebe ho feta mofuta o hlalositsoeng pele ka hore ha ho hlokahale bathusi ba bangata e bile ha o litšenyahelo li phahameng. Theko ea 'geofabric' le 'sealant' e tlase.





Setšoantso se ka lehlakoreng le letšehali se bontša 'me evamasha oa limpopo naheng ea afrika boroa a le pel'a tanka eo a ikhahetseng eona.

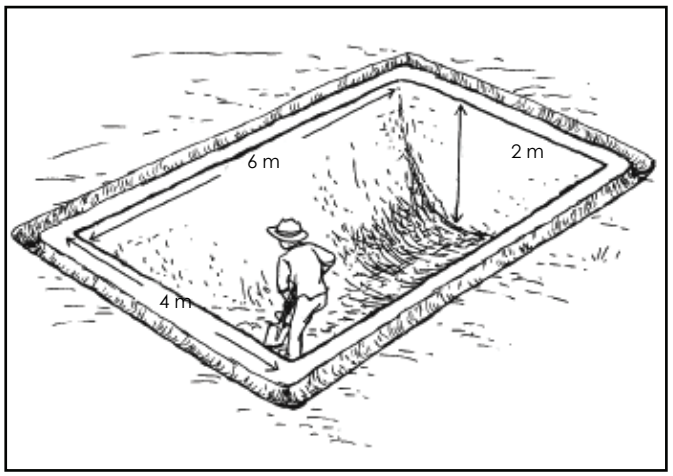
Setšoantso se latelang ka letsohong le letšehali se bontša 'me emily ha akhametsi ho tsoa tankeng eo maboteng le fatše ho aluoeng 'hdpe' 'me eona e koahetsoe ka lesenke. Setšoantšo sena se ile sa nkuoa nakong ea komello ha ho ena le khaello ea metsi. U sebelisa metsi a ka tankeng ho tšella lijalo serapeng sa hae joalo ka ha ho bontšitsoe setšoantšong se ka letsohong le letona.



Pictures courtesy of the Water for Food Movement, PO Box 796, Derdepoort Park, 0035, South Africa



Mokhoa oa ho haha tanka ka mobung u sebelisa polasitiki e bitsoang 'geofabric' 'moho le 'sealant'



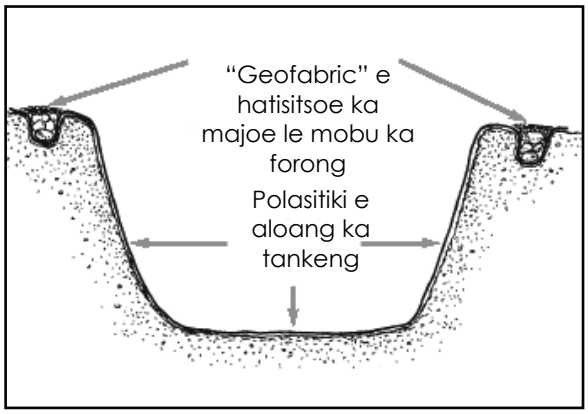
U ka haha tanka e boholo ba lilithara tse likete li mashome a mane a metso e robileng meno e 'meli (48000 L). U hloka bathusi haholo bakeng la ho cheka mokoti. Ka hona e litšenyahelo li phahameng ho e haha.

Cheka sekoti se mahlakore a boholo bo latelang:

Bolelele: likharafu tse tšeletseng,
Bophara: likharafu tse 'ne,
Botebo: likharafu tse peli.

Mabota ha a lokela ho otloloha. U lokela hore u a cheke ka mokhoa oa hore a thulame. Lebota le lokela hore le be boreleli.

Cheka foro ho potapota sekoti. E lokela ho ba botebo ba lisenthimithara tse mashome a mararo. U tla hatisa lipolasitiki ka mobu hore o e tšoare hore e tiee.



Ala polasitiki (geofabric) ka sekoting. Etsa bonnete ba hore karolo ea polasitiki e bolelele ba kharafu bo ka forong e potapotileng sekoti. Hatisa karolo ea polasitiki e ka forong ka majoe le mobu. Ka ho etsa joalo polasitiki e ke ke ea huleha ha e utloa boima ba metsi ka tankeng. Tanka ea boholo bona e hloka 'geofabric' ea boholo ba 90 m^2.

Penta polasitiki ka 'butimen sealant'. Sesebelisoa sena se lokela ho mamella serame le mocheso. Ho seng joalo se ka peparana ha metsi a bata. U tla hloka lilithara tse makholo a mabeli le leshome (210 L) tsa 'butimen'.

Libaka tseo u ka fumanang thepa e hlokahalang ke tse:

Geofabric:

Kaytech factory in Johannesburg
Phone: 011 - 452 5310

Sealant:

Tosas; Spartan factory in Johannesburg
Phone: 011 - 902 1905

2. Mekhoa ea ho noesetsa liratsoana malapeng



Ho na le mehato e meraro e nepahentseng ea ho hlokomela metsi malapeng. Oena ke e latelang:

- Mohato oa pele ke ho bokeletsa metsi a pula a mangata ka moo u ka khonang ka teng.
- Oa bobeli ke ho fetisetsa metsi ao lijalong
- Mohato oa boraro ke ho sebelisa metsi ao ka hlokolosi.

Ho khakeletsa le ho boloka metsi a pula

Mona re tlo shebana le litanka tse khakeletsang metsi a pula, litanka tseo re ka ichekelang tsona hammoho le matampo a ntlafalitsoeng.

Litanka tse khakelatsang metsi a pula

Ba fana ka lithuso tse latelang:

Tseo u li fumanang

- Ho ahoa tanka e le 'ngoe e le ho bontša kapa ho ruta liahi tse leshome tsa sebaka seo.

- Ho ahoa litanka tse tharo tsa boholo bo sa tšoaneng. Ketso ena e ipapisa le hore na marulelo a ntlo a maholo ha kae, le hore na ke metsi a make a ka khakeletsoang. Tanka e nyenyane e ba li lithara tse likete li supileng (7 000 l), e mahareng ke likete tse leshome le metso e mene, (14 000 l) ha e kholo eona e le likete tse mahome a mabeli a metso e mehlano a li lithara (25 000 l).

- Lekala le RSDA li tla fana ka samente, liphaephe, litlamelletsa (fittings), pompo le terata.

Tseo u tlamehang ho ba le tsona

- Sehoai se tšoanela ho ipatlela majoe le lehlabathe la noka

- Motho ka bo mong a tle le likhakeletsi tsa metsi tse tlang ho faseletsoa marulelong

- Sehoai se ipatlele seahi

Mokhoa oa ho aha tanka

Ke khakanyo e ntle hore u fumane seahi se tlang ho u thusa ho aha tanka, kapa ha u sa tsebe seahi se joalo, u ka kopa lekala kapa RSDA ho u thusa.

Melemo ea tanka	Bothata ba ho aha tanka
❖ Metsi a na a pula a ka bolokoa antano sebelisoa ha morao ❖ Litanka tsena ke tsa 'makhonthe 'me li ka sebelisoa nako e telele ❖ Metsi a tsoang marulelong a hloekile ❖ Liahi li ka iphumanela chelete ka ho aha litanka tsena.	❖ Ho aha tanka ena ke mosebetsi o thata o matla ❖ E theko e phahameng ❖ U tšoanela hore o be u tseba ho aha kapa u batle seahi ❖ Metsi ao a ka tankeng a ka se sebelisoe ho fihlela komello e feela.

Ka letsohomg le letona ke setšoantšo sa tanka e ahiloeng ka majoe. Tanka ena e bophara ba limithara tse tharo (3 m) le bophahamo ba 1.8 m. Ha e tletse e tšela metsi a li lithara tse likete tse 'ne (4000 l). Metsi a ka tankeng e tjena a ka sebelisoa likhoeli tse tharo nakong eo ho omeletseng. E nka nako ea libeke tse peli hoisa ho tse tharo ho e aha.

Mekhoa ea ho aha tanka



'Me' ma…. O eme pela tanka ea hae E haetsoeng hore e kahkeletse metsi a pula

Khotha le ho hloekisa sebaka sa boholo ba limithara tse tharo.

Cheka "foundation" e selika-likoe. "Foundation" ena e lokela hoba botebo le bophara bo etsang licenthimithara tse mashome a mane (40 cm), hona ke bolelele bo lekanang le kharafu. Tlatsa foundation ka samente.

Tšela fatše ka samente. Lethopo le ntšang metsi le tla tsoa le hona samentneg ena leo lona le tlo kopangoa le pomopo eo metsi a tlang ho khuoa ho eona.



Bokahare ba tanka ena bo bontša lesoba le fatše leo metsi a tlang ho tsoa ho lona

Pompo eo ho tlang ho khuoa metsi ho eona e tšoanela ho hlahela tlase ho tanka e le hore

metsi kaofela a ka tankeng a tsebe ho tsoa le moo.



Pompp ea tanka e lokela ho kengoa tlase moo tankeng

Aha tanka ea hau u sebelisa majoe le samente. Eona e lokela hoba bophara ba licenthimithara tse mashome a mane (40 cm), le bophahamo ba 1.8 m. Ha u qeta e samente ka hare.



Mona ke lerako la tanka le ahiloeng ka majoe, leo re le bontšoang ke ntate tlale, le ha le e so fele

Etsa bonnete ba hore likhakelatsa pula (gutters) li eme hantle ka ho lima tanka, u ntano emala hore pula ene.



Sekhakeletsi se entsoeng ka masenke se isa metsi ka tankeng

Boholo ba nako, li tanka tsena ha li koaheloe. Ho ntse ho khoneha hore u li koahele ka masenke, nete kapa ka ho aha sekoahelo sa samente. Metsi a tsoang tankeng e koahetsoeng a ka nooa. Empa ha e sa koaheloa, metsi ao a tla be a le litšila haholo hore a ka nooa.

Matamo a ntlafalitsoeng

Ke matamo kapa mekoti e chekiloeng fatše. Matamo ana a ka ahoa ka mekhoa e mangata e fapakaneng.

Lihoai tsa Lesotho li lekile mekhoa e mangata e fapakaneng ea ho aha matamo ana. Eona ke e latelang:

- Matamo a samentiloeng
- Matamo a ahiloeng ka majoe le samente
- Matamo a mobu a pakelletsoeng majoe ka holimo
- Matamo a aliloeng ka polasitiki.

Metsi a kenang ka matamong ana a tsoa fatše. Ka tsela ena, ho ba bobebe hore u iphumanele metsi a mathang ho tsoa marulelong, tseleng le mekotinyaneng e teng pela ha hau.

- Ho a khoneha hore ho ahoe matamo a maholo, a tla tseba ho tšela metsi a mangata, hore a sebelisoe nako e telele ha ho omeletse
- Matamo ana ha a theko e phahameng, a bile a bobebe ho a aha ho feta litanka.

Lebaka le leholo la hore tanka e ahoe hantle ho tloha fatše le maboteng ke ho thibela metsi ho qhalana. Libakeng tse ling mobu oa teng o na le letsopa le lekaneng hore le thibele letamo ho lutla, ka hoo, ha ho hlokahale hore le tšireletsoe ka letho. Athe libakeng tse ling teng ha mobu o ba metsi haholo, o ka ets hore mabota a letamo a oele e be le a lutla.

Matamo a samentiloeng:



'Me' Mamotepane ea ahileng Ha Licupa, seterekeng sa Mafeteng, o ile a i k'hahela letamo le ntlafalitsoeng eaba o ua le samenta. Letamo lena le ne le ahoa ke batho ba bararo ho tsoa hona moo motseng oa Licupa. Ene e le sehoai se tsoang ha Rabolilane, eo eena a ileng a ba bontša hore na letamo la mofuta oo le ahoa joang, anto ba tlohela hore ba tsoele-pele, empa a ntse a ba bontša mona le mane. Letamo lena le ahiloe ka matsatsi a leshome le metso e mene.



Kahong ea letamo lena ho sebelisitsoe samente le terata ea lihoko tsa likhoho feela. Ho iloe ha chekoa sekoti, eaba ho aloa terata kahare. Ka morao ho moo, letamo la samentoa. Lehlabathe le neng le sebelisoa le ne le letoa nokeng ka likhomo.

Letamo le batla le lekana ka mahlakore oohle. Le bolelele ba limithara tse hlano le bophara ba tse 'ne. Botebo bona ke mithara tse peli. Letamo lena le boetse la samentoa moo metsi a phallang a tlang ho kena le teng. Hona ho etsa hore le tle le lule nako e telele le sa senyehe.

Letamo le teratetsoe hore bana le liphoofolo li se ke tsa tanakella moo. Hona le tanka e bitsoang "header tank" e ka tšelang metsi a li lithara tse sekete. Tanka ena ha e behoe fatše, e phahamisoa hore e be limithara tse peli le halofo (2.5m). Mosebetsi oa tanka ena ke ho thusa hore metsi a tsebe ho phalla hantle ka hara mathopo le lipompo tse ka serapeng tseo tsona li nkang metsi ho tsoa tankeng ena. Pompo e hatoang ka maoto ke eona e sebelisoang hore ho pompeloe metsi ka tankeng.



Setšoantšo sena se bontša lethopo le faselelitsoeng sefe

Lethopo le nkang metsi ho tsoa ka letamong le na le sefe qetellong ea lona e le hore le sefe likhoere-khoere, e be ho tsoa metsi a hloekileng feela.

Pele u pompa metsi, etsa bonnete ba hore hona le metsi ka li silindareng le ka lethopong. Ho nka lihora tse kabang peli ho tlatsa metsi ka tankeng ela e bitsoang "header tank". 'Me oona a ka sebelisoa beke kaofela.



Mona moithaupi o ithuta ho sebelisa pompo ea maoto

'M'e Mamotepane u bolela hore haele mona metsi a se a fumaneha haufinyane, a ka tseba ho tsoela-pele ka mesebetsi e meng ea hae. U boetse u khona ho hlahisa meroho e mangata ho feta pele. U iphelisa ka ho hlahisa meroho le sethopo ebe u oa lirekisa. U li rekisetsa likolo le baitšukuli.



Karoloana ea seratsoana le moo ho hlahisetsoang sethopo teng

'M'e Mamotepane u boetse u iketsetsa phaello ea meroho ka ho etsa jeme le ho boloka e meng ea meroho ka libotlolong.

'Me' mamotepane u bontša botlolo ea jeme ea tjoto le lipeo tseo a lirekisang ho iketsetsa cheletea



Mabota a mobu a pakelletsoeng ka majoe

Mabota a matamo ana ha a otloloha hakaalo. A batla a kobehile. A batla a tšoana le sebaka se motheong, empa motho a ka nna a tseba ho hloella ka holimo. Bokahare ba letamo kaofela bo aliloe ka majoe(fatše le maboteng). Majoe ana ka bo oona ha a thibele hore latamo le lutle. Le ha ho le joalo, letamo le ka nna la lutla hanyanyane hobane mobu oa lona o na le letsopa le lengata le tsebang ho tšoara metsi.



U ka nna oa lema joang ba mohloa tšepe maphakong a letamo e le ho thibela mobu ho khoholeha. Ketso ena hape e thusa hore maphako ao a seke a oela ka hara letamo ha ho ka etsahala hore mobu o pakellane moo.

Phetisetso ea metsi lijalong

Pompo tsa matsoho le maoto

Lipompo tsena ha li sebelise motlakase kapa peterole. Li sebelisa feela matsoho kapa maoto.

Pompo tsa maoto

Pompo ena e ahiloe hore e tsebe ho sebelisoa libakeng tsa mahe tse hole le litoropo. E 'mele o monyanyane, e matla e bile a nkeha ha bobebe.

E sebetsa mesebetsi e mengata joalo ka ho pompa metsi nakong ea monoesetso le ho pompa metsi a tla sebelisoa ka lapeng.

Joale re shebana le mefuta e 'meli ea lipompo tsena.

The ApproTEC foot pump (Kenya)



Tšebeliso ea pompo ena

Pompo ena ha e nyanyane hakaalo, empa e matla hape ho bobebe ho e hlokomela le ho ilokisa ka ho sebelisa litšepe tse fumanehang mona hae. E boima ba 22 kg.

Pompo ena e na le mathopo a



mabeli, le tsoelang ka ntle leo lona le leng bolelele ba limilimithara tse mashome a mabeli a metso a mehlano (25mm), le kenang kahare lona le bolelele ba limilimithara tse mashome a mararo a metso e 'meli (32mm). E boetse ena le licilindara (cylinder) tse peli tseo e leng tsona tse suthumetsang metsi hore a tsoe.

Hore pompo ea hau e seke ea u senyehela, le ho thibela likhoere-khoere ho feta, faselatsa sefe ea mathopo le thopong le kenang ka hare ho pompo.



Metsi a ka pompeha hoisa bo phahamong (height) ba limithara tse leshome le metso e mene (14m). Ena le matla a ho hula metsi ka bo phahamo ba limithara tse supileng (7m). Ha pompo entse e hlokometsoe hantle, ena le bokhoni ba ho ntša metsi a bophahamo ba limithara tse supileng hoisa ho tse leshome (7-10m).



Ka motsotsoana, pompo ena e ntša metsi a ka bang halofo ea lithara hoisa ho lithara le halofo (0.4-1.5l). Le ha ho le joalo, nako ena e ipapisa le hore na metsi a ntse a pompuoa ka bo phahamo bo boake. E kanna ea rekelloa le hlooana e masobana eo eona e tla e tsang hore ho noesetsa ho be bobebe u ntse u sebelisa eona pompo ena.

.

Barekisi:

Pompo ena e hlahisoa naheng ea Kenya. Afrika Boroa teng u ka e fumana ka ho ikopanya le:

Contact: Chris Stimie, Rural Integrated Engineering on 082 469 4535 or Tel: 012- 842 4106 Email: dir@rieng.co.za

Or directly: ApproTEC/ Kickstart, Nairobi; PO Box 64142, 00620.

Tel: +254-(0)-20-787 380 / 787 381. Email: approtec@approtec.org

Tšebeliso ea metsi ao u nang le oona ka hlokolosi

Mekhoa ea ho boloka metsi e mangata. Re ile ra shebana le emeng ea mekhoa ena lipampiring tse fetileng tse neng li bua ka ho hlokomela le ho sebelisa metsi. Linthla tsa bohlokoa ke ho:

- Tšireletsa mobu e le hore metsi a bolokehe ka mobung
- Lema makorota
- E tsa liforo tse tla tjekisa metsi hore a kene mobung a se ke a lahleha
- Tšireletsa serapa sa hau hore mobu oa sona o se ke oa omella ke moea
- Kopanya mobu le li putisa mobu

Melemo:

- Nakong ea monoesetso, metsi a ea metsong ea lijalo ka kotloloho, a bile a monyela tlaase mobung.
- O boloka nako le matsoho.
- O boloka metsi, empa hona hoipapisa le hore na u sebelisa lethopo lena joang.

Joale re tlo shebisana mekhoa e 'meli ea ho tšella ka tsela eo e tlang ho boloka metsi, nako, e bile e ke ke ea u batla matsoho a mangata. Mekhoa ena ke: ho sebelisa monoesetso o bitsoang "drip", kapa marotholi, moo teng e leng lethopo le phuntsoeng masobana kapa le faselelitsoeng lihlooana tse nyenyane moo metsi a tsoang le teng, le ho sebelisa liratsoana tse a hiloeng joalo ka lesoba la senotlolo.

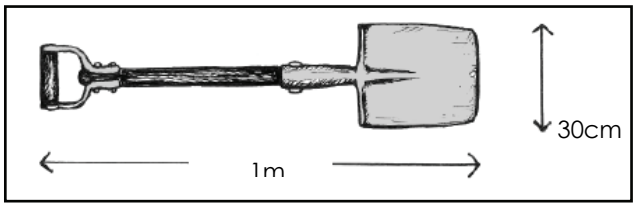
Monoesetso ka lethopo le masobana

Lethopo lena le noesetsang ka masobana a sentseng a ahiloe ho lona, le ahiloe hore le sebetse ka tsela e itseng feela. U ka le sebelisa kapa oa iketsetsa la hau. Empa ha u khothaletsoe hore u leke ho fetola moetso oa lethopo le rekiloeng, ka ha le ke ke la sebetsa.

Thepa ea lethopo lena

Lethopo lena le tla le tsohle tsa lona tse lokelang hore le tsoele pele ka mosebetsi. Le ha ho le joalo, hona le mefuta e mengata ea lisebelisoa tse tsameang le mofuta ona oa lethopo. E ngoe ea tse tloaelehileng ke e bitsoang "Netafin".

"Netafin" e ahiloe ka teramo ea li lithara tse makholo a mabeli (200l), e tsamaeang le sefe. E tla le mofuta ona oa lethopo le masoba leo lona le leng bolele ba ho lekane serapa sa boholo ba bolelele ba kharafu ka mahlakore a mane, li iphitile makhetlo a makholo a mabeli (200 square metres). Halofo ea 200 square metres e leng 100 square metres, e ka noesetsoa hang. Lethopo la mofuta ona le tla le se ntse le entsoe femeng



Masobana a lona a kahare a bile a arotsoe li centhimithara tse mashome a mararo lipakeng (30cm).

Ntate Mokethi, eo e leng moahi oa Mohale's Hoek e sa le a ntse a etsa liteko ka ho sebelisa mokhoa oa ho noesetsa o bitsoang "Netafin drip irrigation" nako e ka bang likhoeli tse tšeletseng.

Eena o boletse joana,

" *Mokhoa ona o mopolokela nako. O boetse o boloka metsi, ka ha metsi joale a ea metsong ea lijalo hang hang* "

Ha letsatsi le likela, ntate Mokethi u tlosa se sebelisoa sena seo a noesetsang ka sona e be u se busetsa hape hoseng, anto tsoela pela ka ho noesetsa. U beha teramo e tletseng metsi holima majoe a mabeli a sephara hore e be holimonyana ho feta liratsoana tsa hae. Ntate Mokethi o arola lijalo tsa hae e le hore se seng le se seng se be



Mona ntate mokethi u re bontša teramo ea hae ea 200l e kentsoeng sefe ea lethopo. Re bona hape lethopo lenang le masobana le behiloeng pela teramo hammoho le nkho e sebelisoang ho tlatsa teramo

haufinyana le lesobana. Mokhoa o na o sebelisoa feela lijalong tse arohaneng joalo ka kh'abeche, e seng tse moleng o le mong joalo ka lihoete.

Linthla tsa bohlokoa

Teramo e lokela ho behoa moo ho seng maqhutsu, 'me eona e phahamele serapa ka mithara kaofela (Bolelele ba kharafu).

Serapa sa hau se tšoanela hore se se ke sa ba maqhutsu, hobane ha sena le maqhutsu, metsi a tla tsoa masobeng a tlabe a sa lekane. A mang a tla tsoa haholo ha a mang a tla tsoa hanyenyane.

Lethopo lena ha le ea lokela ho robala kantle mariha ka ha masobana a lona a tla choatleha ke serame.

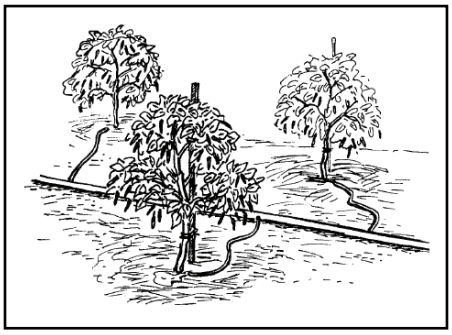
Melemo ea ho sebelisa mathopo ana	Mathata a ho sebelisa mathopo ana
❖ Metsi a anela hantle serapeng kaofela, a bile a kena mobung ka tsela e khotsofatsang. ❖ Metsi a litšila a ka sebelisoang mokhoeng ona oa monoesetso ❖ Lisebelisoa tsohle tsa lethopo lena li fumaneha ha bonolo mabenkeleng.	❖ Ha masobana ana a thibane, a ka buloa ka otla lethopo hanyenyane ka sepekere kapa tšepe e motsu. ❖ Ha ho tsela engoe ea ho a thibulla. Haeba a sa thibulohe ka lisebelisoa tse boletsoemg ka holimo, sebelisa lothopo le lecha. *THLOKOMELISO: U ka khona ho ithekela lethopo lena le masobana oa o ka oa kenyang moo lethopong oa ba oa ikenyetsa tsona.*

Mona ke mehlala e 'meli e bontšang hore na lihoai tse sebelisang SERUMULA li lekile eng.Re tla li bitsa mela ea sepakh'ethi le mela ea seponche kapa likhoele. Mefuta ena e bobolo hore lihoai tse libakeng tse fapakaneng li e sebelise.

Mela ea sepakh'ethi:

Melemo	Mathata
❖ Ha li hloke sefe ❖ Li thibuloha ha bonolo; moma qetellong ea lethopo leo la sepakh'ethi e be oa hula ❖ Metsi a monyela ha bobobe hofeta ha eba a ene a hasitsoe feela.	❖ Liratsoana li lokela ho ahoa moo ho seng maqutso ❖ Mathopo le mela ea sepakh'ethi le tsona li lokela hore li be bophahamo bo lekanang. Ha so se joalo, metsi a tla tsoa moo le oona a ke ke a lekana.

Mokhoa



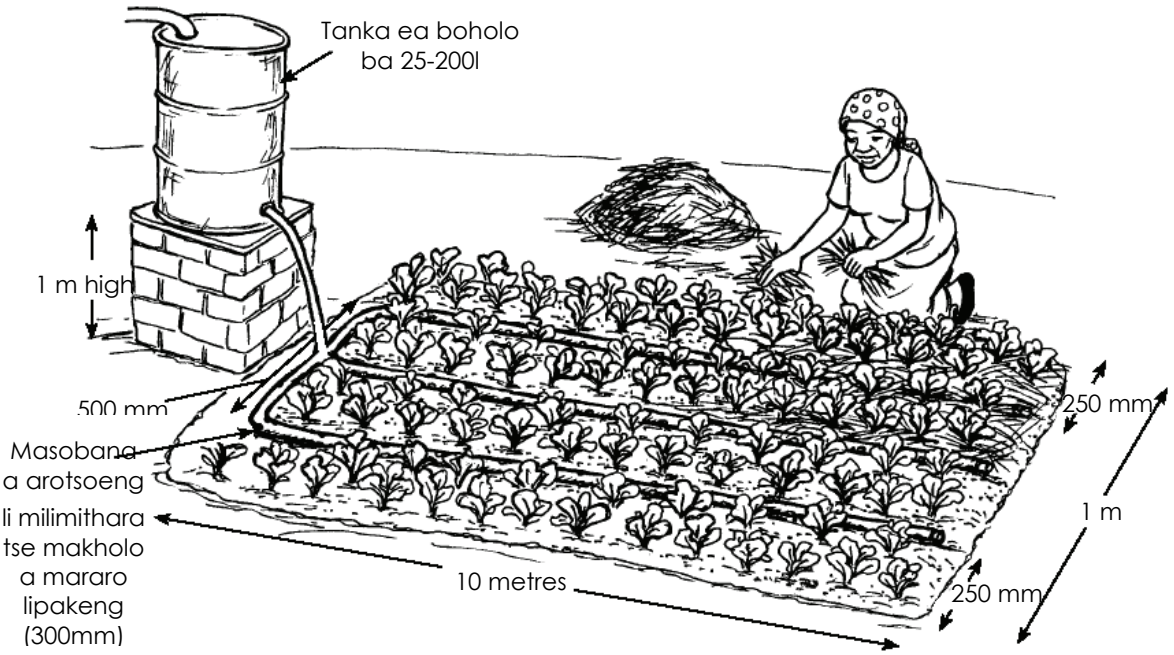
- Sebelisa teramo e ka fumanehang ha bobebe, ebe li lithara tse 25-200. Mokhoa ona o entsoe hore o sebelise li lithara tse 25 tsa metsi ka letsatsi. Haeba u sebelisa retamo ea boholo ba li lithara tse 50, e tlatse, empa u noesetse u ntse u tlolisa letsatsi lipakeng. Ha teramo e le ea boholo ba li lithara tse 200, u ka noesetsa ha ngoe feela ka beke. Le ha hole joalo, hona hotla ipapisa le hore na maemo a leholimo a joang, mobu o u nang le oona ke o joang le hore na lijalo tsa hau li se li holile ha kae. Sethopo ha sena batla ho tšelloa hakaalo.

- Beha teramo ena ka holimonyana ho seratsoana, seo sona se leng bophara ba mithara e le ngoe le bolelele ba limithara tse leshome. Ha seratsoana sa hau se le boholo bo bokana, u tla tseba ho se sebetsa ha bonolo.

- Sebelisa mathopo a mona a tloaelehileng a matšo ho etsa mola o moholo o tlohang teramong. Etsa e meng hape e meraro eo lipakeng tsa eona e leng li milimithara tse makholo a mahlano (500mm), ha bolelele ba seratsoana sa hau bona ele limithara tse leshome.

- Phunya masoba a manyenyane lethopong a arohaneng ka li milimithara tse makholo a mararo (300mm) lipakeng, ebe u Kenya mela ena ea sepakh'ethi masobeng ao. U tla hloka mela ea sepakh'ethi e mashome a robong a metso e meraro (93).

- Lijalo li lengoa hore se seng le se seng se be le mola oa sona oa sepakh'ethi.



Mokhoa ona o noesetsa sebaka sa boholo ba bolelele ba likharafu tse 'ne li menahane ha leshome le metso e mehlano (15m²). E sebelisa li lithara tse mashome a mahlano tsa metsi ka metsotso e mehlano. Ka letsatsi , mola o le mongo a sepakh'ethi o ntša metsi a ka bang li milimithara tse makholo a mabeli a metso e tšeletseng.

Mela ea seponche kapa likhoele

Mekhoa ena e lokile haholo bakeng sa ho noesetsa lijalo tse jaloang moleng o le mong tse kang lihoete, anyanese le lierekisi.

Mela ea seponche

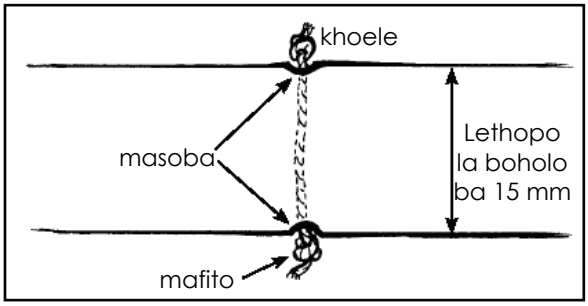
Phunya lethopo masoba u sebelisa sepekere se chesang. Etsa bonnete ba hore masoba ao a hloekile. Masoba ana a be boholo ba limilimithara tse peli le halofo (2.5mm). Sunya likhechana tsa seponche masobeng ao. Ke hona masobeng ao moo metsi a tlo tsoa le teng.

Mela ea likhoele

Mela ena e ntse e tšoana le ea seponche e boletsoeng ka holimo. Phapano feela ke hore mona ho sebelisoa likhoele e seng seponche.

Melemo	Mathata
❖ Mokhoa ona oa monoesetso o ka sebelisoa le lijalong tse lengoang moleng o le mong joalo ka lihoete ❖ U ka arola masoba a lethopong ho ea ka moo u ratang.	❖ Likhechana tsa seponche li lokeloa ho ntšoa selemo le selemo, ‘me hona ke mosebetsi o mangata ❖ Ha ho bonolo ho laola metsi a tsoang moo masobeng.

Phunya masoba a mabeli ka mahlakoreng a lethopo. Kenya khoele masobeng ao e be u etsa lefito ka mahlakoreng ao a mabeli. Botle ba khoele ena ke hore haeba lesoba le ka la koaleha, u ka e hlohlora ho tlosa litšila tse koetseng lesoba leo. Hape e etsa hore metsi a tsoe butle e seng ka sekhahla.







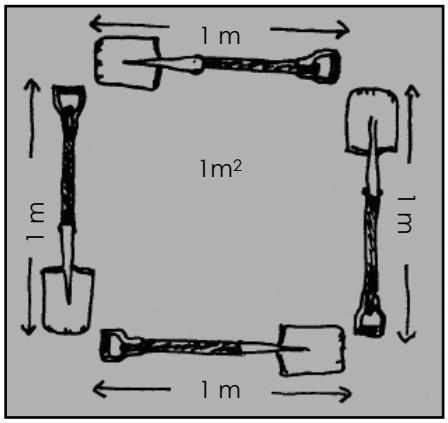
U noesetsa ha kae

Haeba u metha pula ka sesebelisoa se methang pula, u tla sebelisa limilimithara(mm). Milimithara e le ngoe ea pula e lekana le lithara e le ngoe ea metsi mobung oa boholo bo lekanang le bolelele ba likharafu tse ‘ne (square metre).

From: Vikela, May 2003, FSG

Limilimithara tse mashome a mabeli tsa metsi ka beke li lekana le li lithara tse mashome a mabeli a metsi ka beke, ao a lekanang hape le nkho e le ngoe ea metsi mobung oa boholo ba bolelele ba likharafu tse ‘ne (square metre).

Ha u sebelisa monoesetso oa masobana, li lithara tse mashome a mabeli tsa metsi mobung oa boholo ba bolelele ba likharafu tse ‘ne e lekana le limililithara tse makholo a mararo a metso e mashome a mane (340ml) tsa metsi lesobeng ka ngoe ka beke.

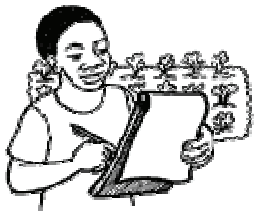


Bonyane ba metsi ao u ka noesetsang lijalo tsa hau ka oona ke limilimithara tse mashome a mabeli ka beke. U ka noesetsa tjena selemo ho pota.

Makhetlo ao u ka noesetsang ka oona

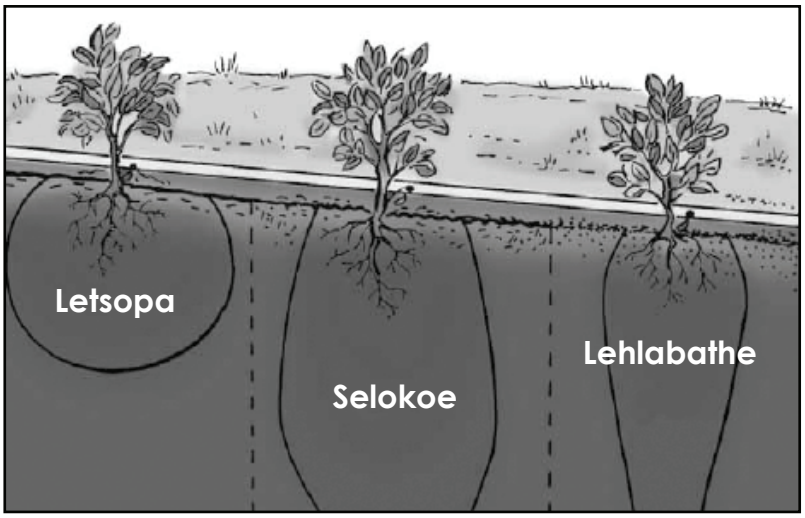
U ka nna oa noesetsa hanyane ka hanyane letsatsi le letsatsi, kapa oa noesats haholo feela e seng mehla eohle.

Ka tšebeliso ena ea monoesetso oa masobana, lijalo li noesetsoa ha ngoe ka letsatsi, tsatsi le leng le le leng. Maqalong a selemo, ketso ena e thusa hore mobu o lule o le metsi. Ha lijalo li se li holile, li se li ka sebelisa metsi ana ao mobu o neng o a bolokile (Hammoho le a mang ao u tlabeng u ntse u noesetsa ka oona letsatsi le letsatsi).



Thlokomeliso ka ho anela ha metsi mobung

Ho anela ha metsi ho bolela tsela eo metsi a tsamaeang ka teng ka mobung. Ho anela hona ho ipapisa le mofuta oa mobu le mokhoa oa monoesetso. Litšoantšo tse latelang li bontša tsela eo metsi a phallang ka teng mefuteng e fapakaneng ea mobu:



- Ha u sheba mobu ka holimo, u tla bona masobana a manyenyane a mongobo,ao mohlomong a tla be a atamelane kapa a arohane haholo.

- Ka fatše teng, masobana ana a latellana.

- U tla lokela hore u shebe na ho etsahalang ka fatše ele hore u tle u tsebe hore na metsi a tsamaea joang mobung. U ka etsa sena ka ho nka thupa ebe u e sunya mobung ho fihlela e se e sa tsamaea. E sunye haufinyane le masobana a lethopong, hape holenyana le oona. Ka tsela ena u tlaba le khakanyo ea hore na metsi a anetse hakae ka mobung.

- Kae kae mobu o tlabe o omeletse, e leng ho bontšang hore na ho thata hakae ho sebelisa monoesetso o na oa lethopo la mofuta oona bakeng sa lijalo tse jaloang moleng o le mong. Lebaka ke hobane batho ba atisa ho beha masobana a lethopo lena haufinyane le sejalo se le seng.

- Sekhahla seo metsi a tsoang ka sona masobeng a manyenyane se tla ama tsela eo metsi a tsamaeang ka eona. Mofuta oa monoesetso o sebelisang mathopo

a puntsoeng masoba a maholo, joalo ka mefuta ea seponche le khoele (tseo re seng re buile ka tsona), li tšoana le mokhoa oa monoesetso o bitsoang "controlled flood irrigation" moo metsi a tlohetsoeng hore a tsoe ka bongata, hona le hore a tsoe e le marotholi.

Lekunutu ha u noesetsa ke hore u shebe hore na ho etsahalang ka mobung!! Se ke oa potlaka ha u noesetsa, iketle!!!

Kaho ea serapa ka tsela e bolokang metsi

Ho bonolo hore u ahe lirapa tsa hau ka tsela eo lit la hloka metsi a manyenyane le hore hape li u bolokele metsi haholo.

Liratsoana tse ahiloeng joalo ka lesoba la senotlolo

Re le tsibisa 'me' Malebohang Matlole le ntate Ralebohang Matlole, ba ahileng Phahameng Morija. Ntate Matlole ea feletsoeng ke mosebetsi li maeneng le mofumahali oa hae, ba lema meroho ho eja le ho e rekisa.

Melemo e meng ke ena:

- Serapa se ka tseba ho fana ka meroho selemo ho pota ka tlasa maemo a fe kapa afe
- Metsi a neng a hlatsoa lijana, liphahlo le a neng a hlapuoa ka oona, a ka sebelisoa ho noesetsa
- Seka ahoa ho lima letlapa kapa letsopa le thata.

Nka aha serapa see sa lesoba la senotlolo ho kae?

Batla sebaka se chabeloang ke letsatsi, haufinyanna le monyako oa ntlo, letlapeng, mobung o thata kapa ho lima letsopa le thata.

Ke hloka eng?

- Mobu o motle o motšo
- Majoe, moiteli, molora oa patsi, joang bo omeletseng, makhasi a omeletseng, litholo kapa matlakala afe kapa afe
- Boloukomo kapa mofuta ofe feela oa thupa kapa nete



Setšoantšong sena re bona hore lesoba la serapa le a bonahala, ha mmoho le basekete e entsoeng ka lithupa eaba e tšeloa joang

Serapa se ke se aha joang?

Moo e tlang hoba bohare ba serapa sa hau, etsa basekete ka liphupa, eona e be boholo ba li centhimithara tse mashome a mane (40cm) mahlakore oohle, le bo phahamo ba mithara le halofo (1.5m).



Mona hape ke mohlala o mong moo basekete e entsoeng ka mokotlana oa lijo tsa liphoofolo

Qala pele ka ho tlasa basekete ena ka lintho tse tla etsa mosuela joalo ka molora oa patsi, joang le moiteli. U hle u e tlatse.

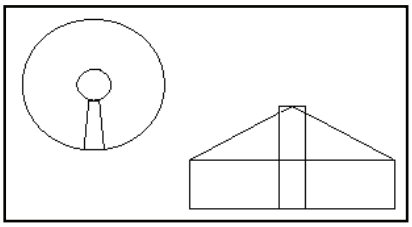
Ho tloha moo basekete e leng teng, metha bolelele ba letsoho ho pota pota. Mona ke moo lereko le tlo tlohang teng. Le tšoanela ho ba boholo ba mithara le halofo ho isa ho tse peli. (1.5-2m). Boholo bona bo methoa ho tloha lehlakoreng le leng la seratsoana ho ea ho le leng. Etsa lerako la bolelele ba mithara e le ngoe le nang le tsela e eang baseketeng. Tsela ena e tlameha ho buleha li centimithara tse mashome a tšeletseng (60cm).



Haha u ntse u pota pota joalo hape u ntse u tšela mobu le moiteli, mobu le molora oa patsi, mobu le matlakala joalo joalo ho fihlela u qeta. Haha seratsoana sena ka tsela eo mobu o tla fihla ho basekete o tšekaletse. U se ke oa o etsa sephara.



Ka letsohong le letšehali ke litšoantšo tse peli tse bontšang hore na seratsoana sena se tla shebahala joang ka holimo le ka lehlakoreng



(from d.hall and v.gibberd, for lrap)

Ha u sheba seratsoana sena ka holimo, se shebahala joalo ka lesoba la senotlolo. A the ha u se sheba ka lehlakoreng e kare ntlo.

Koahela fatše ka makhasi le joang bo omeletseng bo bongata. Lula u koahetse tjena ka mehla. Koahela hape moiteli o ka baseketeng ka joang.

Serapa see se bopehileng joalo ka lesoba la senotlolo ke se sebelisa joang?

1. Thlathlamiso ea lijalo

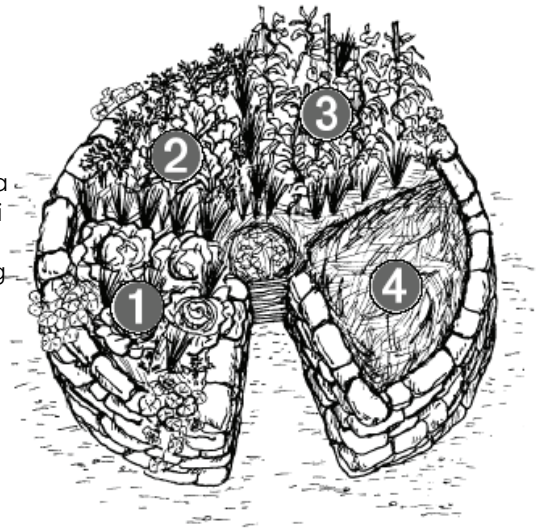
Ke khakanyo entle hore u leme mefuta e fapakaneng ea lijalo libakeng tse sa tšoaneng selemo le selemo. Arola serapa sa hau likaroloana tse 'ne.

Karoloana ea pele ke ea lijalo tse mahaba (Ntle le sepinichi)

Ea bobeli ke ea lijalo tse etsang likotoloana le sepinichi

Ea boraro ke ea lijalo tse kang lierekisi, haholo mariha. Ho ka lengoa hape litapole, "egg plant", tamati, pepere, le chilisi nakong ea lehlabula. Lijalo tsena li hloka molora o mongata oa patsi hore li atlehe.

Karoloana ea ho qetela e lemelloa le kalaka ea boima ba 2kg, e koaheloe ka moiteli le joang bo bongata. Karoloana ena ha e jaloe letho selemo kaofela e ntano lemelloa le moiteli. Ka morao ho moo, ho ka jaloa lijalo tse mahaba.



Setšoantšo sena se bontša ka moo lijalo li ka hlahlamisoang ka teng

Nako eohle ha u jala, sebelisa karoloana e fapakaneng le eo u neng u e sebelisitse nakong e fetileng.

Jala anyanese ho pota pota lijalo tsa hau.

Jala litlama tse monko o bohale joalo ka "chives", "nastrutiums", le "marigolds" qetellong ea serapa sa hau.

2. Ho jala

Nakong eo u jalang, tlosa joang boo u tširelelitseng mobu ka bona (mulch). Etsa mola e be u oa jala. Koahela ka mobu e be u phaphatha hanyenyane. Hang ha u bona peo e mela, fokotsa joang e le hore lijalo tseo li tle li chabeloe ke letsatsi. Se ke oa tlosa joang kaofela e le hore mobu oa hau o seke oa omella.

3. Mokhoa oa ho noesetsa serapa sena



- Metsi a neng a sebelisoa ka tlung a ka tšeloa ka baseketeng ena e bohareng ba serapa. U ka tšela metsi ana ka tlasa joang bo ka baseketeng. Ho tloha moo,

metsi a tla phalla ho anela serapa sohle.

- ❖ Lekhetlo le hlahlamang, tšella ho lima lijalo. Tlosa joang e be u tšella moleng, ha u qeta busetsa joang boo.
- ❖ Haeba u na le nkho kapa teramo eo u sa ebeseliseng, e behe ka serapeng e le hore u tle u tšele metsi ka ho eona, ka tsela ena u tla tseba hore u noesetse e sa le ka meso kapa mantsibuea, e seng hara mocheso oa letsatsi.

Mona re bona ka moo seratsoana sena se tšekaletseng kateng, tšebeliso ea se tšireletsa mobu hammoho le monga serapa a se tšella ka nkho

Malebela a mang hape

Mosuela o etsoang ka sekoting

Mosuela oona ke o e tsetsoang ka hara sekoti, e seng ka holimo joalo ka ho e nne ho etsoe. Ka tsela ena, re boloka mongobo le mosuela ka bo oona o lula o le mongobo nakoana. Mokhoa ona o boetse o boloka lisebelisoa tse hlokahalang ho koahela mosuela o entsoeng totoma.

Mekoti ena e chekoa bophara le bolelele ba mithara e le ngoe le botebo ba mithara e le ngoe. Tsela moiteli, molora oa patsi le litlam-tlama. Mahareng a sekoti, sunya thupa e be u koahela sekoti ka mokotlana oa khale oa lijo tsa liphoofolo kapa joang. Mosebetsi oa thupa ena ke ho thusa hore moea o nne o tsamae hantle ka sekoting.





Litšoantšo tsena tse peli li bontša se hlalosotsoeng ka holimo.

Ho jala la mekoting



Peo ea lijo thollo (tse kang poone, mabele, kor joalo-joalo) e jaloa ka hara mekotjana masimong.

Cheka mokoti oa botebo ba li centhimithara tse leshome le metso e mehlano hoisa ho tse mashome a mabeli (15 -20 cm), le bo phara ba li centhimithara tse mashome a mabeli a metso e mahlano (25cm). Cheka mokoti ena ho tlala tšimo u ntse u e arola li centhimithara tse mashome a robeli (80cm) likapeng. Sekoting se seng le se seng tšela moiteli, molora oa patsi le mosuela kapa matlakala. Ha pula li fihla, jala lipeo tse 'ne(4) mokoting ka ngoe. *(from Footsteps, No. 41 Dec 1999)*

Methipoloho/ Liratsoana tseo mobu oa tsona o tširelelitsoeng ka majoe

Li thusa haholo ha eba u na le mobu o hoholehang ha bobebe kapa ha u batla ho phahamisa seratsoana sa hau. Li boetse li boloka mongobo ka ha majoe ana a tširelelitse mobu qetellong ea seratsoana. Litšoantšo tse bontšang se sa tsoa hlalosoa ke tsena.



Serapa sena se ahiloe motheong. Liratsoana kaofela li ahiloe methipolohong. Ka tsela ena, metsi le mobu li bolokeha ha bonolo



Seratsoana sena se phahamisitsoe, sa tšireletsoa ka majoe ho boloka mongobo

3. Ho nwesatsa serapa hakae le neng?

Mokgwa o atileng wa tshenyo ya metsi ke ho tshela sebaka sesenyane ka metsi bophareng ba serapa sa hao ha nngwe kapa ha bedi ka letsatsi ka a mabedi. Ho a tsebahalahore batho ba etsa hona, ba hopola hore (mohlomong kaofela dijalo ditla fumana metsi a itseng) mokqwa ona ke o tlwaelehileng wa tshenyo hobane bongata ba metsi bo moyafala ka mokgwa wa phofodiboka. Hodimo ba mobu ha bo fumane metsi a lekaneng. Ka ho etsa hoo ha o etse ho loketseng mokgwa oo wa ho nwesetsa o etsa hore metso ya dijalo tsa hao ebe ka hodimo ho mobu, hoo o etsa dijalo tsa rona dipohe ha bobebe, ka hoo re tlameha hore re tshele metsi a lekaneng ka nako le ho tshela a manyane kgafetsa. Reka leka ho tshela metsi a lekaneng ka mora matsatsi a mabedi ho lebella hore diya jwang. 'dijalo tse ngata tse mahareng o ka tshela metsi hangwe ka beke.

Ho nwesatsaho tebileng

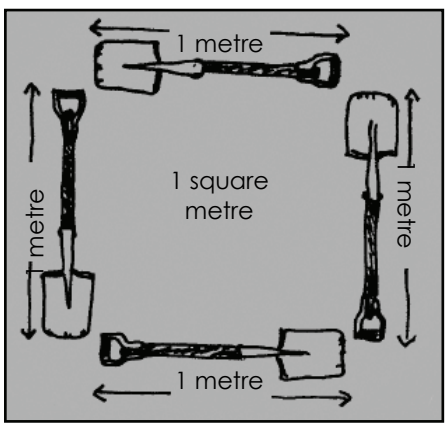
Kaofela reya tseba hore dijalo di ka se mele ntle le metsi ebang dijalo di thola metsi alekaneng di hola ka bofebo, diba le metso e tileng, kahoo o tla una molemo le metso e tileng, makala di ditholwana. Ebang dithola metsi a manyane boka hodimong ba mobu nako le nako, metso ya teng etla ota eka sekgone ho ikemela nakong ya komello.

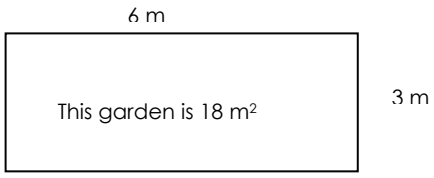
Ho tshella ka botebo, arola serapa sa ha ka diratswana o nwesetse ka mokgwa o tebileng, tbhella diratswana tsa hao makgetlo a mane hoya matsatsing supileng. Hona ho etsa hore metsi a kene ka botebo mobung. Bonyane ba ona bo ka lahleha phofoding.

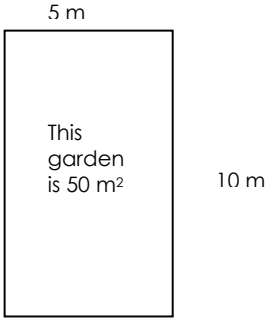


Hlokomela hore ho mwesetsa ka botebo ho ka etswa haholo ebang metsi a kenella fatshe haholo metso ya dijalo e ke ke ya a fihlella, le ha hole jwalo phoso ena ha e a afa jwalo ka ho nwesetsa hanyane le ho nwesetsa ka ho sa tsepamang.

Re sebedisa ho nwesetsa ho tebileng ele hare batla hore. Metso ya dijalo tsa rona e kenelle fatshe mobung. Tshela metsi a mangata, ebang o tshela manyane ho ka ba kotsi.







Ka molao wa momwana dimela di hloka 20 mm ho moesetsa ka beke, ho hlalosa hore 20 litha ya metsi bophareng ba serapana sa hao. 20 mm ka beke elokile ho qala ho nahanela ho yona. Ka hopane dijalo tsa rona ha di hloke metsi a makalo hanle beke kamora beke.

- Ha pula ena dijalo di hloka ho nwesetsa hanyane.
- Ha dijalo di sale nyane dihloka metsi a manyane, jwalo ka ngwana di hloka metsi kgafetsa. Ngwana o hloka ho nwa metsi dihora tse pedi kapa tse tharo kamora hore a hlahe. Peo ya hao kapa sethopo se se omolle, se hlole ha mmalwa ka letsatsi qalehong.
- Ha dijalo di etsa ditholwana jwlo ka mme yahlokometseng, di hloka dijo tse ngata le metsi.
- Dijalo di hloka metsi a mangata ha ho tshesa haholo. Ha ho phodile dijalo dihloka metsi a manyane.
- Hoya ho felang ha bophelo ba tsona jwalo ka leqhekwana dijalo dihloka metsi a manyane.
- Dijalo tse serapeng di fapana ka boholo le mefu ta ya teng kaofela di hloka ho nwesetsa ka ho fapana.

20mm/week is equivalent to 20litres/week which is a 20-litre bucket on 1m².

For drip irrigation systems 20litres/1m² equates to about 340 ml of water/dripper/week.

Tekano ya metsi a rona

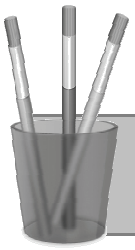
Mokgwa o bobebe ke ho kenya tshepe mobung dihora tse mmalwa ka mora hore o nwesetse serapa. Kamora hore metsi a kenelle hantle mobung. Tshepe ya hao e kena ha bobebe ho fihlella mobung o ommeng o ka tlase. Hona ho fana ka moelo wa hore metsi a kene ha kae fatshe. O ka nka qeto ya hore o nweseditse ka holekaneng. Haeba o metha metsi a pula ka tekanyo ya pula o tla sebedisa mililitha 1mm lilitha e lekana le 1 litha ya metsi bophareng ba 1 m^2 ya mobu.

Malao wa bohlokwa wa ho nwesetsa

Letsatsi ka leng, jwang, neng ho hlaolela dijalo ho etsa tshusumetso e kgolo hore o nwesetsa ka metsi a makae serapeng sa hao. Ke ena melao ya bohlokwa ba ho nwesetsa.

- ❖ Qala sehla sa hao sa ho jala ka mobu o mongobo wa botebo ba metara haholo sehleng sa komello moo ho senang pula dikgweding tse mmalwa, qalong motso o mo nyane ha o fumane, metsi, empa metsi a tlaema ho fihlela dijalo di tla fihlella moo kamora ong sehleng kamora hore o dife ho feta hoo o di fang hona.
- ❖ Efa dijalo tsa hao metsi a mangata hanngwe ka ho lekaneng ka beke. Ka nako eo ho tjhesang o ka fokotsa ka matsatsi amararo empa tshella ka metsi a lekaneng ho etsa bonnete bahore a kenella ho fihlela fatshe mobung wa hao, e seng phofodi e ka hodimo ho 10-15 cm mobung. O ka laola hona ka ho leka ho sireletsa hore phofodi e se lahlehe. Se ka nwesetsa bohlaswa letsatsing le mongobo dimeleng tse teleng.
- ❖ Etsa ho be bobebe, nwesetsa hantle ho ha le hore o tshele marothodi a boima a thata haholo, atla eta hore mobu o kopane kapa ho tsamaisa metsi a hao hantle ntle le ho matha, ho tla hohola mobu lo a hao ho lematse metso ya hao.

- Haola metsi a hao dimeleng tsa hao, ebang dijalo tsa hao di thola metsi a lekanang o tla thola haholo lerothodi ka nngwa, ka ho hloka karolelang dipakeng tsa dijalo tsa hao, dijalo tse fumanang metsi a mangata di sebedisa marothodi a mangata, ha tseo ditholang metsi a manyane di tla ntsha dijalo tse nyane.
- Lekanya. Hlahloba. Boloka direkoto hore o di file metsi a makae o fumane pula e kae. Hape tekanyo ya hao e fetohile ha kae ditankeng tsa metsi selemo le selemo atla fumana ho molemo. Ka kotlololoho o tla fumana molemo wa metsi, le dijalo ho tswa lerothoding. Kgafetsa tjheka ka mora letsatsi hore metsi a hao a kene botebo bo bokae, mongobo o ho kae. Etsa hona ho fihlela o fihlella kutlwisiso ya hore mobu wa hao o fetoha jwang ho hlaelelong le puleng, sheba hape hore ha boka hodimo ba mobu wa hao bo se bo le hakae komellong.



Activity 1
Serapa se hloka metsi a makae?

Maikemisetso

Ho matlafatsa bohlokwa "melao ya menwanwe" hore ho hlokahale dinkgo tse kae ka beke ho dijo tsa hao tse serapeng he hore o ka thola metsi a makae puleng.

Ditaelo

1. Etsa bonnete ba hore o utlwisisa melao e mmedi ya menwana, e hopole.

Hona ha pula:

E bang 1 mm ya pula enele, ho bolela hore 1 litha e netse sebaka se seng le se seng ka 1m x 1m.

Molao wa monwana ke ona: Lerothodi le leleng la pula le fana ka ka 1 litre per m^2.

Ho nwesetsa serapa:

Dibakeng tse ngata serapa se hloka 20 mm ka beke. Ho fana ka 20 mm ka beke o hloka ho fana ka 20 litha ya nkgo ya metsi ka beke bakeng sa sebaka sa 1m x 1m serapeng sa hao.

Melao wa monwana:

20 litha ya nkgo ya metsi ya ka beke sebakeng sa m^2 serapeng sa hao.

2. Sebedisa molao wa monwana hore ho hlokeha metsi a ma kae ka beka serapeng sa hao ha o jetse dirapana tse leshoma tsa bophara be 1m x 6m.
3. Ho hlokeha dinkgo tse kae ka letsatsi ha molemi a nwesetsa matsatsi a tsheletseng ka beke?
4. Molemi o tlameha ho arola dinkgo tseo a tlang ho di sebedisa ka letsatsi?

Dikarabo:

2. *Dinkgo tse 60 buckets (20 litha boholo) ka beke.*
3. *Dinkgo tse 10 buckets ka letsatsi tseo e ntseng ele 200 litha ya dromo kao letsatsi.*
4. *Ee lehanyenyane. Ee seratshana se ka thola hahyenyane hapeho ka baka komello ka pelenyana, kaofela ke mosebetsi o thata hape metsi a senyeha. Ho bohloka ho arola seratswa dikalo tse tsheletseng, nwesetsa sele seng hanngwe ka letsatsi mwesetsa karolo enngwe letsatsi le latelang, nakong e tjhesang nwesetsa dikarolo tsenne tsa diratswana tsa hao ka letsatsi, eketsa palo ya hao ya dinkgo ka letsatsi ebang ho hlokeha.*

How big is your garden? (Remember to just consider the beds. You don't need to include the paths in your measurement)	**How many litres per week do you need to water your garden?**	**How many 20 litre buckets per week does your garden require?**
10 m^2	200 litres per week	10 buckets per week
20 m^2	400 litres per week	20 buckets per week
30 m^2	600 litres per week	30 buckets per week
40 m^2	800 litres per week	40 buckets per week
50 m^2	1000 litres per week	50 buckets per week
60 m^2	1200 litres per week	60 buckets per week

Taola ya ho boloka metsi

Ke mokgwa o lokileng wa ho qala sehla se ommeng ka tanka a tletseng metsi a pula, ka ho nwesetsa ka botebo mobung wa hao. Mokgwa wa yona efapana sehleng se omileng le se mongobo.

Mokgwa watokiso sehleng se omileng

Mariha ha ho sena pula, dijalo di mmalwa, kanako enngwe ha hona pula, empa dijalo ha di mele, hoo ka etsang hore diqetelle di shwele pele re dija.

Mokgwa wa sehla seomilele: Qala e tletse efella esena letho.

1. Ho qala sehla sa komello ka dibethe tsa terentshe dibe mono obo ditanka di tlale metsi o tlo leka metsi a mangata ditankeng ho fihlela mariha a tswa. O tlo qeta sehla seo tanka ya ese ele haufi le ho fela metsi.
2. Ebang o kgathatseha hore metsi a ka fela pele ho sehla, jala sebakeng se senyane serapeng sa hao nakong ya komello.
3. Nahana hore o tlo nka matsatsi a makae ka beke o lokisa serapa sa hao. Arola serapa ka ho lekana hore o se nwesetse le tsatsi ka leng. Mohlala ebang o hopotse ho lokisa ha hlano ka beke arola serapa sa hao ha hlano.
4. Hlaola karolo ele nngwe ya serapa ka letsatsi, se ke wa leka ho fa karolo enngwe le enngwe metsi hanyenyane letsatsi ka leng, ntle le peo ka sethopo sa hao tse hlokang ho nwesetswa hanyane kapa hanngwe ka le tsatsi, ho fihlela metso e tiya le ho kena ka botebo, le ho ka emela maemo afe kapa afe.

5. Sheba metsi a makae ka tankeng, nahana hore pula e ka nako e kae pele ena, nqola tsena letsatsi ka leng. Mariheng a latelang o tle o kgone ho kgola molemo selemong seo.
6. Ebang o bona hore o tla fellwa ke metsi, nka qeto ya hore dijalo tse bohlokwa ke dife ho wena, boloka metsi a setseng bakeng sa tsona, ho bohlokwa ho lahlehelwa ke dirapana tse mmalwa hona le sebetsa ka thata hona le ho lahlehelwa ke ntho enngwe le engwe dirapeng tsa hao, hopola hore mefuta e meng ya dijalo e ka hloka metsi a manyane mohlala khabene e batla metsi amanyane ho feta sepinisha tlhokehong ya metsi o ka nahang ho boloka sepinishatlhokehong ya metsi o ka nahang ho boloka sepinishe tse mmalwa, o be o jala khabeshe e ngata.

Mokgwa wa tokiso sehleng se mongobo

Lehlabuleng ho tlwaelehile hore pula engata, ka lemo tse ding ho ka ba le komello, mathata a boima ha hona le komello nako e telele ka nako e eba sehla seo pula enang ka sona. Moha ke moo metsi a bolokuweng a tlang ho thusa dijalo tsa hao. Ho thata hore o ka lekanya hore o ka lebella tse pula e ntle kapa empe selemong seo. Ka ho re tlameha hoba le maqheka.

Mokgwa wa sehla se mongobose qala hose letho ho qetelle ho tletse.

1. (Letshwaola 2-5 le sebetsa mona)
2. Ho bohlokwa ho boloka serapa sa hao sele mongobo ha o jala, tanka ya metsi etlabe ele haufi le ho fela, e bang o sebedisitse metsi hantle kanako ela ya komello, empa di ka tlala kapele ka pula tse mmalwa tsa pele.
3. Lekanya maemo a hao a ho nwesetsa katekanyo ya pula e nany, Ka hoo se ka nwesetsa ho se bohlokwa. Hopola ho etsa dipalo pala tsa diratswana tse ka hodimo.
4. Kanako eo ho tshesang e bile ho omelletse o hloka ho hwesetsa haholo, empa ha jwale ditanka tsa hao di tietse ho hloka hore o sebedise metsi a teng, ho sebetsang le maemo a komello di tle di tsebe ho tlala hape. Ditanka tsa hao ditlameha ho tlatswa ke pula habedi hlabula. Ha mariha a qala di tlameha hore di be de tletse.

4.Tokiso le polokeho ya tanka



Bobedi bokatlase le bo kahodimo ba tanka ya pokeletso ya metsi ke poloko ya hao lapeng. Ho ka ba molemo ho wena honka boikarabelo ba tanka ho netefatsa tokiso, tlhwekiso, polokeho le tshireletso mollong. E bang ho kgathalla tanka ka ho phethahetseng.

Roof Tanks

Tanka e emeng marulelong e tlameha ho hlwekiswa hang ka selemo. Ditanka tsohle dikentswe dileri, ho bobebe ho kena le ho tswa ka hara tsona.

O ka pakela majwe kapa wa poleistera katlasa. Pompo ele ho fokotsa kgoholeho ya mobu, le ho balehela seretse ka jaretsng. O ka etsa hoo ele ho etsa setshelo sa metsihore se seke sa ba ka tlasa kgatello ya metsi, lerothodi ka leng la metsi le bohlokwa, hona ho etsa hore metsi ao ase eme pela ntlo ya hao, metsi aemeng ka etsa ho thelle fatehe kapa ho nkge, menwang le mafu a fapaneng.



Stones help to decrease splash erosion

Gutters

Dikgitire di thameha ho tlamellwa haufi-ufi le marulelo ho etsa bonnete ba hore metsi a tswang marulelong a mathe ka kotloroho ntle le ho tsholohela ka thoko kapa ho rothela fatshe ebang dikgitiri di lokoloha kamora nako ho ka hlokahala hore ho tiiswe diterata tse tshwereng dikgitiri, ho kaba bohlokwa hore ontshe dikgitire ebang o belaela hore ho ka lehlwa le boima. Boima ba lehlwa bo ka etsa hore kgitiri e kobehe ka ho phethahetseng.

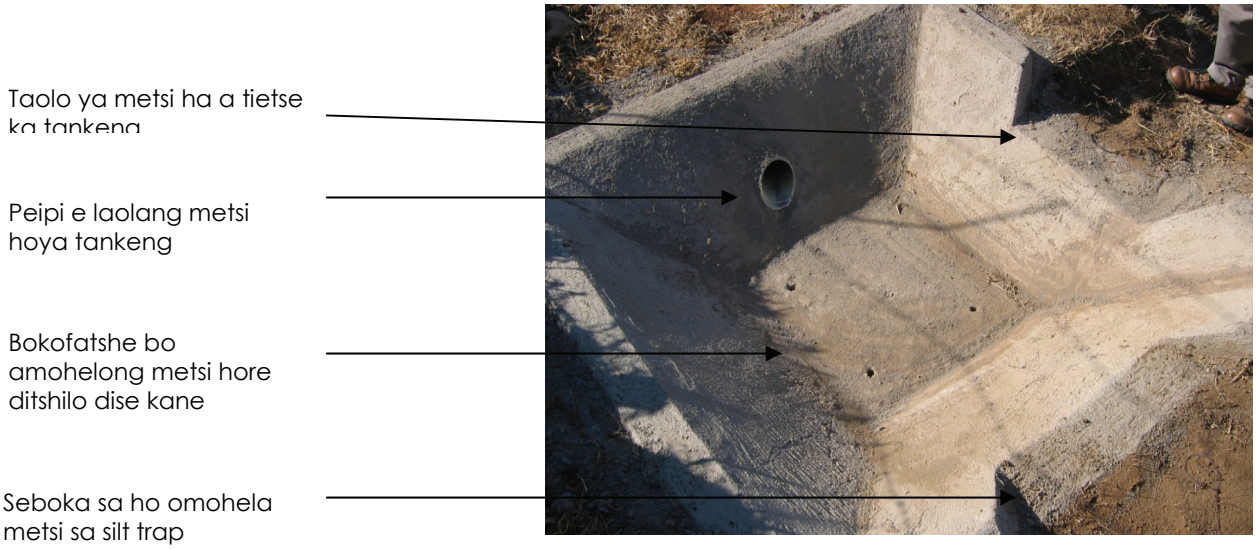


Dikgitire di tlameha ho beha haufi le makenke ho amohela bongaka ba metsi a se wele fatshe.

Dikgitire di tlameha ho lekolwa hore ha di rothise metsi ha. E bang di rothisa metsi marothodi ao a ka thibelwa ka silikone. O ka reka silikone ka tshelete e kaalo ka diranta tse mashome a mabedi ho amang a mabenkele a jwale ka spares shopo le ya rekisa thepa ya ho aha. O tlameha ho hlwekisa kgitiri ya hao jwaleka ha ho hlokeha. Ele hoetsa hore metsi a tswang marulelong a hlweke ka naka tsa pula, ho bohlokwa ho hlwekisa disgitiri hang ka kgwedi.

Underground Tanks

Tanka ya hao ya potseletso ya metsi e ka tlasa mobu e ukgethile e entswe ka polasitiki. Sili trep e etseditswe hore pokeletso ya metsi ho ya ka tankeng le hore ha ditanka ditletse dgone ho qhala metsi. Hopola hore metsi a kenang pokeletsong ya elitanka tse fatshe ha a hlweka hore aka anwa. Your underground rainwater harvesting tanks are a unique design using plastic tanks.



Silt trap e amohela pokelletso ya metsi hoya tankeng.

Hlwekisa silitrep kamora dipula tse ding le tse ding, hlokomela hore meedi e isang metsi ka silitrepeng entse ele sebopehong. Kamora dipula o tlameha ho hlwekisa bokantle ba dibolo tsa ditshepe tse kahara diphaiphe tse yang kaditankeng.



You should clean debris out of the strainer in your silt trap after each storm

Ho kaba molemo haholo ho tshireletsa ditanka tsa hao tse ka tlasa mobu dikgomonng, e bang ho na lejwang bo ka jewang ke dikgomo pela tanka, kenya fense ho potoloha elitanka, kapa ho hong ho ka tshireletsang, ebang kgomo e kgolo e ka hata tanka eka senya haholo.

Ho kaba molemo ho sireletsa ditanka mollong, ho ka bohlokwa ha jwang bo pela tanka bo tloswa o siye sebaka sa dimetara tse tharo ho potoloha le tanka hona ho ka etsa hore o matlafatse polokeho ya ditanka ha hona le bothata. Ntsha sekwahelo sa tanka efatshe o hlokomele hore se selemale kapa ho tshwatleha, velf e sa kguthenge behe pela bokatlase kapa bo kahodimo tena bavelf e kgutheng. Ebehe pela bo ka fatshe ba tanka ka tlasa lemati l tanka.



This was a storage area at a JoJo factory. Notice the circles where the tanks once stood.

Tanka ya ha e thatla le dinotlolo e le ho etsa bonnete ba tshireletso baneng ba ka ba tlang ho bula ditanka ho tlohaohlokomela ho notlela tanka sireletsa senotloko se seruse o ka etsa hona ka tlotsa senotlolo ka oli ya ho pheha, kapa kwahela ka polasitiki, o tlotse ha n yane ka poresetiki hodima lesoba la senotlolo.

Hoya ka bokantle ba jarete ya hao, o ka etsa hore jarete ya hao e shebahale hantle. Ele ho boloka mobu wa hao kgoholehong. Moo holeng bohlakwa ho ntlafatsatikoloho.

Hona ho ka etsa hore o sebediso nako e nyane hore o batalatse hore o sebediso nako e nyane hore o batalatse makukuno ho potoloha tanka, hopola hore hona ho bohlokwa hore laole metsi a hao ho pololoha le ditanka ele hore ho sebe le metsi a emeng ka hodimo ho ditanka tsa hao.



Be careful not to damage the non-return valve at the bottom of your tanks when you are cleaning them.



In this yard, the tanks are surrounded by 3 metres of bare ground for fire protection. Three stone lines help to keep the soil around the tanks shaped to move water away. In the outer circle, aloes, irises, and bulbinella also help to retain the shape of the land as well as add extra fire protection.

Hand Pump

Tanka ya hao e fatshe e kentswa pompo ya polasitiki e sebediswang ka letsoho, mokgwa ona o ikgethi leng o etsa hore ho be bobebe ho pompa metsi ho enngwe le enngwe ya ditanka tsa jojo hore o a tshele kahara lebekere la ho nwesetsa.

Ho bohlokwa ho boloka peipi entsho ka hara tanka ele hore ho se kene dinthwana tse itseng. Netefatsa hore bana ba tseba bohlokwa ba hose kenye dithupa kapa ditshila ka hara tanka. Hobane ditshila tse di ka dula ka hara tsa etsa tshenyo pompong.

Hlokomela hore seretse se etsang setshwantsho ele ho sireletsa kgoholeho ya mobu. Pakela majwe moo metsi atlang ho otla teng. Sena seka o thusa ho boloka sebopehosa mobu ho potloha tanka.



Ntate Tladi shows how to use the pipe pump.

Resource Material for Homestead Food Gardeners

Chapter 5: Handouts (isiZulu)

Handout 1 Ukonga nokusebenzisa amanzi (Saving and using water)

Handout 2 Ukuchelela engadini: Kangakanani, nini nanini? (How much, how often to water)

Handout 3 Indlela Ephephile Yokunakekela Ithangi

Handout 4 Ukuchelela engadini: Kangakanani, nini nanini?

1. Ukonga nokusebenzisa amanzi



Onke amanzi avela emvuleni. Uma sihlala ezindaweni lapho elingani khona kakhulu noma eliba nesikhathi eside ngaphandle kwemvula, sidinga ukuziqoqela thina amanzi. Amanzi siwaqoqela ukuthi sihlale sinamanzi isikhathi eside.

Ukuqoqa amanzi kungenzeka ngezindlela eziningana:

- Sibamba amanzi emvula.
- Songa lawomanzi esinawo.
- Sibambe nalawo agelezayo

Ukubamba amanzi emvula

Lapha sehlisa ijubane lamanzi, ukuze amanzi amunceke enhlabathini. Lapha ngezansi siyakhombisa ukuthi lokhu singakwenza kanjani ezingadini kanye nasemakhaya ethu.

- Faka imfucuza enhlabathini. Sikhulumile ngalokhu ngenkathi sixoxa *ngokulungisa inhlabathi* yakho kanye *nasekwenzeni izinhlobo zemibhede*, kulelibhuku.

- *Isembozo senhlabathi (mulch)*. Lukhona futhi uhlangothi oluxoxa ngalokhu kuleli bhuku.

- Inhlabathi yakho kufanele ukuthi ihlale yembozwe yizitshalo ezimilile. Sebenzisa izitshalo okuthiwa ngama "ground covers" izihlahla ezimfushane kanye nezinde.

- Vikela inhlabathi yakho emoyeni onamandla. Bona kulelibhuku ingxenye ekhuluma *ngokuvikela indawo emoyeni kanye nasesithathweni*.

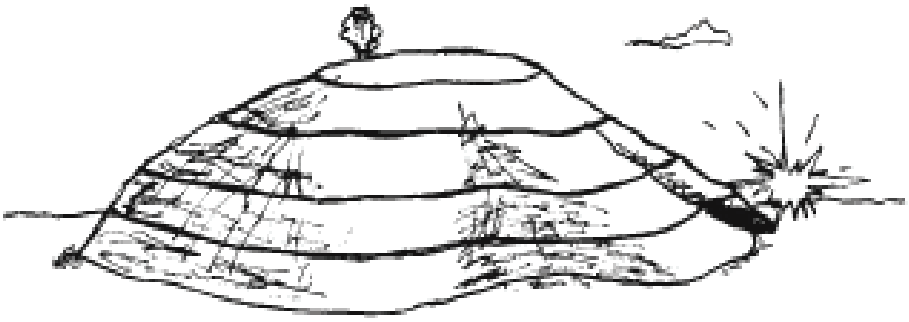
- Uma ingadi yakho isendaweni eyintaba noma eyiqele, imibhede yakho kufanele yakhiwe inqume kabili. Lokhu kuzokwenza amanzi angagelezi ehlele ezansi umathanda, ngoba lokhu kungayigugula.

- Ukwakha imibundu ezokwakhiwa inqume kabili entabeni. Lokhu kunciphisa ijubane lamanzi, futhi liwamise ukuze azike angene anhlabathini.

- Ukwakha ama "swales". Lemibundu lapha yakhiwa ngenye indlela. Lokhu kuchaziwe lapha ngezansi.

Imibundu (contours)

Imibundu lena yenziwa inqume kabili entabeni, noma eqeleni ihambisane nokuma kwentaba (contour line). Uma kwakhiwa lombundu onquma kabili entabeni kulandelelwa omaka ababekwa ngokulandelana ukuze lemibundu ikwazi ukubamba amanzi ngendlela efanele, ingabheki ezansi.



Isithombe esikhombisa imibundu eyakhiwe endaweni eliqele ngendlela yokuthi ingachithi

Indlela yokubona ukuthi umbundu kumele wakhiwe kuphi entabeni

Ungasebenzisa i A-frame uma ufuna ukuthi umbundu wakho owenzayo unquma kabili entabeni ngendlela engabhekile ezansi, engenakuwachitha amanzi.



i aframe yakheka kalula kabi:

1 Thatha amapali amabili alinganayo ngobude, bese uhlanganisa amachopho awo ngocingo noma ngendophu.



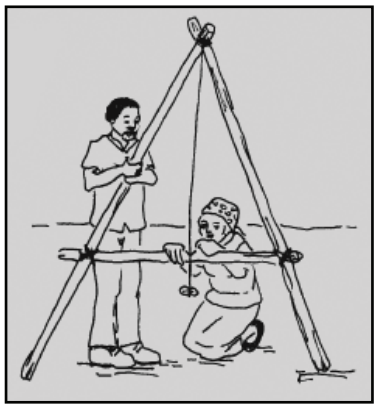
Okudingekayo:

Amapali amabili angamamitha
amathathu ubude;
Ipali elilodwa elingamamitha amabili
Ucingo noma indophu
Itshe elincane

2 Thatha ipali lesithathu ulinqumise kabili, kusukela ubudeni obungangemitha kusukela ezansi.

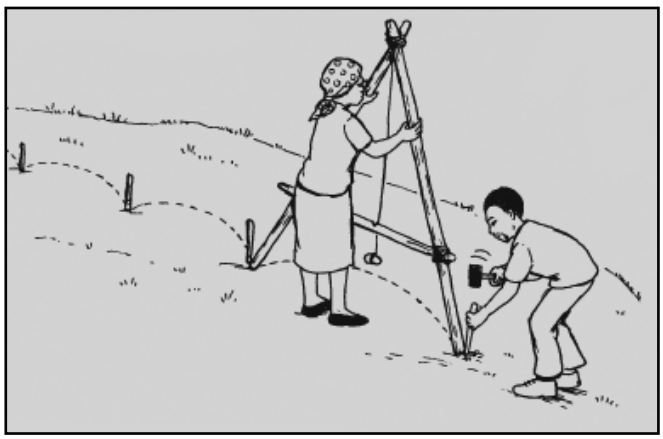


3 Bophela indophu ilenge lapho kuhlangana khona amachopho amapali amabili. Bophela itshe ngezansi ukuze intambo ilenge idonseke. Uma ilenga intambo, itshe kufanele libe sezansana kwepali elinqume kabili. I A-frame yakho yibambe ime endaweni eyisicaba. Uma usukwenzile lokho kufanele ufake uphawu lapho intambo ethinte khona epalini elinqume kabili. Lokhu kufanele kubemaphakathi naphakathi nobude bepali elinqume
kabili.



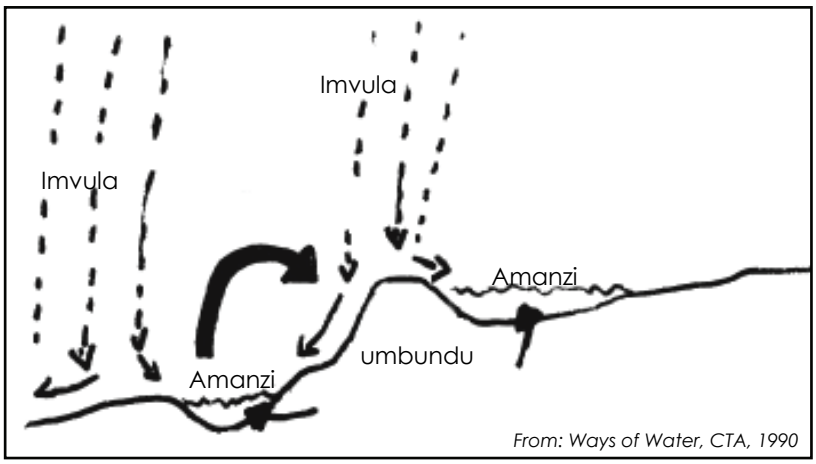
Isetshenziswa kanjani I A-frame:

4 Thola indawo elinganayo (level) ekuqaleni kwalapho ofuna ukwenza khona umbundu (contour). Uma usuyithole kahle lendawo, shayela izikhonkwane lapho kumi khona imilenze yomibili ye A-frame. Emuva kwalokho susa umlenze wangakwesobunxele uwuse phambili. Uma usuwumisa futhi umlenze phambili, wubeke phansi uma intambo elengayo isiqondene nalapho owenze khona umaka epalini elinqume kabili. Uma sekunjalo bethelela isikhonkwane esilandelayo.

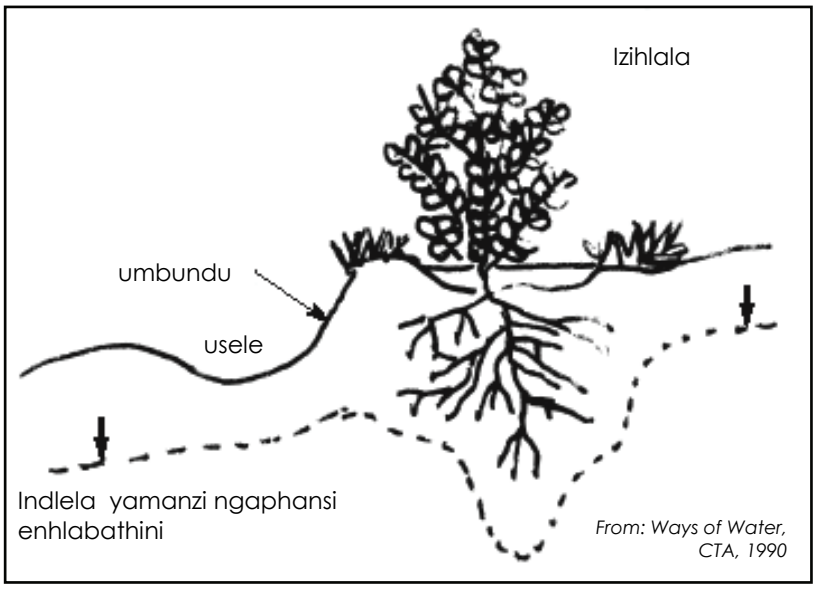


From: Farmer-to-Farmer Handbook, FSG, 1996

Qhubeka uhambisa imilenze ngalendlela uze uqede ukwenza umaka lapho umbundu wakho oyohamba khona.

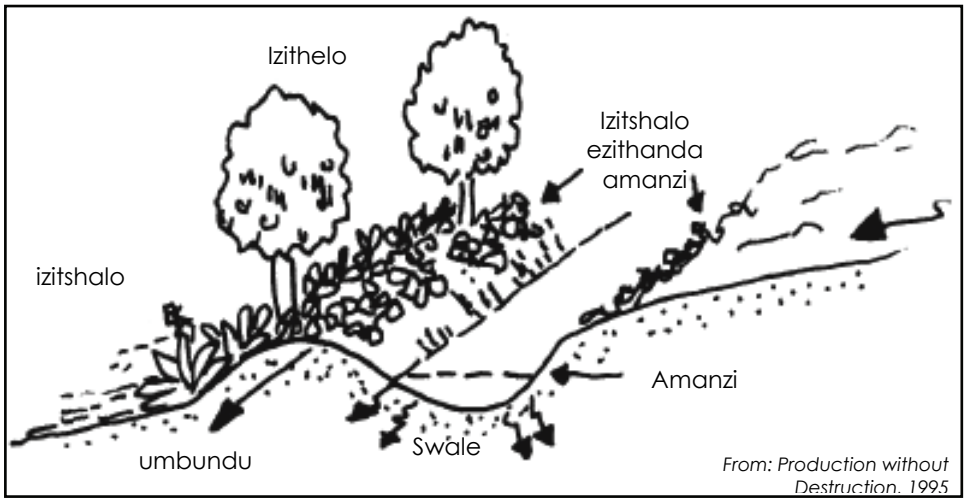


Uma usuwakha umbundu uqobo lwawo kufanele umbe lapho odwebe khona ngenkathi usebenzisa I A-frame. Inhlabathi oyimbayo kumele ibe ngenhla komsele. Ukujula komsele kumele kube ngu 30 cm ukuya phansi, futhi ivuleke ngo 30 cm. Uma lina izulu, imvula izobambeka ngenhla kombundu kanye nasemseleni uqobo. Amanzi azobambeka aze azike esikhundleni sokuthi agelezele ezansi. Njengoba nenhlabathi ikhukhuleka ngenhla kombundu, kugcina sekukhandeke nethantala lamanzi elincanyana. Lelithantala lamanzi lithatha isikhashana ukuthi linyamalale.



Kubakuhle ukuthi ngenhla kombundu lapho kuma khona amanzi kutshalwe izitshalo ezithanda amanzi. Lokhu kuyasiza kakhulu ekubambeni inhlabathi embundwini. Kusiza futhi izitshalo zakho futhi ngamanzi. Lena yindawo ekahle impela ekutshaleni izithelo kanye kanye namakhambi. Bona futhi ikhasana elichaza ngokuvikela izitshalo emoyeni kanye nasezithathweni, ngoba kukhona nokunye okwengeziwe okumayelana nezitshalo ezikahle ezingatshalwa. Njengoba imisele iye igcwale inhlabathi ngokuhamba kwesikhathi, kuye kudingeke ukuthi ibuye ikhishwe ukuze umsele wakho uhlale ukulungele ukwenza umsebenzi wawo.

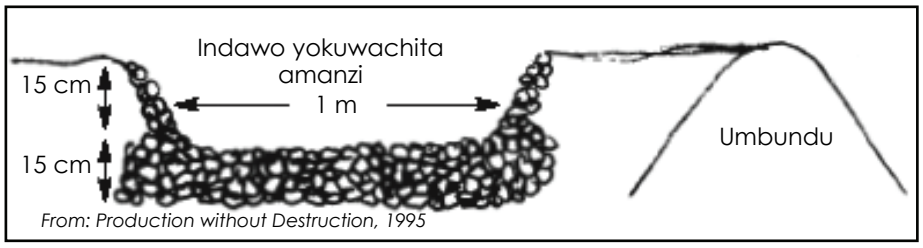
Ama Swales



Ama "Swales " kanjalo nawo ayimibundu eyakhiwa inqumise kabili entabeni. Umehluko lapha ukuthi inhlabathi ikhishwa ithelwe ngezansi, hayi ngenhla. Lena yindlela ekahle yokubamba amanzi endaweni yakho. Ngalendlela amanzi ungawabamba ngokuphindwe kabili uma uqhathanisa nemibundu (contours) echazwe ngenhla.

Ama "swales" awaholeli ekuthini ugcine usunamachitshana njengoba kwenzeka kulokhu okuchazwe ngenhla. Izindonga zama "swales" zitshalwa izitshalo ezithanda amanzi, kanye nalezo eziphila isikhathi eside. Uma kuya ngokuya kugcwala inhlabathi emseleni, kuye kufuneke ukuthi ibuye ikhishwe.

Izindonga zemibundu kufanele ukuthi zakhiwe ziphakame ukuze amanzi angeqi nangeshwa ngaphezu kwayo. Uma kukhona ingozi yalokhu, kumele ukuthi kwakhiwe indawi yokuwachitha amanzi. Lokhu kuzokwenza ukuthi amanzi angezi mawala ukuya ezansi.



2. Ukuchelela engadini: Kangakanani, nini nanini?

Eyodwa nejwayeleke kakhulu Indlela yokunisela emosa kakhulu ukuthi unisele ngamanzi amancane yonke ingadi kanye noma kabili ngosuku noma nsukuzonke noma kabili. Kuyazeka ukuthi abantu bakwenza lokhungo becabanga ukuthi "okungenani zonke izitshalo zithola imbijana yamanzi." Loluhlobo lokunisela mbijana eqinisweni lingukumosa okukhulu ngoba chishe wonke lawomanzi ahamba nomhamuko asuke esemhlabathini ophezulu awenzilutho olutheni. Amanzi angashonile phansi abanga ukuba nezimpande zingagxili emhlabathini; okusho ukuthi okungukuthi izitshalo zethu kungablula ukuwa. Esikhundleni salokho singafaka amanzi anele ngesikhathi sinciphise izikhathi zokunisela. Singazama ukufaka amanzi amaningi bese seqisa usuku sibone ukuthi lokho kubanjani. Uma sikhula izitshalo njengesipinashi esesikhulile noma ikhabishi eseliphakathi nokukhula singanisela kakhulu kanye ngesonto.

Ukunisela ngokujulile

Sonke siyazi ukuthi izitshalo zingekhule ngaphandle kwamanzi. Uma izitshalo zithola amanzi anele zikhula zingxile zibe nezimpande eziqinile okusho ukuthi zizokhiqiza kakhulu ziqine zibe namakhasi nezithelo. Uma zithola ingcosana yamanzi aphelela nje phuzulu ngesikhathi zonke izimpande azizukushona phansi izitshalo zakho angeke zikwazi ukumelana nembalela noma zizokufa ngesikhathi seshisa.

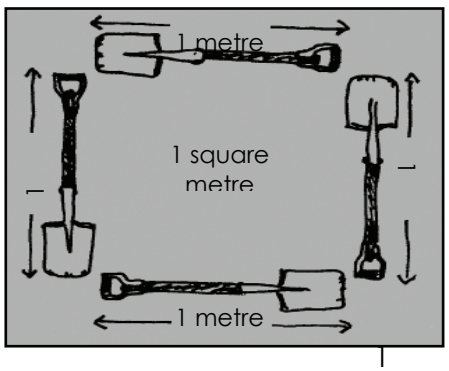


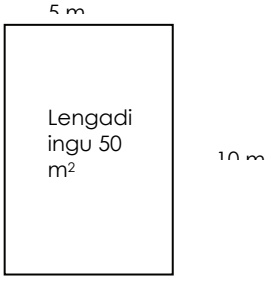
Ukwenza ukunisela okuthe thuthu hlukanisa ingadi yakho izigatshana bese unisele ngokujulile izinsuku ezine (4) kuyakweziyisikhombisa (7). Lokhu kuzovumela amanzi amaningi ukuba ashone phansi bese ayingcosana ahamba nomhwamuko.

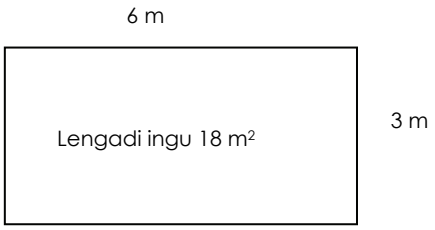
Qaphela: ukunise okungxilie kungenzeka ngokweqile.Uma amanzi ezokwehla kakhulu izimpande zingekwazi ukufinyeleka kuwona. Futhike leli elinye lamaphutha kunokuthelela kancane kakhulu.

Sisebenzisa ukuthelela kakhulu ngoba sizama ukuthi izimpande zezitshalo zethu zingxile emhlabathini. Ukunisela ngamanzi amaningikungabi njalo kubaluleke kakhulu.

Njenganelula elifushane izithelo zidinga ngamanzi amanzi angu 20mm ngesonto. Lokhu kusho ukuthi kudingeka ufake u 20 litres endaweni eyisikwele samahalav u amane (1x4 spades).







20mm/ ngesonto uyisiqalo esihle ohlelweni lethu kodwake ngokwesitshalo akudingeki inani elingaka lamanzi isonto nesonto.

- Uma kunezimvula izitshalo sidinga ukuchelelwa kancane.
- Uma izitshalo zisencane zidinga amanzi amancane njengabantwana babantu nje badinga njalo. Abanwana babantu badinga ukuncela njalo emvakwamahora amabili kuya kwamathathu emva kwamasonto amabili bezelwe. Kanjalo nezithombo zakho akumele zome ngakho zihlole izikhathi eziningi ngosuku uma asandakuzitshala.
- Ngesikhathi izitshalo zakho sezikhiqiza izithelo njengomama oncelisayo zidinga ukundla okuningi namanzi.

20mm/week =
20litres/week =
20-litre bucket on 1m².

For drip irrigation systems
20litres/1m² = about 340 ml of water/dripper/week.

- Izitshalo zidinga amanzi amaningi ngoba kusuke kushisa kakhulu. Uma kuyikhathi samakhaza sidinga amanzi amancane.
- Uma sezikhulile izitshalo njengabantu abadala izitshalo zidinga amanzi amancane.
- Izitshalo ezisengadini yakho ziba izinhlobo ezahlukene nezingalingani ngakho zonke zidinga amanzi ngezindlela ezahlukene isonto ngalinye.

Ehla kangakanani amanzi ukuya phansi?

Indlela elula ukufaka insimbi emfishane uyishinise embhedeni wakho amahora ambalwa emvakokuthelela ngesikhathi amanzi eseshone phansi emhlabathini. Insimbi ingena kalula emhlabathini omanzi ize ifike phansi emhlabathini owomile kungumqondo omuhle wokubona ukuthi amanzi ehle kangakanani ukuya phansi. Hlanganisa nendlela yokuthi izimpande izitshalo zakho zehla kangakanani bese uthatha isinqumo sokuthi amanzi asenele yini. Uma ngabe uyawakala amanzi emvula lokhu ungakuhlola ngama millimetres. 1mm wemvula ulingana no 1 litre wamanzi endaweni engu 1m².

Umthetho wokuchelela

Usuku nosuku uchelela nini nakanjani izithombo zakho ekugcineni kwencike ekutheni angakanani amanzi owasebenzisayo. Lapha sinemithetho embalwa.

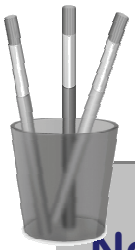
- Qala iskhathi sokutshala Umhlabathi wakho umantiswe okungenani ngango 1mm ukushona. Ikakhulu ngesikhathi komile nezimvula ziyingcosana izinyanga ezibalwa. Ekuqaleni izimpande ezisencane angeke zifinyelele kulawo manzi kodwa amanzi azogcineka bese izithombi ziyawamunca ekuhambeni kwesikhathi sonyaka uma sezidinga amanzi angaphezulu kowafakile.

- Izithombo zakho zinikeze amanzi amaningi kubekanye ngesonto. Ezikhathini ezishisa kakhulu kufanele usifinyeze lesisikhathi kube kanye njalo ezinsukwini ezintathu, faka amanzi anele onesiqiniseko ukuthi ashone phansi emhlabathimi ayi into ezothathwa ngumhwamuko nje emhlabathini wakho ongaphezulu ongu 10-15cm. Ungasebenzisa isembozo ukunciphisa ukuhwamuka komhlabathi.

- Zama ukunisela ngamathonsi amancane njengaweshawa kunamathonsi amakhulu (azogxisha umhlabathi wakho) noma ageleze kahle kunokuba ageleze kakhulu angabangela ukumuka komhlabathi wakho izimpande bese ziyalimala.

- Thela wonke umbhede ngamanzi. Uma zonke izitshalo zithola amanzi ngendlela elinganayo ungathola izitshalo eziningi ngethinsi ngalinye ngesikhathi ezinye zithola ingcosana yamanzi zizokunika isivuno esincane.

- Bheka ukale gcina izilinganiso zenani lamanzi ochelela ngawo ugcine nenani lamanzi emvula enile usuku nosuku nanokuthi amanzi ehla aphinde anyuke kanjani ethangini lakho. Minyaka yonke ungaleza libe ngono izinga lamanzi akho ngokuqoqa ithonsi nethonsi. Njalo gubha emva kwemvula nemvula ukuze ubone ukuthi amanzi oshone kangakanani emhlabathini. Kwenze lokhu uze ube nokuqonda kabanzi ukuthi ubanjani uma uchelelwa noma unethwa yimvula uqhubeke nokuhlola uze ubone ukuthi umhlabathi wakho ongaphezulu usuqala ukoma yini.



Umsebsnzi wokuqala 1
Ngabe angakanani amanzi adingwa ingadi yakho?

Inhloso

Ukwakha umgomo wokuthi mangaki amabhakede ngesonto nokundla ingadi yakho ekudingayo ngokuthi angakanani amanzi ongawathola emvuleni.

Nqubo

1. Qisekisa ukuthi uyazi kahle lemithetho emibili futhi uyikhumbula kahle.

Imvula enile:

Uma ingu 1mm imvula enile kusho ukuthi ingadi yakho ithole amanzi angango 1 litha indawo engu 1mx1m.

Yonke imvula 1mm ilingana no 1 litha nge m^2

Umthetho uthi: Yonke imvula 1mm ilingana no 1 litha nge m^2.

Ukuchelela ingadi:

Chishe ingadi yonke idinga manzi angaba ngu 20mm ngesonto.

Ukunikeza amanzi angu 20mm ngesonto kudingeka ufake u 20 litha ubemunye wamanzi ngesonto indawo engango 1mx1m umbhede osengadini.

Umthetho uthi: Ibhakede elilodwa elingu 20 litha wamanzi ngesonto kuyoyonke indawo engu m^2 yombhedi osengadini yakho.

2. Manje sebenzisa umthetho ukuthola ukuthi mangaki amabhakede amanzi ongawasebenzisa embgedeni engu 10 etshaliwe1mx6m owadingayo.

3. Mangaki amabhakede ngosuku uma umnini ngadi echelela usuku nosuku izinsuku eziyisithupha ngesonto.

4.Ngabe kufanele umnikazi wengadi awahlukanise kuyoyonke imibhede nsukuzonke na?

Izimpedulo:

2. *Amabhakede angamashumi ayisithupha (60) angu 20 litha ngesonto.*
3. *Amabhakede iyishumi ngosuku alingana chamashi ne dramu elilodwa elingu 200 litha ngosuku.*
4. *Qha nomakanjani qhabo yonke imibhede ongayifaka ikotshana ingoma ngokukhulu ukushesha-konke ukusebenza okunzima nokusaphaza amanzi ayigugu. Kungcono kakhulu: ukwehlukanisa ingadi yakho izizgaba eziyisithupha 6 bese uchelela izigatshana esisodwa ngosuku kuthi ngosuku olulandelayo uthuthukele embhedeni olandelayo. Ezikhathini ezishisa kakhulu yandisa amanzi onisela ngawo ngengxenye yokuthathu kokukodwa ngosuku umakunesidingo yandisa amabhakede insela ngawo ngosuku.*

Inkulu kanganani ingadi yakho? (Khumbula wenze imibhede. Asikho izidingo sokufaka izindlela ekukaleni kwakho)	**Mangaki ama litha amanzi adingwa ingadi yakho?**	**Bangaki o 20 litha bamabhakede abadingwa ingadi yakho ngesonto?**
10 m^2	200 litha ngesonto	10 amabhakede ngesonto
20 m^2	400 litha ngesonto	20 amabhakede ngesonto
30 m^2	600 litha ngesonto	30 amabhakede ngesonto
40 m^2	800 litha ngesonto	40 amabhakede ngesonto
50 m^2	1000 litha ngesonto	50 amabhakede ngesonto
60 m^2	1200 litha ngesonto	60 amabhakede ngesonto

Ukuphathwa kwamanzi agciniwe

Kungumqondo omuhle ukuqala isikhathi sokulima amathangi akho ngisho aphansi emhlabathini. Icebo lethu lahlukile ngesikhathi zemvula nezokoma.

Icebo lokunisela esikhathini zokomisa kwezulu

Ebusika lapho kungani mvula kunengcosana yezitshalo. Mhlawumbe iyana imvula kodwa ayanele ukukhulisa izitshalo zakho zizezivunwe. Ekuqaleni izitshalo zikhula kahle ekugcineni ziyafa singakafiki isiskhathi sokuthi zingadliwa.

Isu langesikhathi komile: EKUQALENI AGCWELWE EKUGCINENI APHELILE

1. Qala isikhathi esingenazimvula ngombhede wakho ombiwe kahle omanzi namathangi akho egcwele amanzi. Ungazama ukusebenzisa amanzi akho uBusika bonke ngendlela othanda ngayo ungathi uyoqenda uBusika cishe eseyophela.
2. Uma unokukhathazeka ngokuthi amanzi angashe akuphelele ngaphambi kokuphela kwesikhathi sokoma tshala ingxenyana encane yengadi yakho.
3. Thatha isinqumo sokuthi uzochelela izikhathi ezingaki engadini yakho ngesonto. Hlukanisa ingadi yakho izigatshana ezilinganayo (Isibonelo uma uhlele ukuchelela kahlanu engadini yakho yehlukanise izingxenyana ezinhlanu (5).
4. CHELELA INGXENYE EYODWA NGOSUKU ENGADINI YAKHO, ungazami ukuchelela ngamanzi amancane imibhede yengadi yakho nsukuzonke. (ngaphandle kwezimbewu nezithombo ezidinga amanzi amancane kanye noma kabili ngosuku zize izimpande zikhula ngokwanele zikwazi ukuhambisana nokuchelelwa mbijana.
5. Bheka ukuthi angakanani amanzi asethangini lakho, ulinganise ukuthi angakuqhuba kangakanani ngaphambi kokufika kwezimvula. Lokhu kulobe phansi nsuku zonke uzokwazi ukuthathela kukho ngonyaka olandelayo.
6. Uma kubukeka sengathi amanzi akho azokushodela bheka ukuthi iziphi izitshalo ezibaluleke kakhulu kuwena qhubeka nazo nalawo manzi osele nawo, Kungcono ukulahlekelwa ingcosana yemibhede kunokuvuna kanzima kuyoyonke imibhedeni yakho. Yiba nakho emqondweni wakho ukuthi kunohlobo oluthile lezitshalo oludinga amanzi amancane kunezinye Isibonelo ikhabishi lidinga amanzi amancane kunesipinashi. Ngakhoke ezinkathini ezimbi yiba nezitshalo zesipinashi eziyimbijana nekhabishi eliningi.

Icebo lokunisela ezikhathini zemvula

EHlobo kujwayeleke ukuthi kube noxhaxha lwezimvula, kodwa kweminye iminyaka kuyoma kakhulu. Izikhathi ezinzima kakhulu kulapho kubanesikhathi eside sesomiso okukanye kube nezimvula ezinhle enyakeni ilaphoke amanzi owagcinile ekusiza khona ukuphephisa izitshalo zakho. Kanzima ukuthi ungabona kanjani ukuthi lonyoka uzoba nezimvula ezinhle noma ezimbi, ngakho sifanele silungiselel izikhathi ezimbi kakhulu.

Icebo esikhathini sonyaka esimanzi: QALA UNGENALUTHO GCINA EGCWELE

1. (Emaphuzwini amabili kuya kwamahlanu 2-5 angena lapha futhi)
2. Uma kunokwenzaka mantisa umbhede wakho uma utshala. Amathangi akho angacishe aphele uma uwasebenzise ngendlela ngesikhathi lomisile , kodwa lingagcwala ngokushesha ezimvuleni ezimbalwa zokuqala.
3. Bhalansisa ukuchelela kwakho nenani lwezimvula ezinile, ngakho unganiseli uma singekho izidingo. Khumbula izibalo ezibekwe ngenhla.
4. Maphakathi nesimo sezulu ezishisa kakhulu Uzodinga ukunisela kakhulu, kodwa kufanele kube ligcwele uzoliqeda ngesikhathi ubhekene nezikhathi zokomisa kwezulu lizophindeligcwale. Okungenani Ithangi lakho fanele likwazi ukugcwala noma kabili ngesikhathi saseHlobo lifanele libe ligcwele Ekuqaleni koBusika.

3. Indlela Ephephile Yokunakekela Ithangi



Amathangi womabili wokuvuna amanzi emvula phansi nangaphezulu aligxathu elikhulu lokutshala izimali emakhaya. Kubaluleke khakhulu ukubamba iqhaza ukuqinisekisa ukuthi Ithangi lakho ulingcina lihlanzekile futhi liphephile ulivikele nasemililweni. Uma amathangi lakho ulinakekela ngendlela azokunika amanzi engadi yakho.

Ithangi Lesifulelo

Ithangi lokukhongozela amanzi esifulelweni kumele okungenani ulihlanze kanye ngonyaka. Wonke amathangi afakwe amaleli (imikhwelo) ukuze kubelula ukungena uphume (ukwehla wenyuke).

Umelwe ubeke amatshe noma ukhonke ngaphansi kumpompi ukuze kugwemeke ukuguguleka komhlabathi nomonakalo ongabangwa udaka ebaleni (egcekeni) lakho. Ufanele ukubeka isitsha sokukhongozela amanzi ngoba ithonsi nethonsi libalulekile akungabi namanzi- ama egcekeni eduze nendlu yakho. Amanzi



Umelwe ubeke amatshe noma ukhonke ngaphansi kumpompi.

achincayo abayinkundla yomiyane angabanga nezifo eziningi.

Omaligada

Omaligada kufanele bahlangane kungathi basondela khakhulu esifulelweni ukuqinisekisa ukuthi wonke amanzi aginqika esifulelweni awela kumaligada awadinqikeli emhlabathini. Uma umaligadakufika isiskhathi sokuba uxege ubophe ngocingo ukuze uqine ubuyele esimeni sawo. Kunconywa ukuba uwususe umaligada wakho uma kuba nezexwayiso zokukhithika kweqhwa elikhulu ngoba isisindo seqhwa singawu gobisa umaligada.



Omaligada kufanele bahlangane kungathi basondela khakhulu esifulelweni ukuqinisekisa.

Umaligada kufanele uhlolwe ukuthi awuvzi yini. Ukuvuza kungavaleke nge silicon. Isilicon ungayithenga ezitolo eziseduze nawe ngemali engu R20 “laphokudayiswa khona izinsimbi zezimoto” ezitlo nasezotolo zempahla yokwakha. Kufanele uhlanze umaligada wakho ngokuyisidingo ukuze amanzi asethangini lakho agcineke ehlanzekile. Ngesikhathi sezimvula kunconywa ukuba kanye njalo ngenyanga umaligada wakho.

Amathangi aphansi

Amathangi akho okuvuna amanzi emvula aphansi oplastiki enziwe ahluka. Khumbula ukuthi amanzi emvula owavuna ngethangi laphansi awaphuzwa.

Anendawo yokukhipha amanzi uma egcwala kulesitsha sokukhongozela.

Kunepayipi elisa amanzi ethangini.

Kunesithiyo esenzelwe ukuthi kungangeni umhlabathi omuningi.

Isithiyo isona esifaka amanzi emvula emathangini akho aphansi futhi uma egcwala khakhulu abe ngendlela yokuchitheka.



Silt trap leading to underground rainwater harvesting tank also serves as an overflow.

Hlanza Isithiyo sakho ngemuva kwemvula ngokusebenzisa isipeto. Uhlole njalo ukuthi umsele ohambisa amanzi esithiyweni ukuthi akukho yini okuwuphazamisayo nga usawaletha ngendlela iyiyo amanzi. Uthintithe nesisefo esisepayipini eliya emathangini akho.



Hlanza Isithiyo sakho ngemuva kwemvula ngokusebenzisa isipeto.

Kubaluleke khakhulu ukuvikela amathangi akho aphansi ezinkomeni. Uma izinkomo zidla eduze namathangi abiye ngocingo noma ubeke ameva awazungeze amathangi akho. Ngoba uma inkomo enkulu ingagibela phezu kwamathangi ingawabulala.

Futhi kuyinto ebaluleke khakhulu ukuvikela amathangi akho emlimweni. Kunconywa ukuthi usike utshani obuseduze namathangi noma ucente ibanga elingamanyathelo amathathu (3m) uzungeze amathangi akho. Kufanele ukuba ukhande ibhande ukugwema umlilo wequbula.



This was a storage area at a JoJo factory. Notice the circles where the tanks once stood.

Susa udoti osesivalweni esingaphansi ethangini lakho eliphansi. Qaphela ukuthi ungalimazi valve efakwe ngaphansi efakwe ethangini.

Wonke amathangi akho anezingidi nezihluthulelo ngakhoke ungaqinisekisa ukuphepha kulabobantwana abangazama ukuvula amathangi. Uzodinga ukuwavula amathangi akho noma ungeke uvame Kunconywa ukuba uwavikele ekugqwaleni (ekuluseni). Lokhu ungakwenza ngokuthi ugcobise izingidi zakho ngamafutha okupheka ukalakateni enye Indlela ungalissonga (ungaligoqa) ngo plastiki noma uwavale ngalokho esibamba ngayo amaphepha amakhulu ezimbobeni lapho ufaka khona isihluthulelo.



Qaphela ukuthi ungalimazi valve efakwe ngaphansi efakwe ethangini.

Kuncike ekutheni igceke lakwakho limi kanjani mhlawumbe kungathi emhlabeni ozungeze amathangi akho wakhe imibundu (indunduma) ukugwema ukuguguleka komhlabathi. Lokhu kusho ungabi nomsebenzi oyingcosana isikhathini eside kunokuba ungalokhu uzama ukulungisa indawo yakho ezungeze amathangi akho. Khumbula lokhu Kubaluleke kakhulu ukungawavumeli amanzi ukuba ame eduze ngethangi lakho akhandele amanzi Indlela yokwe mdlula eceleni angaqondi emathangini akho.



In this yard, the tanks are surrounded by 3 metres of bare ground for fire protection. Three stone lines help to keep the soil around the tanks shaped to move water away. In the outer circle, aloes, irises, and bulbinella also help to retain the shape of the land as well as add extra fire protection.

Isigwedlo sesandla

Lamathangi angaphansi komhlaba afakwe lpayipi elinesigwedlo sesandla. Lesisigwedlo esahlukile senziwe ngendlela elula yokug-wedla amanzi aphume kujojo angene esitsheni sokunisela.

Kubaluleke khakhulu ukuba ipayipi elimnyama uligcine lisembotsheni yethangi kungcola okungena kujojo wakho. Gcizelela nakubantwana bakho ukuba bangahlohli izinduku noma udoti ethangini ngoba udoti uzovimba noma icinanise okungaba kubi khakhulu kulimaze lsigwedlo sakho.

Qaphela umonakalo wodaka esithombeni. Ukugwema lenxovanxova beka amatshe emhlabathini lapho kuconsela khona amanzi. Loku futhi kuzokusiza ukugcina umhlaba wakho usesimeni esihle.



uBaba Tladi uyakhombisa usebensiza kanjani isigwedlo sesandla.

Ukuchelela engadini: Kangakanani, nini nanini?

Eyodwa nejwayeleke kakhulu Indlela yokunisela emosa kakhulu ukuthi unisele ngamanzi amancane yonke ingadi kanye noma kabili ngosuku noma nsukuzonke noma kabili. Kuyazeka ukuthi abantu bakwenza lokhungo becabanga ukuthi "okungenani zonke izitshalo zithola imbijana yamanzi." Loluhlobo lokunisela mbijana eqinisweni lingukumosa okukhulu ngoba chishe wonke lawomanzi ahamba nomhamuko asuke esemhlabathini ophezulu awenzilutho olutheni. Amanzi angashonile phansi abanga ukuba nezimpande zingagxili emhlabathini; okusho ukuthi okungukuthi izitshalo zethu kungablula ukuwa. Esikhundleni salokho singafaka amanzi anele ngesikhathi sinciphise izikhathi zokunisela. Singazama ukufaka amanzi amaningi bese seqisa usuku sibone ukuthi lokho kubanjani. Uma sikhula izitshalo njengesipinashi esesikhulile noma ikhabishi eseliphakathi nokukhula singanisela kakhulu kanye ngesonto.

Ukunisela ngokujulile

Sonke siyazi ukuthi izitshalo zingekhule ngaphandle kwamanzi. Uma izitshalo zithola amanzi anele zikhula zingxile zibe nezimpande eziqinile okusho ukuthi zizokhiqiza kakhulu ziqine zibe namakhasi nezithelo. Uma zithola ingcosana yamanzi aphelela nje phuzulu ngesikhathi zonke izimpande azizukushona phansi izitshalo zakho angeke zikwazi ukumelana nembalela noma zizokufa ngesikhathi seshisa.

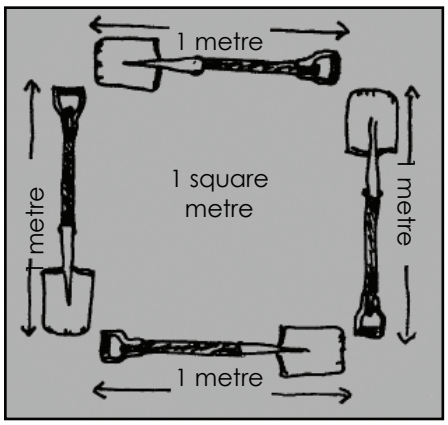
Ukwenza ukunisela okuthe thuthu hlukanisa ingadi yakho izigatshana bese unisele ngokujulile izinsuku ezine (4) kuyakweziyisikhombisa (7). Lokhu kuzovumela amanzi amaningi ukuba ashone phansi bese ayingcosana ahamba nomhwamuko.



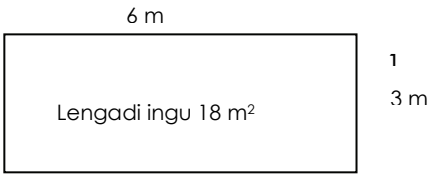
Qaphela: ukunise okungxilie kungenzeka ngokweqile.Uma amanzi ezokwehla kakhulu izimpande zingekwazi ukufinyeleka kuwona. Futhike leli elinye lamaphutha kunokuthelela kancane kakhulu.

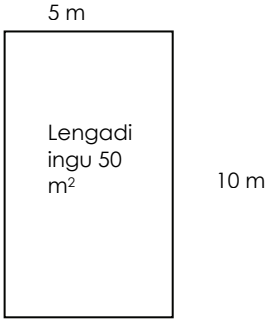
Did you know that plants can also suffer if there is too much water around their roots all the time? If the soil is water logged, the roots don't get enough air. Plants need well-drained soils to prevent the roots from rotting .

Sisebenzisa ukuthelela kakhulu ngoba sizama ukuthi izimpande zezitshalo zethu zingxile emhlabathini. Ukunisela ngamanzi amaningikungabi njalo kubaluleke kakhulu.



Njenganelula elifushane izithelo zidinga ngamanzi amanzi angu 20mm ngesonto. Lokhu kusho ukuthi kudingeka ufake u 20 litres endaweni eyisikwele samahalavu amane (1x4 spades).





20mm/ ngesonto uyisiqalo esihle ohlelweni lethu kodwake ngokwesitshalo akudingeki inani elingaka lamanzi isonto nesonto.

- Uma kunezimvula izitshalo sidinga ukuchelelwa kancane.

- Uma izitshalo zisencane zidinga amanzi amancane njengabantwana babantu nje badinga njalo. Abanwana babantu badinga ukuncela njalo emvakwamahora amabili kuya kwamathathu emva kwamasonto amabili bezelwe. Kanjalo nezithombo zakho akumele zome ngakho zihlole izikhathi eziningi ngosuku uma asandakuzitshala.

20mm/week is equivalent to 20litres/week which is a 20-litre bucket on 1m².
For drip irrigation systems 20litres/1m² equates to about 340 ml of water/dripper/week.

- Ngesikhathi izitshalo zakho sezikhiqiza izithelo njengomama oncelisayo zidinga ukundla okuningi namanzi.

- Izitshalo zidinga amanzi amaningi ngoba kusuke kushisa kakhulu. Uma kuyikhathi samakhaza sidinga amanzi amancane.

- Uma sezikhulile izitshalo njengabantu abadala izitshalo zidinga amanzi amancane.

- Izitshalo ezisengadini yakho ziba izinhlobo ezahlukene nezingalingani ngakho zonke zidinga amanzi ngezindlela ezahlukene isonto ngalinye.

Ehla kangakanani amanzi ukuya phansi?

Indlela elula ukufaka insimbi emfishane uyishinise embhedeni wakho amahora ambalwa emvakokuthelela ngesikhathi amanzi eseshone phansi emhlabathini. Insimbi ingena kalula emhlabathini omanzi ize ifike phansi emhlabathini owomile kungumqondo omuhle wokubona ukuthi amanzi ehle kangakanani ukuya phansi. Hlanganisa nendlela yokuthi izimpande izitshalo zakho zehla kangakanani bese uthatha isinqumo sokuthi amanzi asenele yini. Uma ngabe uyawakala amanzi emvula lokhu ungakuhlola ngama millimetres. 1mm wemvula ulingana no 1 litre wamanzi endaweni engu $1m^2$.

Umthetho wokuchelela

Usuku nosuku uchelela nini nakanjani izithombo zakho ekugcineni kwencike ekutheni angakanani amanzi owasebenzisayo. Lapha sinemithetho embalwa.

- ❖ Qala iskhathi sokutshala Umhlabathi wakho umantiswe okungenani ngango 1mm ukushona. Ikakhulu ngesikhathi komile nezimvula ziyingcosana izinyanga ezibalwa. Ekuqaleni izimpande ezisencane angeke zifinyelele kulawo manzi kodwa amanzi azogcineka bese izithombi ziyawamunca ekuhambeni kwesikhathi sonyaka uma sezidinga amanzi angaphezu.

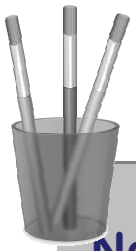
- ❖ Izithombo zakho zinikeze amanzi amaningi kubekanye ngesonto. Ezikhathini ezishisa kakhulu kufanele usifinyeze lesisikhathi kube kanye njalo ezinsukwini

ezintathu, faka amanzi anele onesiqiniseko ukuthi ashone phansi emhlabathimi ayi into ezothathwa ngumhwamuko nje emhlabathini wakho ongaphezulu ongu 10-15cm. Ungasebenzisa isembozo ukunciphisa ukuhwamuka komhlabathi.

- Zama ukunisela ngamathonsi amancane njengaweshawa kunamathonsi amakhulu (azogxisha umhlabathi wakho) noma ageleze kahle kunokuba ageleze kakhulu angabangela ukumuka komhlabathi wakho izimpande bese ziyalimala.

- Thela wonke umbhede ngamanzi. Uma zonke izitshalo zithola amanzi ngendlela elinganayo ungathola izitshalo eziningi ngethinsi ngalinye ngesikhathi ezinye zithola ingcosana yamanzi zizokunika isivuno esincane.

- Bheka ukale gcina izilinganiso zenani lamanzi ochelela ngawo ugcine nenani lamanzi emvula enile usuku nosuku nanokuthi amanzi ehla aphinde anyuke kanjani ethangini lakho. Minyaka yonke ungaleza libe ngono izinga lamanzi akho ngokuqoqa ithonsi nethonsi. Njalo gubha emva kwemvula nemvula ukuze ubone ukuthi amanzi oshone kangakanani emhlabathini. Kwenze lokhu uze ube nokuqonda kabanzi ukuthi ubanjani uma uchelelwa noma unethwa yimvula uqhubeke nokuhlola uze ubone ukuthi umhlabathi wakho ongaphezulu usuqala ukoma yini.



Umsebenzi wokuqala 1
Ngabe angakanani amanzi adingwa ingadi yakho?

Inhloso

Ukwakha umgomo wokuthi mangaki amabhakede ngesonto nokundla ingadi yakho ekudingayo ngokuthi angakanani amanzi ongawathola emvuleni.

Nqubo

1. Qisekisa ukuthi uyazi kahle lemithetho emibili futhi uyikhumbula kahle.

<u>Imvula enile:</u>

Uma ingu 1mm imvula enile kusho ukuthi ingadi yakho ithole amanzi angango 1 litha indawo engu 1mx1m.

Yonke imvula 1mm ilingana no 1 litha nge m^2

Umthetho uthi: Yonke imvula 1mm ilingana no 1 litha nge m^2.

<u>Ukuchelela ingadi:</u>

Chishe ingadi yonke idinga manzi angaba ngu 20mm ngesonto.

Ukunikeza amanzi angu 20mm ngesonto kudingeka ufake u 20 litha ubemunye

wamanzi ngesonto indawo engango 1mx1m umbhede osengadini.

Umthetho uthi: Ibhakede elilodwa elingu 20 litha wamanzi ngesonto kuyoyonke indawo engu m^2 yombhedi osengadini yakho.

2. Manje sebenzisa umthetho ukuthola ukuthi mangaki amabhakede amanzi ongawasebenzisa embgedeni engu 10 etshaliwe1mx6m owadingayo.

3. Mangaki amabhakede ngosuku uma umnini ngadi echelela usuku nosuku izinsuku eziyisithupha ngesonto.

4.Ngabe kufanele umnikazi wengadi awahlukanise kuyoyonke imibhede nsukuzonke na?

Izimpedulo:

2. *Amabhakede angamashumi ayisithupha (60) angu 20 litha ngesonto.*
3. *Amabhakede iyishumi ngosuku alingana chamashi ne dramu elilodwa elingu 200 litha ngosuku.*
4. *Qha nomakanjani qhabo yonke imibhede ongayifaka ikotshana ingoma ngokukhulu ukushesha-konke ukusebenza okunzima nokusaphaza amanzi ayigugu. Kungcono kakhulu: ukwehlukanisa ingadi yakho izizgaba eziyisithupha 6 bese uchelela izigatshana esisodwa ngosuku kuthi ngosuku olulandelayo uthuthukele embhedeni olandelayo. Ezikhathini ezishisa kakhulu yandisa amanzi onisela ngawo ngengxenye yokuthathu kokukodwa ngosuku umakunesidingo yandisa amabhakede insela ngawo ngosuku.*

Inkulu kanganani ingadi yakho? (Khumbula wenze imibhede. Asikho izidingo sokufaka izindlela ekukaleni kwakho)	**Mangaki ama litha amanzi adingwa ingadi yakho?**	**Bangaki o 20 litha bamabhakede abadingwa ingadi yakho ngesonto?**
10 m^2	200 litha ngesonto	10 amabhakede ngesonto
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50 m^2	1000 litha ngesonto	50 amabhakede ngesonto
60 m^2	1200 litha ngesonto	60 amabhakede ngesonto

Ukuphathwa kwamanzi agciniwe

Kungumqondo omuhle ukuqala isikhathi sokulima amathangi akho ngisho aphansi emhlabathini. Icebo lethu lahlukile ngesikhathi zemvula nezokoma.

Icebo lokunisela esikhathini zokomisa kwezulu

Ebusika lapho kungani mvula kunengcosana yezitshalo. Mhlawumbe iyana imvula kodwa ayanele ukukhulisa izitshalo zakho zizezivunwe. Ekuqaleni izitshalo zikhula kahle ekugcineni ziyafa singakafiki isiskhathi sokuthi zingadliwa.

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2. Uma unokukhathazeka ngokuthi amanzi angashe akuphelele ngaphambi kokuphela kwesikhathi sokoma tshala ingxenyana encane yengadi yakho.
3. Thatha isinqumo sokuthi uzochelela izikhathi ezingaki engadini yakho ngesonto. Hlukanisa ingadi yakho izigatshana ezilinganayo (Isibonelo uma uhlele ukuchelela kahlanu engadini yakho yehlukanise izingxenyana ezinhlanu (5).
4. CHELELA INGXENYE EYODWA NGOSUKU ENGADINI YAKHO, ungazami ukuchelela ngamanzi amancane imibhede yengadi yakho nsukuzonke. (ngaphandle kwezimbewu nezithombo ezidinga amanzi amancane kanye noma kabili ngosuku zize izimpande zikhula ngokwanele zikwazi ukuhambisana nokuchelelwa mbijana.
5. Bheka ukuthi angakanani amanzi asethangini lakho, ulinganise ukuthi angakuqhuba kangakanani ngaphambi kokufika kwezimvula. Lokhu kulobe phansi nsuku zonke uzokwazi ukuthathela kukho ngonyaka olandelayo.
6. Uma kubukeka sengathi amanzi akho azokushodela bheka ukuthi iziphi izitshalo ezibaluleke kakhulu kuwena qhubeka nazo nalawo manzi osele nawo, Kungcono ukulahlekelwa ingcosana yemibhede kunokuvuna kanzima kuyoyonke imibhedeni yakho. Yiba nakho emqondweni wakho ukuthi kunohlobo oluthile lezitshalo oludinga amanzi amancane kunezinye Isibonelo ikhabishi lidinga amanzi amancane kunesipinashi. Ngakhoke ezinkathini ezimbi yiba nezitshalo zesipinashi eziyimbijana nekhabishi eliningi.

Icebo lokunisela ezikhathini zemvula

EHlobo kujwayeleke ukuthi kube noxhaxha lwezimvula, kodwa kweminye iminyaka kuyoma kakhulu. Izikhathi ezinzima kakhulu kulapho kubanesikhathi eside sesomiso okukanye kube nezimvula ezinhle enyakeni ilaphoke amanzi owagcinile ekusiza khona ukuphephisa izitshalo zakho. Kanzima ukuthi ungabona kanjani ukuthi lonyoka uzoba nezimvula ezinhle noma ezimbi, ngakho sifanele silungiselel izikhathi ezimbi kakhulu.

Icebo esikhathini sonyaka esimanzi: QALA UNGENALUTHO GCINA EGCWELE

1. (Emaphuzwini amabili kuya kwamahlanu 2-5 angena lapha futhi)
2. Uma kunokwenzaka mantisa umbhede wakho uma utshala. Amathangi akho angacishe aphele uma uwasebenzise ngendlela ngesikhathi lomisile , kodwa lingagcwala ngokushesha ezimvuleni ezimbalwa zokuqala.
3. Bhalansisa ukuchelela kwakho nenani lwezimvula ezinile, ngakho unganiseli uma singekho izidingo. Khumbula izibalo ezibekwe ngenhla.
4. Maphakathi nesimo sezulu ezishisa kakhulu Uzodinga ukunisela kakhulu, kodwa kufanele kube ligcwele uzoliqeda ngesikhathi ubhekene nezikhathi zokomisa kwezulu lizophindeligcwale. Okungenani Ithangi lakho fanele likwazi ukugcwala noma kabili ngesikhathi saseHlobo lifanele libe ligcwele Ekuqaleni koBusika.